Computer Graphics

Visual Proceedings

Annual Conference Series, 1993

A Publication of ACM SIGGRAPH

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Message From SIGGRAPH 93 Co-Chairs

SIGGRAPH is an unusual community. Contributions to the conferences and the organization come from many disparate groups including artists, animators, designers, educators, engineers, entrepreneurs, inventors, and scientists. Traditional roles and distinctions break down in this community—engineers and scientists make splendid works of art, artists make substantial technical contributions, and most significantly, both sides talk to each other. Diversity and this eclectic mixture of people make SIGGRAPH strong. This year's conference places a special emphasis on providing opportunities to experience interactive and immersive environments in a variety of contexts that include art, design, technology, and animation.

The application of techniques, the use of tools, and the communication of content give the works in designing technology, electronic theater, machine culture, and tomorrow's realities their significance. Use and application of technique in a rapidly changing discipline like computing need to be thoroughly documented in order to leave behind a meaningful record of the state of practice in 1993. For the second consecutive year, the SIGGRAPH Visual Proceedings will serve as the document of record for the contributions made by the SIGGRAPH community to the advancement of the use and application of computer graphics and interactive techniques.

Designing technology, electronic theater, machine culture, and tomorrow's realities present today's leading edge in visual and interactive work. The presentations go beyond applying traditional techniques with new media; they explore new opportunities afforded by the advances in technology. The presentations also make us aware of the larger task ahead: to question the evolving role of technology in a rapidly changing society so that we might understand the impact of our actions in the global community.

This SIGGRAPH 93 Visual Proceedings, together with the other printed publications, CD-ROMs, and videotapes, complete the record of the activities in computer graphics presented at SIGGRAPH in 1993 and will contribute to the knowledge base for years to come.

Robert L. Judd
Los Alamos National Laboratory

Mark Resch
Luna Imaging, Inc.

SIGGRAPH 93 Co-chairs

Introduction

The 1993 Visual Proceedings documents the dynamic, visual contributions to SIGGRAPH 93. These contributions represent the experimentation and artistic expression of visual artists, scientists, and engineers. The Visual Proceedings also records a unique phenomenon of the electronic age. The major contributions to art, science, and entertainment are uniquely transdisciplinary in character. These contributions are often the result of intensely collaborative efforts, drawing directly on diverse disciplines for their inspiration. The specialist, working in isolation, is rapidly becoming the exception in both the artistic and the scientific worlds.

The Visual Proceedings is a collection of works selected for four distinct programs at the conference: designing technology, the electronic theater, machine culture, and tomorrow's realities. Each program has a volunteer chair and an advisory committee that has established a focus and criteria for inclusion. The committee members and chairs have solicited contributions that push the boundaries for the arts, design, and communications. The work presented in each program is exploratory, international in scope, and at times challenging. The submissions have come from individuals, small groups, and major corporations. The quality and diversity of the work indicate that a healthy climate of innovation exists for graphics and interactive computing in the arts and design. The contributions are clearly less self-conscious in their use of technology. Much of the defensive and polemic attitude contained in earlier computer art is replaced by straightforward use of the technology. Artists, film makers, designers, engineers, and computer scientists have all discovered the potential of the immersible character of computing technology for artistic work.

The SIGGRAPH 93 Visual Proceedings is designed to be the "source book" of a new period for the arts and technology. This period is characterized by the recognition that artist and designer can specify new ends through computer technology—not just use it to automate the means to achieve familiar ends. The work shows both artistic and technical maturity. Critics will describe, analyze, and interpret the substance of this work. The substance is here and invites the viewer to move from audience member to actor and participant. The art and design of 1993 are progressively temporal, interactive, non-material, and multi-sensory, and are empowered by their use of the computer.

Thomas E. Linehan

Thomas E. Linehan
Editor

Designing Technology

"Lipstick on the Bulldog"

Designing Technology

Alyce Kaprow, Chair

The designing technology show is about the critical importance of designers in the process of creating products. It is about the intersection of design and technology, and about how collaboration and participatory development are a key to product excellence.

Designers define, articulate, synthesize, collaborate, create, implement, build consensus, organize, compromise, communicate, visualize and make something real by putting a "casing" around the "product."

Steve Jobs once said he envisioned the computer as prolific as the toaster. Nicholas Negroponte predicted that there would be a digital clock in every appliance in the home and office. Both were right.

As the industries that produce computers and consumer electronics mature, and as their once-rarefied products become commodities, we face crossroads. No longer are the primary users of computers and electronics necessarily people with professional degrees in computer science and engineering; they are people using everyday tools for everyday tasks at home, in public arenas, and in business.

As products demand more and more from the users because they deliver more and more complicated functionality, the role of design increases in importance. As the functions of similar products mimic one another, the manner and ease in which they operate will define their excellence and distinguish them from their competition.Our products must meet the needs of a multi-cultural, multi-lingual, multi-skilled, and multi-goaled population. We cannot assume that the user will be fluent in computer-speak, patient with the inconveniences of version-one solutions, and delighted over each and every technical breakthrough. Some will be technophobic, some impatient, some physically challenged, some illiterate. Athletes, doctors, teachers, laborers, computer programmers, CEOs, and farmers all use a diversity of products. They are for all of us; and the coherence of their look and feel will make or break their success. All products were "designed," though some not as well as others.

Illustration by Alyce Kaprow

The underlying intent of the designing technology show is to demonstrate how designers play a critical role in product development, and in how a multi-disciplinary collaborative team better insures product excellence. The message from those who understand the necessity of coherent and collaborative design, and the value of design-thinking is that designers not only improve the visual appearance, but bring a coherence and logic to the planning that is unique and extremely important.

The computer is perhaps the most powerful tool we have at out fingertips; but, until it became visual, it was thought to be exclusive and unforgiving.

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As products demand more and more from the users because they deliver more and more complicated functionality, the role of design increases in importance.

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Visual communication needs to be taught, just as verbal communication and mathematical skills are; all are essential.

Collaboration is hard because it often counters the way we have learned to achieve.

• • •

Responsible design is everyone's business. This not only includes the look and feel, but its longevity, its credibility as a useful product, and its responsiveness to the environment, both visually and ecologically.

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Design is not a luxury for Fortune-500 companies; it is a necessity if companies are to compete in world markets. Communication

The work in the show exemplifies these ideas. Each presentation explains how collaborative teamwork and design influence improve a product's usability and functionality, and excites the user with visual excellence. For instance, the IBM EXPO Information Service not only offered some practical solutions to providing basic information, it delighted visitors with a means to communicate in ways they might not have anticipated. In another example, Vent Design developed a keyboard that allows personal adjustment to reduce stress and fatigue.

Interaction designers and design strategists are advocates for the user. They define and map functionality, navigation, and usability. Designers combine and synthesize, visualize and communicate, and lay out 2D, 3D, and virtual space. They bring to product planning coherence and an overview of these issues.

Designers contribute to the development effort differently than those that come to it from the engineering or business/marketing sides. Most design discussions are more about functionality and usability than style and appearance. A product's "look" evolves so that its usefulness and usability are improved. What may appear to some as an exercise in decoration is really about how the product should function.

The message this show is sending is that collaborative teamwork that includes the designer from day one will significantly improve the product, and will add value to the end result—not just stylistic decoration. The development process will make the difference; excellent products are the proof of its success.

A Few Definitions

Let's begin with three definitions as they pertain to the theme of designing technology—product, design, and interface:

- Product: anything that results from a development effort. That can be a 3D object, a space or environment, printed material of any size and shape, or the virtual that exists only on a screen. It can be a complex appliance, a bicycle, an operating system, a user's manual, an on- screen help system, or a multimedia presentation.
- Design refers to organizing and styling information. It includes graphic design, surface and volume design, spatial design, and screen design that define the product's look and feel. Design also considers the interaction, content, communication and temporal relationships. It is the coordination between all of these to present a coherent package.
- Interface is the "dialog" between product and user. Interface is about interaction, and interaction happens between all types of users and all types of products.

Why Collaboration is Hard to Do

It is common to be taught that work is best done in an isolated, singular manner. We sat at our school desks instructed that we should never discuss answers and ideas with others in the class. Those who came to the solution first and alone were rewarded. Only in some rare instances do we now find project-oriented classrooms and curricula.

This isolated approach is continued in the work place, especially by those who excelled in school using these methods, often times not realizing that they send a message contrary to collaboration and teamwork. The hierarchical relationships that result from this methodology perpetuate the myth that collaboration on an equal ground is the antithesis of individual excellence. Well, this just doesn't work very well in our multi-goaled, multicultural, multi-skilled, multi-lingual world. Those who have experienced the collaborative approach invariably understand that synergy and strength in numbers and insight will create a solution far greater than the individual parts. Those who understand this not only have insight into the expertise of other disciplines (thus a heightened awareness of the product's requirements), but also gain an inherent trust and respect for all team members' contributions.

Collaboration is hard because it often counters the way we have learned to achieve. It requires a different standard for evaluating the progress of development. Participatory design, where teams evolve solutions based on user-centered analysis, works. The presentations in the show prove this.

There are at least two different ways to analyze a problem: a step-by-step analysis of each task that needs to be done (the trees); and by seeing the overall project as a coordinated effort (the forest). Both need to be part of the analysis, but one approach may not be clearly seen by the other. Additionally, people who excel in creating and caring for the individual trees may not choose to worry about the design of the whole forest; and vice versa. Collaboration is good and brings together these methods and skills. Project managers in charge of development need to understand both points of view, but often excel in only one.

I believe that it is far easier to articulate the measurable tasks between point A and point B than it is to articulate the subjective overview of how work is holistically progressing. There are parallels between this analysis and that of design and engineering. It is often difficult to justify something that is not specifically measurable, like design and the psychology of human factors; but such contributions are essential.

The process of design is often thought of as mysterious and vague. It is not always specifically quantifiable; it does not always have measurable points of demarcation; the process is more subjective and holistic. At times it is a lack of understanding about what design is that causes the confusion.

Process, Tools, Product

For the purpose of description, it is convenient to look at the topic of development in three areas: process, tools, and product. The process is the continuum of steps and stages, combined with people and ideas that shape the product's outcome from concept to finalization. The product is the result of the effort, as described earlier. The tools are those used by the developers to describe, plan, and manufacture the product. In the context of collaborative development, the process is the most important of the three.

The goal of producing excellent products should be a given. While this goal is clearly not always achieved, for the sake of convenience, let's work backwards and begin with excellent products. How to guarantee this is precisely the issue at hand.

Tools describe the method of operation and make the process possible. A designer can sketch a product drawing with a pencil, create a prototype in clay or foam-board, or describe it with a CAD workstation. What tools are used to describe, plan and manufacture the product will be chosen because they are available, dexterous, comfortable, able to communicate the essential information, and accessible. A stick in sand is as valid a tool as a million-dollar workstation, so long as it is appropriate and communicates information to those who need it.

The choice of tools to a certain degree dictate the manner in which people work and communicate. They may even leave their mark stylistically. Tools can reduce the time we spend on tasks and shift our work styles. Examples in the show demonstrate this. For instance, Computer Designics shows work by Sharp, Shiseido, and Sony design teams, as does DesignSpace from the Virtual Space Exploration Lab at Stanford that presents a working environment using virtual reality tools to describe products at remote sites or to colleagues in offices down the hall.

The process is the key issue. Our working relationships and expectations about each other's responsibilities and contributions set the style of product development. The designer should be a key team member in this scenario because the main experiences and insights that a designer brings to the project are the abilities to analyze and visualize and to synthesize information in a structured, coherent way.

The design process is more than the ability to sketch and choose colors. Designers should not work in isolation any more than engineers should. Nor should their skills just be tacked onto the end to make it look good. What should be avoided is the development cycle where product specs are "thrown over the wall" from marketing to engineering to design to human factors specialists, without the dialog between all the collaborators along the way. How can we attempt to develop for our multi-faceted world without the expertise from every corner offering insight and analysis? How can we compete with those who do?

Strategists or Service Bureaus

Designers are not all alike, just as programmers are not equally agile in writing all types of software. Some are graphic designers, some design form and volume, and some design space. Many designers are concerned with individual appearance and signature, creating fabulous printed material, furniture, clothing, and other artifacts that carry a very personal message and style. Other designers focus their attention on individual pieces for clients, such as a brochure or illustration, an annual report or poster. They typically do not get involved with long-term planning for the product line or company identity.

This show is about interaction design, and designers who actively plan and define products. It is about defining product look and feel, functionality and usability, and company strategy and identity.

The show challenges the perception of those who hire the skills and talents of the people in the design community. Many people consider design to be a service trade, producing items such as business graphics or a trade show booth. At best, in these circumstances, designers are thought to be a brilliant visualizers of ideas; at worst they are perceived as service bureaus. But, insight into the overall strategy and direction a company and/or product can take is also a valued design contribution. Presentations in this show illustrate a different concentration of design innovation and farther-reaching roles that are possible. For example: The Doblin Group demonstrates process and design strategy; IDEO shows their involvement with innovation and design planning.

The intersection of design and technology is often represented by the tools the design community now has available: page layout, illustration, CAD, 3D modeling, rendering and the like. These examples—excellent as they are—are drawn from situations involving tool users, not tool makers. Though the work that is being done might be brilliant examples of design, it does not necessarily

on a global scale necessitates coherence and accessibility of information.

* * *

If look-and-feel are so important to the success of products and communications, why do we continually place the skills associated with design in a category of second-class citizenship?

* * *

Designers need to embrace this cause as well. It is the combined responsibility of the design and engineering communities to champion collaborative and participatory development.

If we need the powers of "left-brain thinkers" to define our logical world, we need the powers of the "right-brain thinkers" to handle the visual and temporal one. More importantly we need communication between them.

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The strength to challenge the norm, and to take a risk is what must continue to drive this industry.

• • •

Responsible design is everyone's business. This not only includes the look and feel, but its longevity, its

exemplify the role of design and visualization in the process of product development.

This is a very fine-line distinction, and one that often confuses people. Indeed, the designer who produces a brilliant poster, strong in style and accent, may be the same designer who is involved with the interface of a new operating system, and may very well use the same computer tools. The focus is different for different clients. There is, happily, a transfer of skills from one activity to the other.

Education

Environmental designer Kevin Lynch maintains that 80% of the information we absorb is visual. If that is true, why do we spend so little time during our formal education learning to understand visual language and how to communicate visually? Indeed, it is worse than ignored, it is often put into the category of expendable when budgets are tight. If look-and-feel are so important to the success of products and communications, why do we continually place the skills associated with design in a category of second- class citizenship?

Visual communication needs to be taught, just as verbal communication and mathematical skills are; all are essential. This must begin in primary school with a concerted effort and respect for the value such skills bring to problem solving and communication. Scientific visualization is essential, as is the visualization of business data, the definition of volume and form, and the layout of an environment. Not everyone will become a designer; but, the respect for a designer's contribution will be a direct result of the respect visual skills are given in school.

Companies must educate their workers to understand and respect the input of disparate and collaborative groups. Though it appears to threaten the control of hierarchical structures, such creative communication is essential for creative product development. Collaborative teamwork does not mean a free-for-all without leadership. The design process is no more chaotic than any creative brainstorming; accountability and responsibility are still important. But, often such a team seems to threaten many who don't understand it. We must begin training in visual communication and collaborative problem solving in the earliest schools, and continue to reinforce these ideas in the work place.

Human factors experts are often viewed as substitutes for designers. Engineers who code the interface typically place it on the screen as they see convenient. When it doesn't work, they call in the designer to "fix" it. Some designers view these eleventh-hour attempts as "putting lipstick on the bulldog."* It is no substitute for good design from the start.

Programmers and product planners often ask how to work with designers. Conversely, designers ask how to work with programmers and hardware engineers. Designers visualize and have strong opinions about intangible issues; engineers may make C-code jokes and describe colors by RGB numerical equivalents. Neither starts out trusting the other. It is essential to learn how to converse, how to share common ground, and to respect the other for the quality of experience and insight and the difference in point of view. We must learn enough about each other's domains to communicate essential information on a continual basis.

Respect for differences in approach and the ability to take risks are critical to solving the needs of our world and in manufacturing worthy and reliable goods. The strength to challenge the norm, and to take a risk is what must continue to drive this industry.

Common Ground

All of us are all part of the same effort, whether we come from marketing, engineering, education, design, cognitive psychology, anthropology, training, or elsewhere. The work in the show exemplifies the methodology and philosophies of collaboration and design visualization. It includes all facets of product development and invites everyone to engage in this collaborative method.

In one way or another, most products enable and empower us to do things—an expanded definition for tools. They must work well; they must be comfortable and familiar to be used safely and effectively. The telephone is a tool. It has changed the way we work and communicate, and it changed our expectations about almost everything we do. FAX machines have gone one step further. Desktop personal computers with powerful graphics, layout, and imaging software plus peripherals have empowered each of us in ways unthought of just five years ago.

Design is not a luxury for Fortune 500 companies; it is a necessity if companies are to compete in world markets. Communication on a global scale necessitates coherence and accessibility of information. What will distinguish one product from another is not the abundance of functions but the manner in which they are presented to the users.

Some of the best examples of products are those described as "fun to use," "comfortable," "familiar," and "easy." They invite people to use them, they teach people to master them, and they chal-

*Quoted by Dick Oakley, IBM Corporation, as told by Norm Cox, Cox & Hall.

lenge people to go further. Most are very good looking as well. We enjoy using them; this is not a negative feature, but value-added...and no accident. Well designed products help sell themselves.

Responsible design is everyone's business. This not only includes the look and feel, but its longevity, its credibility as a useful product, and its responsiveness to the environment, both visually and ecologically.

Designers need to embrace this cause as well. It is the combined responsibility of the design and engineering communities to champion collaborative and participatory development. If we need the powers of "left- brain thinkers" to define our logical world, we need the powers of the "right- brain thinkers" to handle the visual and temporal one. More importantly we need communication between them. This will happen more effectively once we allow our own brains to converse from both sides.

Mutual respect and delight for each contributor on the team is an essential beginning. Not trying to second-guess the expertise and insight of each other's disciplines will allow open discussion and collaboration. Designers have a responsibility to champion their own talents and expertise; we all have the need for dialog.

The computer is perhaps the most powerful tool we have at out fingertips; but, until it became visual, it was thought to be exclusive and unforgiving. We now have opportunities to empower people. Taking on the challenge of enriching our lives will take the concerted effort of all skills and talents, from both sides of the brain.

— Alyce Kaprow, Chair
Designing Technology,
SIGGRAPH 93

Acknowledgements

This show and catalog could not have happened without the support of many people. Bob Judd and Mark Resch, co-chairs of SIGGRAPH 93, have done more than simply give this show a home; they have embraced its ideals and theme from the onset. Without their enthusiasm and delight for the show, it could not have happened. I cannot say enough to acknowledge their input and contributions.

Members of the entire SIGGRAPH 93 committee must also be thanked for their input and enthusiasm. There are too many to name in this introduction; I wish I could. Additionally, the support of those who are not on the committee, but who have touched this work in one way or another, are greatly appreciated. To Dave, Joey and Jake: thanks for your unwavering support and love.

In closing, I wish to particularly thank the members of the designing technology committee who helped define and mold the show. I could not have asked for a more creative, encouraging, and enthusiastic group with which to work. The process of defining and designing this show exemplifies everything that we as a group wish to encourage: collaboration, cooperation, respect, and a great deal of laughter and love for one another and the effort at hand. To Lauretta, Peter, Dawn, Elizabeth, Kristee, Robin, Tom, Masa, Rob, and Ken: I could not have done this without your continuing support and help. Thank you all.

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The main experiences and insights that a designer brings to the project are the abilities to analyze and visualize and to synthesize information in a structured coherent way.

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What will distinguish one product from another is not the abundance of functions but the manner in which they are presented to the users.

Selection Criteria for Designing Technology

Design contributes to what makes a product rich and human. Design help synthesizes the disparate concerns and smoothes the edges, bringing many disciplines together in the final product. Designers contribute beauty and excitement that enriches the process, and a magic that delights the user.

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In choosing the work for the show, the focus was on design excellence and the collaborative process. The results of these efforts exemplify the meaning of design in its broadest definition.

The presentations in the designing technology show present work that demonstrate both design excellence and collaborative teamwork in the development effort. Each project speaks to the chief themes of this show in a different way; each echoes the ideals that designers contribute significantly to a product's functionality, usability, and overall excellence; and that multi-disciplinary collaborative teams are a necessity in the process of product definition and design.

Different disciplines and expertise must work together to design what a product is to become. Whether the presentation demonstrates hardware, software, interface, or strategic planning, the message is similar: The designer is a significant contributor in many ways and should be an integral part of the team from the beginning; and, we need to come together as a team with respect for all team members' expertise to insure collaborative, participatory design.

In choosing the work for the show, the focus was on design excellence and the collaborative process. The results of these efforts exemplify the meaning of design in its broadest definition. Design contributes to what makes a product rich and human. Design help synthesizes the disparate concerns and smoothes the edges, bringing many disciplines together in the final product. Designers contribute beauty and excitement that enrich the process, and a magic that delights the user.

The collection of work in the show in part displays the delicate balance between process, tool, and final product. It also balances projects having to do with hardware design, software design, interface and multimedia design, and non-computer products. The work was chosen without quota; that is, we did not set out to present a certain number of examples in any of the above categories. We selected the exhibits based on their concern for the two main themes: design excellence and collaboration. From there we loosely collected the work into representative areas, though no such "map" exists in the show that might limit the viewer's interpretation of any individual presentation. The projects might be grouped as follows: a definition of process and strategy, interface design, volume design, interactive multimedia, and a peek into future products—specifically that of computer interface and interaction. When viewing the work it is best not to narrowly focus on these groups, as most of the presentations fit into more than one category. Look at them as a collection of projects that individually demonstrate design excellence, and together champion the ideals of this show.

— Alyce Kaprow, Chair
Designing Technology,
SIGGRAPH 93

From Alice to Ocean:

Alone Across the Outback

Rick Smolan

Against All Odds Productions

From Alice to Ocean: Alone Across the Outback is the astounding story of 27-year-old Australian Robyn Davidson, who set off to cross the desolate Australian outback on foot, accompanied only by four camels and a dog. Robyn Davidson's own account of the journey "Tracks" became a worldwide bestseller.

Rick Smolan, the world-famous photographer who created the "Day in the Life" series photographed Robyn's trip for National Geographic magazine. Smolan combines his own award-winning photographs with Robyn's text.

From Alice to Ocean is noteworthy as the first illustrated book ever packaged with its own interactive PhotoCD disk. The PhotoCD provides the reader with a new way of experiencing an illustrated book, allowing them to imagine themselves on Robyn's epic journey and actively participate in her story.

The interactive PhotoCD disk tucked inside of From Alice to Ocean represents what many people are calling the most successful example of interactive media combined with traditional book publishing to date. The new computer technology has the potential to change the way that illustrated books are published, and ultimately may reshape the publishing industry itself.

Not only does it demonstrate the power of combining new and traditional publishing technology, it also shows the power of combining design and technology. Smolan worked together with Kodak's PhotoCD department as the technology was being developed to produce the PhotoCD in conjunction with the book.

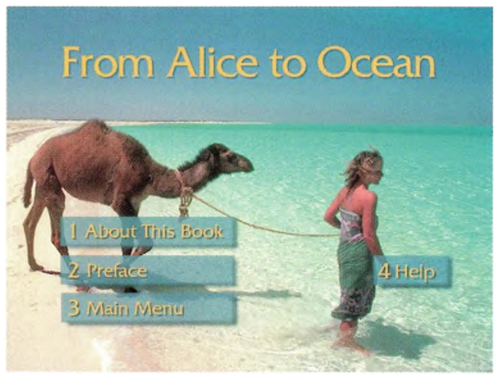
Smolan did much of the layout work at the (then Kodak) Center for Creative Imaging. There he worked on not only the book layout, but the screen images for the PhotoCD. At that point he was working with the technologists to pool skills and ideas to produce the work that was greater than the sum of its parts.

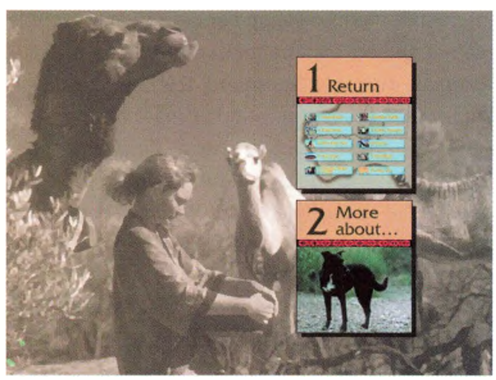
Smolan is hopeful that the technology showcased in From Alice to Ocean will encourage others to explore the potential of interactive technology. "Interactive publishing is the uncharted territory and I hope the other publishers interested in this new medium will use what we've done as a reference point and be inspired to experiment as well."

From Imergy

Working in concert with Eastman Kodak's PhotoCD Imaging Team, Imergy produced the interactive PhotoCD as a companion to the book. Playable at home on a TV set in full color, the PhotoCD allows the viewer to visit segments not covered in the book.

Peter Mackey collaborated with Smolan and Kodak to edit Davidson's narrative and link it to the appropriate images. Menu and sound effects were designed to be simple, to avoid interfering with the beauty of the story and provide an easy interface for the consumer.





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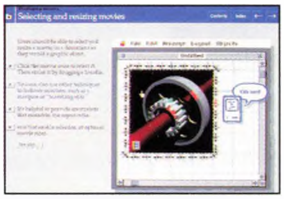
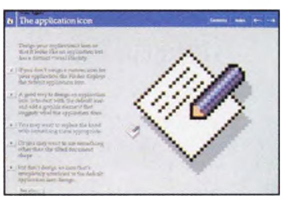
Often, a design project includes educating others about what design is, how it differs from other disciplines (like engineering or human factors) and how it can contribute to the quality of a product.

— Peter Spreenberg

The lines between designer and technologists is fading. Nothing will take the place of designers who can artfully put together elements to create wonderful visual pieces.

— Rick Smolan





We realized that the power of technology and design should be measured by how they empower people.

— Alben+Faris

Making it Macintosh:

The Macintosh Human Interface Guidelines Companion

Alben+Faris

Harry J. Saddler, Apple Computer, Inc.

Making it Macintosh: The Macintosh Human Interface Guidelines Companion is an interactive instructional product designed and developed by Apple Computer, Inc. Making it Macintosh uses computer-based animation and interaction to document the Macintosh user interface, illustrate human interface design issues, and provide interface implementation strategies for software developers.

Making it Macintosh demonstrates that quality, clarity, and ease of use in interac1tive media (and by extension, any computer software) is facilitated by the early and full participation of skilled designers in the development process. An interactive media development effort must include team members experienced with a welter of technologies: digital video, sound, text, data retrieval, computer-based animation, programming, and scripting. Taken together, these skills and technologies will produce interactive media that is both stable and efficient. But to achieve real communication requires not only technologists, but competent designers as well.

Beginning with an idea and a commitment to design quality, the project brought together technologists with little design training and graphic designers with little interactive media experience to produce a remarkable and effective product. We thus offer (at least) two lessons: first, that the early commitment to design is borne out, and second, that successful designer/technologist collaboration happens day-by-day and decision-by-decision, from the beginning of the project to the end.

Our installation at SIGGRAPH traces the development of Making it Macintosh from project planning and team building through prototyping and implementation. We use this history to explore the intersection of design and technology, examine the relationship of designers to technologists, and ask if such distinctions are even valid in the realm of interactive media development.

Other aspects of the design and development process that are highlighted:

- Design goals, successive design evolution, and the final design solutions
- The effect of technical capabilities and constraints on design
- The application of the design concept to all components of the product
- Human interface issues in interactive media
- Are usability and interactivity new graphic design concepts?
- The roles and interactions of graphic, interface, and instructional designers
- Technologists and designers learning to use each other's tools

The released version of Making It Macintosh: The Macintosh Human Interface Guidelines Companion will also be available for demonstration and hands-on interaction.

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Collaborative Design and Development for Surgery Equipment

Bill Schaaf, Design EDGE

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Industrial design is all about the relationship between people and objects in their environment, about looking at the issues of appearance, function, cost and sales and addressing them in concepts which explored the limits of each.

— Bill Schaaf

Focus

The presentation will describe the process, steps, and tools utilized by Design EDGE to develop high-technology equipment.

Brief

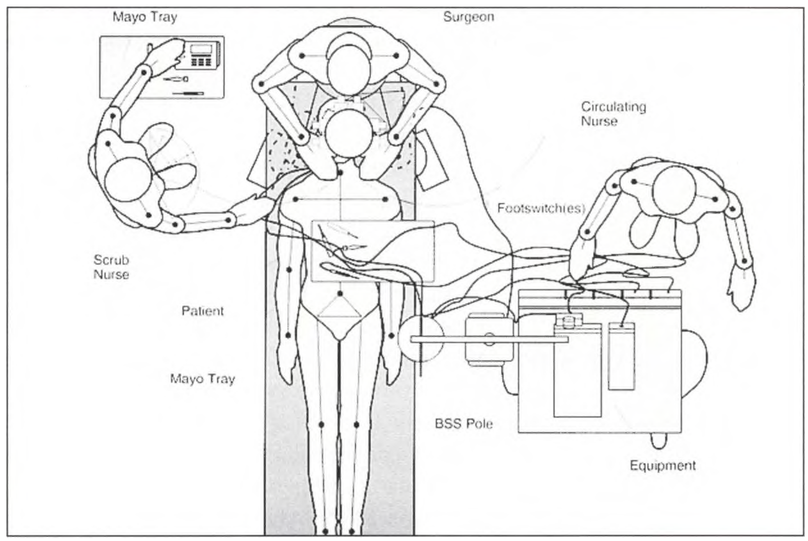
The presentation will have two primary functions. First, to demonstrate the value of having designers involved in all phases of product development from product specification to final product release. Second, to highlight the tools utilized by Design EDGE and IO Lab to develop surgery equipment. In particular, the presentation will show the value of appropriate use of computers to aid in the product development process.

The material will be presented as an "active timeline" following the steps utilized to develop Johnson & Johnson's new opthalmic surgery equipment.

Background information will contain a brief description of Design EDGE and the IO Lab division of Johnson & Johnson. It will then continue with the issues involved in the development of products for surgical environments. The process of designing appropriate products begins with the knowledge of the user and environment.

Initial stages will demonstrate information gathering by means of questionnaire, interviews, and quality function deployment matrices defining the customers and targeting their wants and needs. Exploration of preliminary concepts and the tools used to generate them will then be highlighted. Two-dimensional and 3D component configurations, marker sketches, and fome-core study models will all be shown.

Testing of concepts will contain ergonomic analysis by computer layouts as well as interviews at medical tradeshows and in laboratory settings. Additional stages will describe the reasons for selecting a touch-screen interface as well as the unique problems that need to be addressed in interface design and how they were approached. Later stages also describe the creation of multimedia instructional videos and the design of user manuals.



Designers today must have cross-disciplinary skills in order to assist the difficult communication of fragile, fresh ideas. They must see all sides, while including non-quantitative values.

— Stephen Peart

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An engineer in the field for 30 years working on the boards (drafting) is now handed an engineering computer and told to be productive. This can sometimes be a difficult transition, but fortunately the blow is somewhat cushioned by the very fact that

CompositAir Mountain Bike Project

Steven John Ivie and John Cook

Designworks/USA

Carbon-fiber Mountain Bike Frame: A Design Study in Technology and Human Interface

SP Systems, a Camarillo, CA based composites manufacturing company, contacted Designworks/USA to develop a new application for their carbon-fiber production capability. Due to advancing technology in these materials, and an inherent interest in sports, a product for the bicycle industry was targeted.

This turned out to be a fortuitous choice for both CompositAir and Designworks/USA. The project designers at Designworks/USA and the key engineer at CompositAir were avid mountain bikers, and a synergy quickly developed.

An early consideration for the assignment revolved around the development schedule target for introduction at a major trade show. To be able to work within the compressed deadline required considerable planning on Designworks/USA's part to determine the combination of resources needed to execute the project.

Designworks/USA has taken the position through the years of the importance of developing a product's form in 3D, i.e., what we would call traditional industrial design. This would seem to be at odds with the current thinking for design execution being done by computer through the systems such as Alias, ProEngineer, and other development software. The bike frame project appeared to be an ideal candidate for this combination of leading-edge technology and hands-on form development.

The philosophy used on this project centered on using both computer-generated surface development and an extensive evolution of 3D modeling. It was felt that the combination of a designer's feel for form and a computer's delivery of exact data for further development would result in the best all-around package.

After a series of design sketches evolving the concept from rough ideas to full-size layouts, several soft foam models were produced to understand and evaluate the emerging complex structure. These models proved very useful for the client's production team. They were able to suggest numerous subtle refinements that helped visualize the molding techniques and identify potential problems they were likely to encounter later.

Integrated with the model development, the basic structure and form was programmed into the Evans & Sutherland CDRS surface development system. As details evolved in the complex form, CDRS allowed both designers and engineers to judge the impact on other areas of the structure. The software's ability to quickly produce photo-realistic illustrations, create sections and joining details, and project multiple variations saved many person hours and gave the client options not previously considered. This exchange of ideas and refinement through solid and realistic modeling and computerized images allowed to project to move ahead with confidence. Slowly but accurately the frame became reality.

The final step in this process was to verify in hard model form the completed design. Using data from CDRS, sample components in the frame could be fabricated by stereolithography, CNC milling, and other prototype techniques. At this point we had a true representation of the product and a clear buy-off of the design.

Under hard prototype testing during the summer and fall of 1992, the new concept proved to have greater torsional rigidity, overall strength, and durability plus more vertical shock absorption than any conventional aluminum, chrome moly steel, or composite frame on today's market.

An enthusiastic client presented their concept to the market on time and within the marketing objectives. Critical review by industry has endorsed the concept, and from early award-winning publicity the bike appears to have met its basic goal of bringing together technology and human interface to an exciting new design.

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the design field is the embodiment of change.

— Steve Ivie

There is a very very fluid membrane around the different people in the group and the skills they each have, and with the aspects of the whole project in which these skills were used.

— Luaretta Jones

We have such a team-base approach to all projects that your role changes from week to week, from team to team, from client to client.

— John Cain

Designers are people that produce things that people interact with.

— Rick Robinson

■ ■ ■

While we don't understand a lot about creativity, it isn't about a bunch of unconventional people happening upon wacky ideas by the stroke of luck any more than electrical engineering is merely the act of arranging circuits in the most optimum pattern based on established rules.

— Nathan Shedroff

Designing Technology

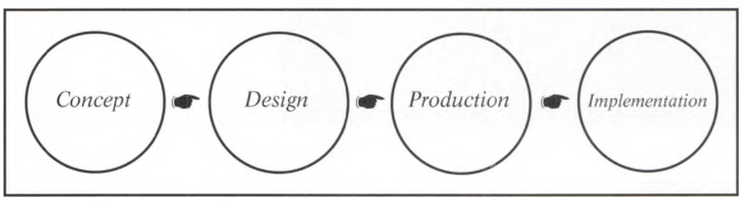
Rick Robinson and John Cain

Doblin Group

There is a lot of talk in the computer press these days about bringing designers into the technology development process.

There is a lot of talk in the design press these days about how technology affects the aims and tools of design.

We think that the two communities are standing really close but facing opposite directions. There is a lot of hand waving, a lot of buzzword speaking, and not much real joint work, not much real communication.



The key to communication is a common language. Our installation illustrates a simple framework for the creative process that Doblin Group uses as a bridge between technologists and designers. We find that this not only represents the process, but also reveals a vastly enhanced 'reach' that a common framework offers to both disciplines. We present this conception in three 'layers':

- A presentation of four simple 'moments' in a general process of designing any artifact
- Illustrations from our own work that are both tools for the process and artifacts from it, and
- A final overlay that stresses the interconnections of the process and the interpenetration of the two disciplines.

We believe that the interaction of information design, communication design, research, and technology (united in what we call strategic design planning) produces interesting, interactive, and involving artifacts and experiences. Our exhibit is not just about that phenomenon, it is a product of designer-technologist collaboration.

Four Simple Steps

- Concept—Although both designers and technologist are planning, researching, brainstorming, choosing methods and a hundred other similar things at this point, you usually find designers saying, "Don't bother me with the technical details at this point" and technologists saying, "let me get the thing working before you start putting cosmetics on it."
- Design: Similar processes, but big differences in assumptions and vocabulary usually make this phase the most likely to be contentious. Clarifying overall goals, developing shared models of key aspects like "interaction flow" and "look and feel" help integrate the production of just about anything from a food processor to a word processor.
- Production: What constitutes a prototype? Who's doing version control? What do you mean that isn't ready yet? This phase probably has the most real give and take currently, but we think that certain organizational and communications challenges remain.
- Implementation: At this point (real things getting made, for real people to use), most designers assume they are out of the loop, with no more real work to do. Unfortunately, most technologists assume the same thing.

In addition to discussing opportunities for collaboration during each of these stages, we demonstrate connections between stages and the degree to which the skills and interests of the two disciplines interpenetrate.

Design Tools

We illustrate the four process 'moments' using Doblin Group in-house design software tools listed below. We look at the different stages in the development of these tools as well as their current state (hands-on demonstration).

- Transformations and Analysis, software that supports subjective assessments of design requirements (or anything else.) and synthesizes clusters, networks, and phase/space maps.
- Video Analysis Tool, a tool to support our video-ethnographic research into how people use and react to artifacts, messages, and spaces.
- Spaniel, a Multimedia database of Doblin Group people, ideas, and methods.

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Dick's World

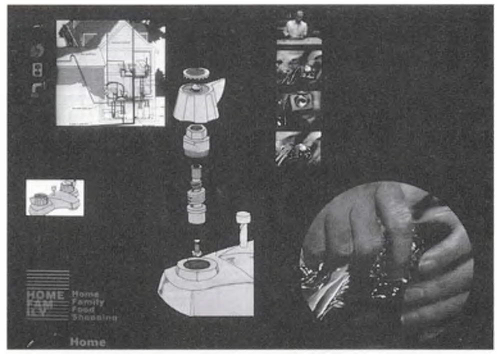
Richard Oakley, IBM

Dick's World was put together about a year ago in response to IBM's search for a competitive multimedia interface. Several applications had been released with several different interfaces, none of which followed any sort of basic design principles. It was obvious that graphic designers had not been an integral part of the "interface design team"—they had only been asked to put lipstick on the bulldog.

As a result, the members of the IBM Design Program spent a few nights sketching out what we thought the future might be. Interactive HDTV was high on the list because of all the alliances going on between entertainment, cable TV, computer, and consumer electronics companies. Since there was also a strong future involving Personal Digital Assistants (PDAs), we were looking for an interface that would work on screens ranging in size from calculators to living room walls. We asked Muriel Cooper and Associates (MC&A) to create a demonstration that would be presented to the IBM senior management. MC&A merges the disciplines of design and programming and this exercise, we hoped, would point out the value that graphic design can introduce to the interface design process. That point was clearly understood and steps are now being taken to integrate design into several development labs.

Dick's World does not answer all the interface issues, but two concepts become apparent. One is that through the use of traditional graphic design skills, a wealth of information can be displayed and arranged so that the viewer does not get confused. The other is that one can navigate through this information without the help of menus, dialog boxes, and most of the other administrative debris seen today. The interface becomes invisible—it is the information alone that is presented. Since this solution also does not deal effectively with varying screen sizes, the need for continued investigation is clear.

In the not-so-very-distant future, as software applications merge the various mediums of film, sound, illustration, and typography, so must companies merge the appropriate skills into their software development.



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I don't think that human factors people know anything about the visualization of information. But a human factors person in general has a background in cognitive psychology and testing. I think that designers and human factors specialists can compliment each other. One is a social science context and one is a visual one.

— Muriel Cooper

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Designers give the product a real world look, that helps familiarize the user to the process.

— Keith Ohlfs

The IBM Guest Services System at EXPO '92

Lauretta Jones

IBM T.J. Watson Research Center

Make it work, make it good, make it great.

— Stephen Boies

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On the most successful teams, each contributor has skills in more than one area in order to chip in as needed.

Visitors to EXPO '92, the recent world's fair in Seville, Spain, enjoyed a novel collection of multimedia applications at any of 231 networked touch-screens of the IBM Guest Services System. Visitors found pavilion locations, stories about the participating countries, and the daily news, all in a colorful pictorial style in Spanish, English and French. They also used their magnetically encoded entry tickets to make restaurant reservations, take

their pictures, send voice-and-image messages, and save finger paintings. As the official information service provider for EXPO '92, IBM defined, developed, installed, and operated this unique public use transaction system.

With interactive multimedia, roles are defined as production evolves. Perhaps as the interactive multimedia ma-

Goals

The primary goal of the Guest Services System was to enhance the quality of a guest's visit to EXPO '92. To meet this goal, the system clearly had to be easy to use and quick to respond. It had to be fun and attractive to compete with the diversions of a world's fair. And it had to survive the severities of the Sevilian weather and heavy usage. The design team wanted to make use of an interconnected network of kiosks to allow EXPO guests to not just passively read information, but to actively create information.

Team

The Interactive Transaction Systems (ITS) group at IBM Research believed it was important to bring a variety of skills to the project from its inception. Computer scientists, psychologists, engineers, programmers, and graphic designers all contributed to the design and implementation. The collaboration extended beyond the research group, with the involvement of IBM Spain, EXPO '92, third-party suppliers, the pavilion participants, and the EXPO visitors themselves.

Process

The design process began by defining a high-risk vision: the selection of information and services that would appeal to millions of fair-goers. There were some who counseled that our ambition overreached possibility. To ensure the vision became reality, the design team worked closely as equal partners to iteratively evolve each detail of the system: content design and creation, services design, user interface design and testing, hardware specifications, networking, and system management. The evolving system prototype was placed on the EXPO site where pre-opening tourists could try it out while team members discretely took notes. These important observations were fed back into the design process.

The team shared the work of coordinating efforts with EXPO, restaurants, and pavilion staff, photographers, news providers, and maintenance and operations crews. Even the 33 kiosk structures that housed the guest stations and the bright signage that tied the kiosks together in the minds of the visitors benefited from this group approach. Each team member had primary responsibility for certain aspects of the project, but each one could be counted on to jump in anywhere at any time they were needed.

Results

The Guest Services System was, by any measure, a resounding success. Between ten and 15 million visitors were estimated to have used the system. The operation of the system was impressive, registering over 99% availability during the six months of operation, 19 hours each day, every day. At a typical week at EXPO, guests saved 126,000 video images, 63,000 finger paintings, and sent 42,000 multimedia messages. They touched the screens 92,000,000 times.

Equipment

Each of the 33 Guest Services System kiosks on the EXPO site held seven guest stations. Each station was comprised of a 33 Hertz PS/2 Model 95 with 16 MBytes of memory and 1.2 GBytes of storage, linked to a server via token ring. The entire kiosk was linked to the Central Kiosk Control by fiber cable, where another 66xx PS/2s provided storage of visitors' finger paintings, video images, messages, and restaurant reservations and monitored the status and activity of each guest station.

An IBM 19-inch 6091 display (1280 x 1024 x 256 colors) with a touch overlay was the primary interaction device. Each station also featured a video camera and lights, microphone and speakers, and ticket readers.

Designing Technology Presentation

The demonstration model in the designing technology show is a specially adapted stand-alone version of the final Seville system. It holds nearly half of the pavilion stories, and includes a new 'behind-the-scenes' story on the making of the system. We are also showing a 15-minute documentary video with highlights of visitors enjoying the Guest Services System.

We want to acknowledge the contributions made to this project by IBM Spain, EXPO '92 staff, the Guest Services System News Team, the 100 EXPO international participants who supplied stories about their pavilions, Associate Designers (kiosk design), Mapasa (kiosk signage), and the millions of fair-goers who used the system.

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tures as an industry, this will change, but I hope not! It's more fun the way it is, if occasionally unnerving.

— Abbe Don

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An interface designer is a combination artist, computer scientist, psychologist and someone who likes to have fun with technologies.

— Rick Smolan

• • •

EVERYBODY designs things if they do they job exemplary. Every time you kick in your problem-solving skills, you are designing.

— Nathan Shedroff

Dancall *Logic* Mobile Telephone Design Project

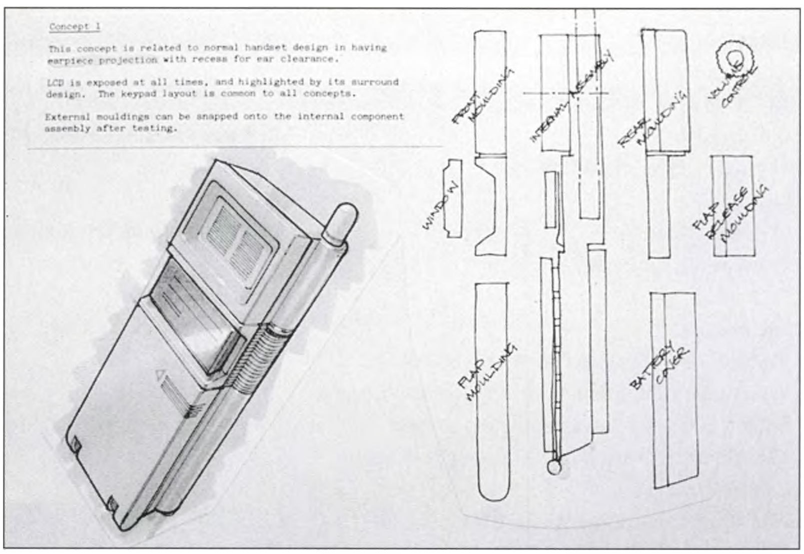
Peter Spreenberg

IDEO

I think it is really important for the computer industry, or any industry which is using designers, to understand that design is a powerful tool that can be very effective in helping companies realize their corporate vision and goals. It is not a superficial surface treatment to be brought in and used at the end of a project.

— Alben+Faris

IDEO's user-centered design process is composed of six stages: understand, observe, visualize, evaluate, refine, and implement. These stages seldom occur sequentially–it is more common for us to be engaged in two or more simultaneously and iteratively. Here we describe the process in more detail as it was applied to the development of the *Logic* range of mobile telephones for Dancall, a medium-sized Scandinavian manufacturer.



Understand

Although IDEO had prior experience designing telecommunications products for Dancall, we needed to understand more about the design objectives for the *Logic* range. We began by asking questions like, "Who are the users?," "Do they have any special requirements?," and "What are the opportunities and limitations of the technology?" This questioning process helped us arrive at a succinct project brief.

Observe

Observations and interviews allow us to gain an understanding of the people who will use a product or system. For Dancall, we interviewed a small number of car telephone users to understand how they used their phones and to appreciate the kinds of difficulties they had in using them. We find that conducting detailed observations of a few selected users is preferable to the "wide and shallow" studies typically conducted by market researchers.

Visualize

Observations help designers to understand today's uses and scenarios but the creative leap occurs when we develop scenarios of the future. We developed four characters that represent Dancall's market: a Finnish architect, a UK insurance agent, a Malaysian entrepreneur, and a Danish salesperson. We created scenarios for these characters to help us imagine how they would use cellular telephones. As we developed the scenarios, the characters began to take on lives of their own. We created sketch drawings, models, and storyboards of concepts that fit each character's occupation, personality, and lifestyle.

Evaluate

Evaluation is an on-going activity and should be an integral part of development. For Dancall, we tested user interface simulations and appearance models in focus groups with potential users. Human factors designers play an important role in this stage and provide "reality checks" for design concepts.

Refine

In this stage, the more promising concepts or innovations are refined. For Dancall, we assembled photographic storyboards that showed our scenario characters using appearance models. We also developed engineering prototypes of some mechanical components and interactive simulations to demonstrate the appearance and behavior of the user interface.

Implement

During this stage, IDEO generates mechanical drawings for tooling and manufacturing of the hardware components and detailed guidelines and specifications for the user interface appearance and behavior. We worked closely with Dancall to ensure a smooth hand-off to their in-house engineering group.

We are convinced that the scenario development process enables us to provide more innovative and appropriate product solutions. The *Logic* range has been well received throughout the industry and has won numerous design awards. The

designers involved represented different disciplines and backgrounds–industrial design, interaction design, human factors, and engineering–and IDEO believes this multi-disciplinary approach to design contributed in part to the success of the products.

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- Bill Moggridge, Industrial Design/Interaction Design
- Roger Penn, Model Making
- Peter Spreenberg, Interaction Design
- John Stoddard, Industrial Design
- Suzy Stone, Engineering
- Marc Tanner, Industrial Design
- Bill Verplank, Interaction Design

Dancall Radio A/S:

- Bent Gøbel, Manager, Design and Engineering
- Steen Hansen, User Interface Design
- Bent Møller-Pedersen, Director of Strategy
- Allan Nielsen, Product Manager
- Peter Petersen, Development Manager

Figure 1: *Upon Nil's promotion, the company bought him a cellular telephone and a facsimile unit for use in his SAAB 9000 car. His personal cordless handset, which he uses in his office and at home is also compatible with his car's new system. While driving, he uses the telephone voice recognition controls. He likes the way this lets him keep his hands on the steering wheel and retain control of his car.*

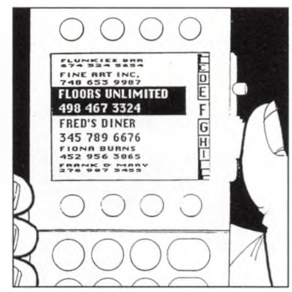


Figure 1: *The central part of the displayed text is clearly legible. The upper and lower periphery is compressed to give an indication of text to come. The display lists all the numbers in the memory alphabetically. He can Scroll through the letters on the right side of the display by using the thumbwheel. To select, he pushes the small button next to the thumbwheel as the reversed-out scroll bar passes over the vendor's number.*

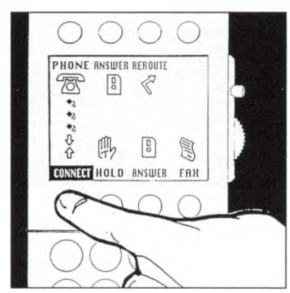


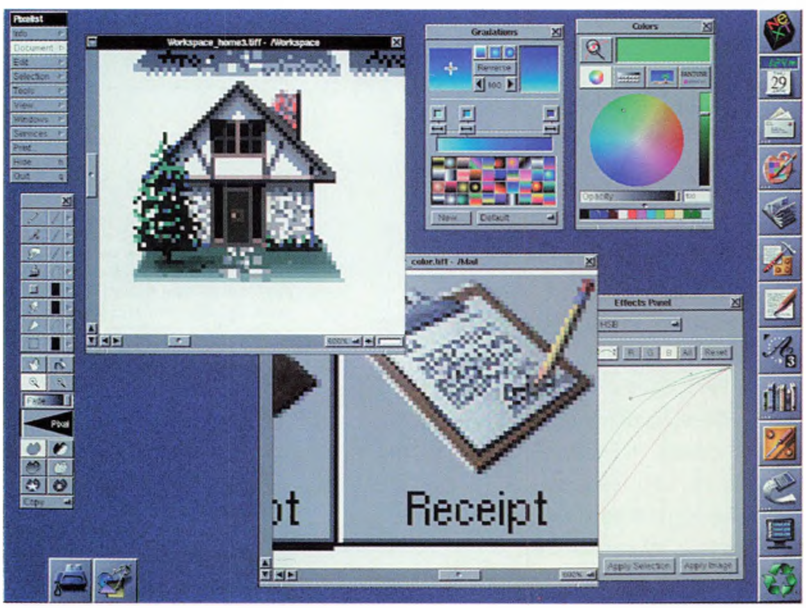
Figure 3: *Nils touches the 'Telephone' key and the selected number appears in the telephone display. He pushes the 'Connect' key below the display. The display graphically shows a connection being made to the vendor's telephone. Icons along the top line of the display show that the vendor also has an answering machine and a call re-routing number is available. Nils could choose to direct his call to either of these by pushing the soft key next to the appropriate icon.*

Evolution of the NeXTstep Interface Design

Keith Ohlfs

Imageworks

NeXTstep, NeXT's state-of-the-art interface, is acclaimed within industry for its ease of use, object-oriented architecture, and graphic design. How was NeXT able to create an object-oriented user interface in a few years that is now the target of every major operating system supplier? Taligent, Solaris, Microsoft, and other less-known companies are hurriedly claiming they will have the operating system of the future, in one to three years. The big three are throwing hundreds of engineers and designers at the problem in hopes that mass quantities of people will result in a quicker product. If NeXT had taken that approach, NeXTstep would have never seen the light of day. The NeXTstep development team included only a handful of programmers, one graphic designer, and one micro-managing, visionary CEO.



NeXTstep has evolved over the last five years to be a very complete, objected-oriented operating system and user interface. Its graphical evolution can be traced by the development of the objects that make up the core of the interface. This presentation outlines the evolution of the graphical user interface, from the very basic building blocks of the system, such as views and windows, to the more elaborate objects that evolved from them, including the color panel, font panel, file viewer, and Dock. Through interacting with the NeXTstep "family tree" of objects, one can find out the processes that took place to result in any of the aspects of the user interface.

For instance, if one wished to see the evolution of a widget, one could click on the widget to find out where it came from, what objects it inherits, what it looks like, and what decisions influenced that look. One could also find out what was its function, how a marriage was achieved between form and function, how the designer worked with the programmer, and what complications resulted (if any). Other information includes what ideas were perhaps discarded, how the widget was tested, what were the results, what is the future of the widget, and what other widgets did it influence in its development.

All of the objects in NeXTstep have a history that will be presented through mock-ups of early designs, animations, sounds, and textual descriptions. This evolution will be presented in an interactive environment on a NeXTstep-based computer system. The user can explore any aspect of the interface by clicking the mouse. Seldom has the development of an entire user interface been chronicled in such a way. Theories of evolution and survival of the fittest apply just as well to computer interfaces. They have evolved very rapidly over the past ten years and will continue to do so. By studying how they have evolved we can better prepare ourselves for the designs and interactions of the future.

Without knowing the full capabilities your "engineers" are possessed with you cannot recommend the interface designs that would best suit a particular system. The more familiar you are with it's guts, the better you will be equip to prototype a system and interact with the programmers.

— Keith Ohlfs

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Voices of the '30s:
A Case Study in Interface Design

Abbe Don, IN CONTEXT

Nathan Shedroff, Vivid Publishing

Pat Hanlon, a high-school English teacher and Bob Campbell, a high-school librarian, developed the original HyperCard/videodisk prototype in order to teach students about John Steinbeck's novel, The Grapes Of Wrath. They used photographs, oral histories, and archival film footage transferred to videodisk to provide the students with an emotional and experience-based understanding of the time period. They also included essays and activities that helped the students make connections between the social and political issues pertinent to the 1930s and those same issues today.

The prototype grew organically from 1985 to 1990 as it was used in Pat's classroom and as the features of HyperCard changed. The main design criteria was to keep the system open-ended to encourage the students to browse and engage in exploratory learning as they made their own connections between different elements provided in the database. The students also added material, especially to the bibliography.

Voices of the '30s integrates documentary photographs, newsreel footage, historic speeches, folk songs, and text as it brings to life the 1930s and the Great Depression. The HyperCard-based CD-ROM enables students to browse casually or search for specific information in the Resources section while the activities encourage students to pursue independent research and to make connections between the social, political, and cultural issues of the '30s and many of those same issues that are relevant today. The SIGGRAPH presentation includes hands-on access to the final product side-by-side with a custom interface that describes the design process as the project moved from "labor of love" prototype to published product.

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- Kristina Hooper Woolsey, Apple Computer, Inc.
- James Cottle, James Cottle Photography
- Wings For Learning: Lisa Paul, Steve Willis

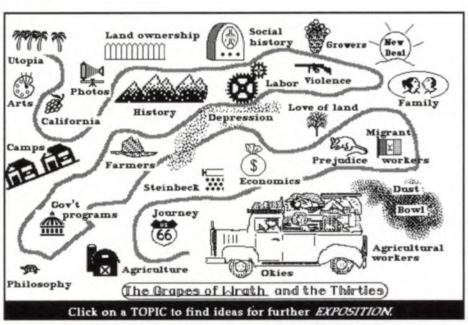
Part of the designer's task is to listen to the varied viewpoints from other team members and to explore concepts which appropriately incorporate their input while encompassing as many design criteria as possible.

— Bill Schaaf

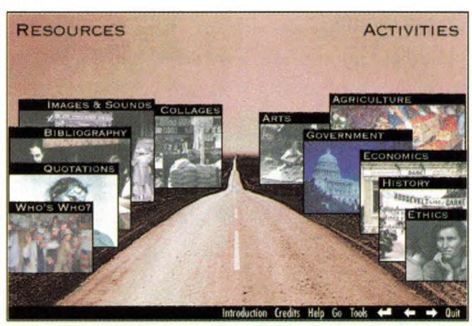
Marketeers seldom can tell the difference between facade design and a truely engineered design that "works" from every angle. They never do appreciate the latter because it tends to sell itself.

— William Chapin

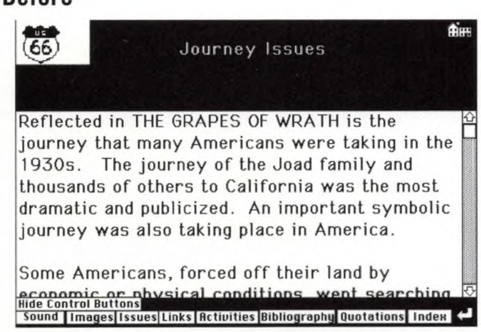
Before



After



Before



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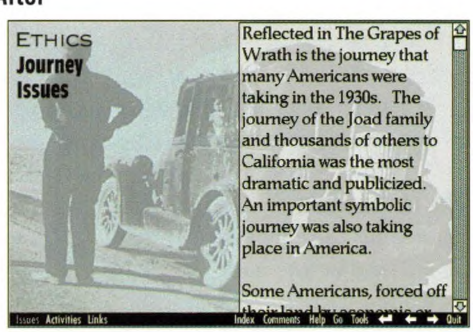


When my great-grandmother taught be to bake challah, she would throw the ingredients in one by one and say in Yiddish, "a bisel und a bisel machn a fule chisel" which translates as "a bit and a bit makes a full bowl." The skills a designer needs are a bit and a bit of traditional graphic design (such as layout, color theory, typography and fonts); computer skills (including interface design, interaction design, information design; conceptual skills (the hardest to quantify but perhaps the most important); col-

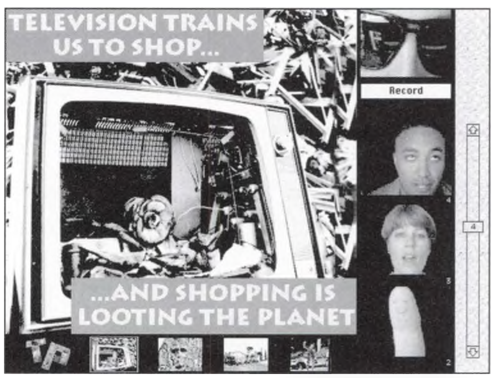
Designers' Tales

Kristee Rosendahl, Rosendahl Arts & Design

Abbe Don, IN CONTEXT

Designers' Tales, a Macintosh-based, real-time video bulletin board system, enables users to contribute to an evolving portrait of the design community. The system is intended to collect stories about the design process, tricks of the trade, or other personal anecdotes, especially those that reveal the kind of knowledge that designers learn by participating in hands-on collaborations rather than the formal knowledge available in design text books.

The design challenges for this project range from understanding the technical limitations of digital video on the Macintosh to overall interaction design, both on screen and in the physical installation.



The specific steps in the design process include:

1) Select appropriate topics and questions. The system will offer several topics to act as a catalyst for discussion. Topics include some playful questions as well as some questions culled from the interviews conducted with each of the contributors to the SIGGRAPH designing technology show.

Inspiration

What do you do for inspiration?
What people have influenced or inspired you?
Are they designers or from another field?

Process

What is your favorite part of the design process?
What is your least favorite part of the design process?

Tricks of the trade

What are your favorite tools?
What are your favorite toys?
What are your favorite fonts?

Designer identity

What do you call yourself?
What is the stereotype of a designer?
Are you doing what you were trained to do?

2) Set a context through the look and feel of the screens that encourages users to offer thoughtful responses.

3) Lay out the individual digital video segments so that it is easy to navigate through them. The layout will be based on a traditional grid system that is a classic graphic design tool. It also melds well with digital video that is best displayed in a rectangle with a 4:3 ratio.

4) Develop an easy-to-use interface for recording and reviewing a video response.

Designers' Tales is the second in a series of installations intended to explore how digital video technology can be used to build communities and foster dialog among users in a public setting. Future systems will be networked and enable users to add their own topics. The current system is based on TPTV, a real-time video bulletin board about environmental issues, created by Abbe Don, Mark Petrakis, Nick West, and Mitchell Yawitz, exhibited at The Interactive Experience at SIGCHI 1992, in Monterey, CA.

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Sketching Layouts Over Time

Karen Donoghue

MIT Media Lab

Sketching offers an intuitive form of data compression, one in which visual ideas can be quickly expressed. Means for communicating design ideas to a computer should be as straightforward and as expressive as freehand sketching: the system should allow for rapid creation of alternative visual ideas, expressivity, and ease of use. Electronic sketching allows the user to capture the act of sketching: speed, pressure, and tilt of the stylus reflect the motions of the hand during sketching, offering a new means for capturing stylistic solutions to communication problems.

In this electronic medium, the "page" is no longer 2D or 3D. It also contains the added dimensions of time, and is perhaps more accurately described as a "substrate layer" upon which marks are made and interpreted. In this new medium there is no established visual language; however, we can begin to extrapolate traditional graphic design methods into this dynamic environment.

The system described here is both a gestural and line notation interface that employs a gestural visual language defined for the domain of graphic design. The goal of this prototype system is to explore aspects of communicating visual qualities of elements (such as text on a page) through the articulation of sketching gestures, and controlling the dynamic behaviors of these elements in an intuitive, expressive way. The "substrate layer" upon which the sketch is made understands the implications of these marks. Sketches are interpreted in terms of their geometric, spatial, haptic, and temporal qualities. A grammar for interpreting the sketch components as syntactical objects and their physical and temporal properties is defined using conventions from the domain of graphic design.

Designers typically begin to visualize ideas by means of thumbnail sketches. These early sketches represent loosely-defined ideas or "visual markers" that can stand for high-level representations of elements of the design. This abstraction away from detail allows the designer to focus on higher-level information in the design. Our prototype system allows the designer to rapidly create thumbnails and indicate through gestures some of the lower-level visual information in the design. While sketching a page layout, this might include components such as a title, main image, caption, and several paragraphs, each of which are recognized by the system as syntactical objects. By varying the articulations of the hand during sketching through changes in pressure and tilt, the designer can gesturally indicate the visual qualities of these objects, such as visual weight, importance, and focus. Textual objects are interpreted as canonical type in terms of their boldness, condensedness, and point size. For example, force exerted by the hand during sketching is interpreted as indicative the weight of the type: the tilt of the pen during sketching controls the type's translucency.

Our static page layout grammar extends into the dynamic domain. The designer can annotate the page layout with notations that are understood to imply temporal behaviors, or behaviors that happen over time. One example might be to use sketching to indicate that the image on the page should follow a path to the right edge of the page and shrink over time, indicating velocity and translucency change using variations in acceleration and pressure expressed through the stylus. In this way, the temporal behaviors of the objects on this dynamic page are "roughed out" by means of rapid sketches without requiring explicit storyboarding techniques or mathematical equations.

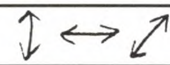
Change to Object	Sketch
Location	
Orientation	
Scale	
Visual Weight	

Table showing relationships between sketches denoting temporal behaviors and their resultant physical qualities for text and image objects which change over time.

The proliferation of electronic newspapers and interactive books will require design tools that enable designers to easily control temporal behaviors of objects on multidimensional "pages." Methodologies employed by graphic designers provide a model for the way in which these new electronic document layouts will be designed. These methods include the use of rapidly-made thumbnail sketches and prototypes. Temporal behavior of the objects on these pages, such as the way an article "fades" as its content becomes obsolete, can be "roughed out" very rapidly using information im-

laborative skills (ability to communicate with people from different disciplines, anticipate and meet deadlines, dependability, flexibility, patience and a good sense of humor!). A bit of video and sound, animation, and/or programming doesn't hurt either!

— Abbe Don

• • •

There is a problem with designers slugging to out with developers, there needs to be a bi-directional understanding and respect of each other to work together.

— Karen Donoghue

Graphic designers who are good really know how to organize and prioritize information and to present it and persuade. They make up part of the team that no one else can replace.

— Muriel Cooper

• • •

If you use the word iteration people jump to the wrong conclusion. I think when you talk about iteration it brings to mind rapid prototyping which is the idea of developing a working screen. Then people critique and decide that the design is right. So the itera-

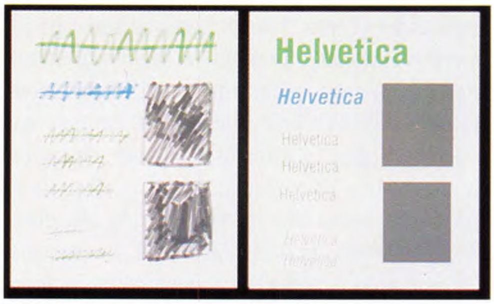


Figure 1

Figure 2

Figure 3

Figure 4

Figures 1-4: *A time-lapse view showing the result of interpreting a rough thumbnail sketch and replacing it by successively finer granularity information. Figure 3 & 4, Adobe Systems, Inc.*

Figure 1 *Rough thumbnail sketch.*

Figure 2 *Same sketched components replaced by canonical type and image objects. Their visual qualities such as weight, transparency, and color are expressed through the way in which the sketches were made with the input stylus.*

Figure 3 *Layout from Figure 2, with real type and images replacing the canonical type and image forms. The red arrow is a visual remnant of a sketching gesture indicative of how an object on this page should behave over time, changing its qualities (e.g., boldness) according the way in which the arrow was sketched.*

Figure 4 *shows the dynamic behavior of the object over time. The grey translucent trail indicates how the object has moved its position and visual qualities according to how the sketched arrow was made.*

plicit in the way the thumbnail sketches are made. This system provides a designer with a fast, intuitive, and expressive means for denoting objects, as in a page layout, whose syntactical and semantic qualities are understood to have stylistic meaning. Additionally, it provides a rapid means for denoting temporal and dynamic relationships and behaviors of these objects.

This research was performed under the direction of Muriel Cooper at the Visible Language Workshop, MIT Media Laboratory. This research was sponsored by Paws, Inc. and Hewlett-Packard. The designer would especially like to thank Candace Obert for assistance in the software development of this system.

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▪ Karen Donoghue, MIT Media Lab

Computer Designics

Tomohiro Ohira

Nippon Computer Graphics Association

'Computer Designics' is a phrase coined to indicate a new design movement that aims at humanizing computer and information technology, and it is the basic subject of the Design Committee of NICOGRAPH. It means dealing with the expansion of design areas (the tangibles as well as the intangibles) and design processes (the flow from user's requirements, through manufacturing, using, and discarding, to recycling) and the designer's role by actively using computers and information technology.

Sharp Outline of its Design System

From the viewpoint that a CAD system is necessary for design work, Sharp has developed the unique MEIBUS (3D) and CAPGraph (2D) database systems, which encompass standard design knowledge and expertise. Experienced designers have participated in the development to incorporate the expertise of many designers into the database. As a result, these systems have been developed from the viewpoint of users.

Our designers examined shape design and text/graphic design on a CAD system when designing the video camera recorder. The design mock-up was output by a NC machine tool installed in our design department, and a cut-and-try was done to examine the design. Three- and 2D data of the finalized design, the latter for text graphic design, were handed to the technical department for use in the technical design.

We use a CAD system to design internal printed circuit boards and metal molds. Designs of shapes, text graphics, metal molds, and circuit boards are now made in an integrated manner using a CAD system.

Shiseido 'Pack' Design System

'Pack' is the system that provides the necessary users interface for package design such as cosmetic bottles. This system was developed by Shiseido's designers group so that the designers themselves can operate the system. 'Pack' has total functionality, ranging from modeling, simulating colors and materials, and rapid-prototype modeling. The development method of the system is also unique in that the designers and the system developers are members of the same division, and that the developers themselves have experience as designers. This makes it possible for the system developers to grasp the designers' needs and reflect them smoothly and accurately in the system's development.

'Computer Designics,' Sony

Since the introduction of the world's first D-1 Component Digital VTR, the DVR-1000/DVPC-1000 Sony D-1 VTRs have earned a well-deserved reputation for excellence in component digital signal recording. Component digital recording is now

playing an increasingly important role in editing, complex picture manipulation, and archiving of film-based programming by overcoming the performance limitations of analog VTRs.

Sony has met the challenge of developing the technologies that are necessary to provide users with even more advanced digital performance and has now introduced its second-generation D-1 VTRs: the DVR-2100 and 2000.

Thanks to a new Dynamic Tracking technique, developed exclusively for the D-1 format, the DVR-2100 is capable of broadcast-quality playback speeds

tion happens in the design phase, but not down through the operational phase. It is the depth of penetration here that the word 'evolution' captures better than 'iteration.' We start with a very small system which is a real working system that will not be thrown away.

— Charlie Wiecha

Programmers and engineers see the designer's role as that of imaging products. Some consider the team as one to create interface designer on the screen and to develop the system as a tool for design.

— Nicograph

over the range of -1 to +2 times normal speed. Furthermore, Sony's advanced semiconductor technology in devices such as VLSI and Gate Array Circuits results in the compact size and light weight of the DVR-2100, which is of single crate construction.

To integrate the VTR effectively into component digital systems, component digital I/O ports are fitted to the DVR-2100 as standard. To work in an analog environment, optional video and audio A/D and D/A converters are also available. The DVR-2100 accepts the three sizes of cassettes (S, M, and L), with a maximum recording time of six minutes for S-size, 34 minutes for M-size, and 94 minutes for L-size.

To achieve its outstanding operational performance, the DVR-2100 features automatic compensation systems for playback equalization and tracking, while the channel condition can be easily monitored on its control panel.

The many advanced technologies and the robust mechanical design of the DVR-2100 offer many benefits in highly creative video production, expanding the range of applications for D-1 VTRs.

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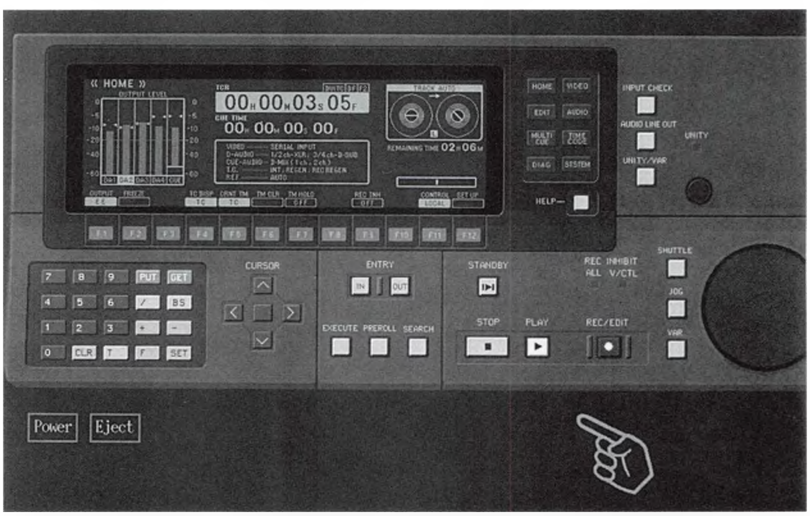


■ ■ ■

Teams, by definition, must be collaborative, and the most crucial skills for collaboration are people skills.

Computers for the Rest of Us

1992 Apple Interface Design Competition (joint first prize)

Robin Baker, Royal College of Art

Summary

The 1992 Apple competition brief was distributed to seven universities worldwide. The participating students, who formed interdisciplinary groups, were asked submit product ideas based on the theme of 'scalable computing.' The brief asked for the design of the products and interfaces for three computers to be used in a three-to-five-year future scenario.

The Interface Metaphor

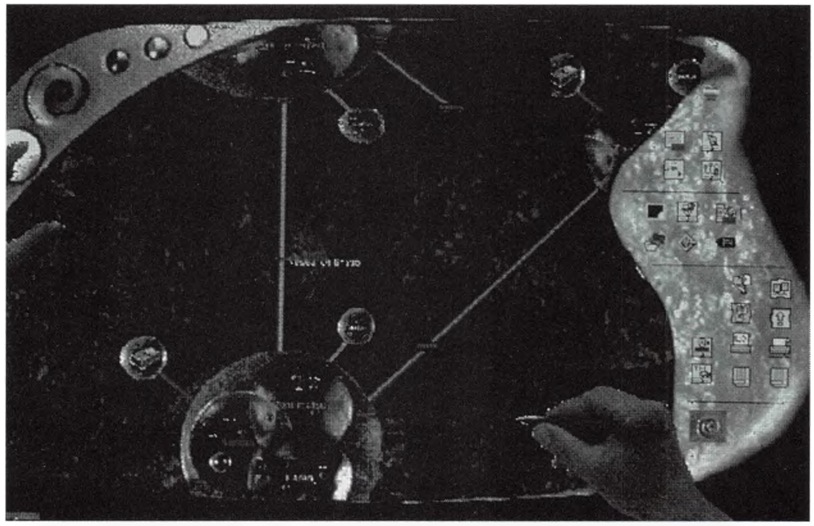
Nautilus was the name given to the interface on all three products. It represents the underlying structural metaphor behind the interaction, and is broadly based on the metaphor of information flowing. The Nautilus metaphor came about through early observations about the kinds of language people use to talk about information, for example: navigation, data flowing, data streams, surfaces, depth, filtering and distilling. People also refer to being lost in a 'sea of information,' or 'oceans of data.'

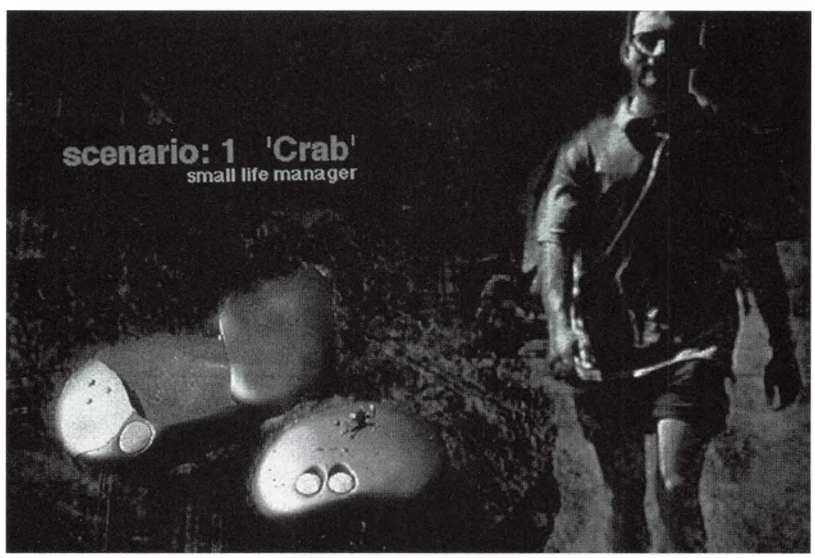
The metaphor fitted with the general philosophy to explore softer styling forms and more naturalistic feeling interfaces, a stark contrast to the traditional rectilinear boxes that have become familiar.

The metaphor also supports the ideas of networks and agents: rivers represent connections in networks (data flowing) and fish, agents. One of the key ideas was to use the concept of depth in interaction. Depth represents different levels of interaction complexity so that user tasks, or applications, are located near the 'surface,' while more organizational and computer-specific tasks are represented on 'deeper' levels.

The Computers

The Crab is the smallest of the three devices. Perhaps it is best described as a personal digital assistant, a life manager that takes the contents of a user's pockets and attempts to make them work electronically. A few of its typical tasks might be to store and retrieve small bits of information such as phone numbers, maps, dates, and appointments. It also has the functionality of a 'Walkman,' a camera, and a personal information store. These functions are downloaded from a central network when required. The form of the crab echoes the ideas of depth in the interface by using two levels. It also includes several solutions to the problems of limited screen size such as a tilting/scrolling technique that couples with a fish-eye lens effect on the edges of the screen.





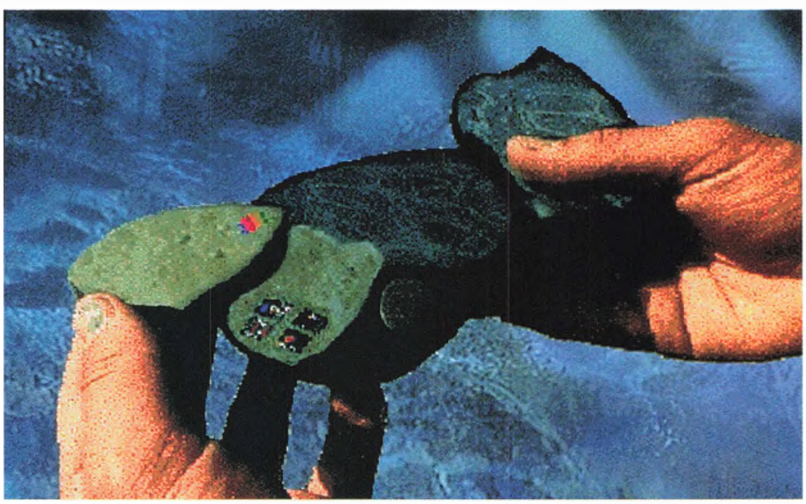
The Manta computer is a pen-operated portable desktop device. Its central idea was to allow users to create ideal individualized working environments comprised of applications that the user builds from component tools and functionality modules. The environment is navigated through using a 'depth dial zoom' and a trackerball.

Technical skills and horsepower can always be bought even at a moment's notice but you can't just buy collaborative progress. It must be directed and nurtured.

— Nathan Shedroff

The primary assets that a visual designer brings to the development process are a highly developed stylistic sense and the ability to present information in very compelling ways, some-

The Dorsal Computer is essentially a powerful workstation. Its primary function would be to perform complex information retrieval tasks from various networks. It will also help to store/retrieve and visualize complex data. The Dorsal uses infrared, wireless, short-range networks to communicate and add functionality to the Crab and Manta.



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Designing a Visual Database For Designers

Robin Baker

Royal College of Art

Summary

The project addressed the need of large garment manufacturing and retailing companies to reduce the time required to develop new garments within tight cost and quality constraints. The project had two stages. First was the empirical research into the fashion design environment; the second was the design and prototyping of software tools to aid fashion designers. This example allows fashion designers to draw on past work when designing new garments, incorporates a novel approach to casual data entry and attempts to make the use of computer systems emotionally engaging and memorable.

The Design Problem

A system was designed with two basic purposes:

- To capture key information about garments during their development life, and thereby form an archive of 'garment history'
- To make the garment history archive accessible to fashion designers in support of their current design work.

The Design Process

The design team consisted of an interaction designer, a graphic designer, a cognitive scientist, and a cognitive psychologist. The use of interaction design techniques enabled rapid progression from an initial problem analysis, through design concept sketches of user interaction, to production of artifacts to support users.

Cognitive science methodology was used to increase understanding of the fashion design process that was found to be 'messy' as it involved widely differing perceptions of the way garments were designed and developed. However, the research identified the need to support the work of fashion designers by increasing the availability of historical information about previous garment designs.

Conclusion

To make the transition from knowledge generated by research, to a clear design strategy, requires a 'creative leap.' Visual and interaction design techniques ensure the leap is made toward efficient and pleasurable human-computer interaction. Factors in the acceptance of the system included the use afforded by familiar and memorable imagery that appeared to outweigh strict legibility issues, and the priority of a visual design solution, which was a key factor in making database technology accessible to novice computer users.

> *thing that software people do not practice everyday.*
>
> *— Karen Donogue*

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For and In Conjunction With

- Marks & Spencer, Ltd.
- Courtaulds Textiles
- Coats Viyella.

> *The ability to create and visualize abstract concepts and imagined objects or actions is one of the most obvious contributions designers can make to the development process.*
>
> *— Peter Spreenberg*

A Brief History of the Expanded Book Toolkit

Bob Stein

The Voyager Company

Product development is an art, not a science.

— Bob Stein

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What we find is that the real work gets done when people start to understand each other's disciplines, people begin to understand the working of each other's crafts.

— Harry Saddler

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Communication, both visual and linguistic has always been a vital skill for a designer. Good interpersonal skills are difficult to teach and yet are critical to the designer.

— Bill Schaaf

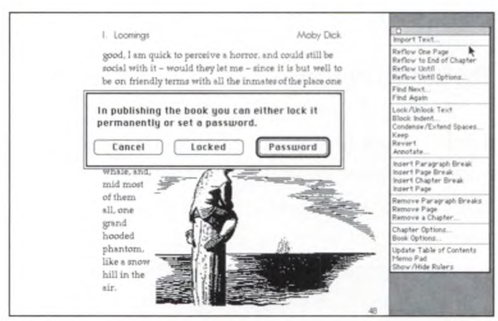
A Brief History of Expanded Books

On June 16, 1990, a small conference was held at The Voyager Company's Santa Monica office. It brought literary theorists and scholars together with programmers and designers to explore what computer technology could bring to the reading experience. After a day-long conversation the participants generally agreed that simple paper books represented a remarkably compact and efficient technology: they were portable, easy to use, convenient and cheap. Computers were none of these. All in attendance agreed that until affordable, powerful, and simple hand-held reading devices appeared on the market, computer-based text could not become a practical alternative to paper, judged to be at least five years away.

About nine months later, Voyager received a prototype of Apple Computer's Macintosh PowerBook. Within hours one employee had put a few pages of a novel onto it. It looked...like a book. Designers from Voyager's art department and programmers and producers began to discuss how a book should look and act on the computer screen. By the summer of 1991, the Expanded Books project was in full swing. The object was to design and produce a line of books for reading on the PowerBook. Three books were chosen for this first attempt: a contemporary thriller, a cult favorite, and a literary classic. Rather than provide an extensive (and expensive) multimedia experience, the books were meant to exemplify the standard features computer-based books should have. The design team for this project was fluid and ad-hoc; it included a staff programmer, a text specialist, a programmer/writer, and a visitor from Apple UK's technical support staff (who later joined the company). Graphic designers were frequently consulted on issues of typography, layout, and visual interface issues. Almost everyone who visited the company during this period was corralled and shown prototypes of the evolving books, and then asked to comment.

In January of 1992, the first three books were released and the next stage of the project began: to produce computer-based books at the rate of three per month. This posed new design challenges, for the improvised software tools that were used to develop the first books were not suited to the demands of a regular production schedule. Voyager assembled a design team consisting of members of the original book development group along with members of the new book production staff. Their goal was conceptually simple: to create a toolkit that would automate much of the process of creating the books and that was easy for non-computer specialists to learn to use quickly and effectively.

Again, the loose organizational structure at Voyager led to rapid and innovative development. Book production team members could quickly try out and criticize the newly developed tools, leading to many changes and improvements. The programming team could watch how the tools were used in an actual production environment and adjust the toolkit's feature set. Documentation was written and laid out in camera-ready form by one of the development team's members in parallel with the development work, allowing the toolkit's feature set to remain fluid until very late in the product development cycle. Continual discussions between the developers and Voyager employees working on other projects, along with Voyager's ongoing practice of demonstrating works-in-progress to visitors, contributed to the design and implementation as well. As a result, it took less than five months from inception of the Expanded Book Toolkit project to its commercial introduction at the Boston MacWorld Expo in August of 1992.



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Design Space

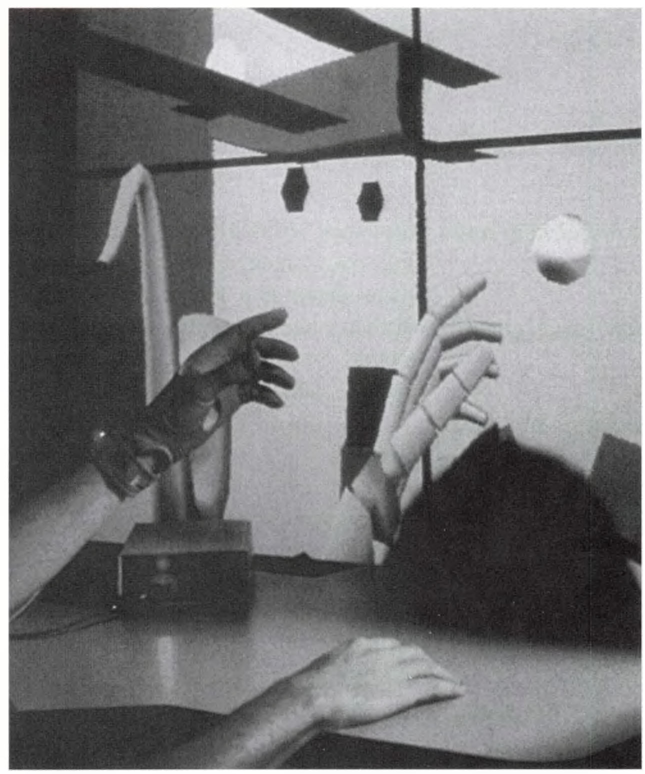
William Chapin

Virtual Space Exploration Lab

DesignSpace: An Exhibit of Developing Technologies for Design

DesignSpace exhibits an interpretation of future design media drawn from work at Stanford University's Center for Design Research (CDR) that facilitates collaborative design between remote stations through a shared virtual space. CDR was founded in 1983 as an industrial-academic collaboration and interdisciplinary R&D center to improve the engineering and product design process. The CDR accepts design problems from industry and confronts them with creative design teams for the purpose of design process observation and study, experimental design practice, and new design tool development. A long-term CDR goal is to aid the design process so that creativity, reuse of design knowledge, and human skill are not impeded by problem complexity. While modern design tools commonly use computer-assisted project scaling (do one by hand; do n by computer), computer interfaces often interfere with the designer's creative flow of thought and manual skills. At CDR, researchers and designers collaborate on projects to develop devices and interfaces to better map manual skills to data operations, experiment with alternative means of design knowledge storage and retrieval, and investigate design tool effectiveness. DesignSpace encapsulates some of these developing technologies into a conceptual design environment.

At each DesignSpace station, designers work in a physical studio environment, but with a large projection window into the shared virtual 3D space. The "semi-immersive" aural, visual, and dexterous interaction within the virtual environment frees the user to work in both the physical and virtual design spaces. Hand and wrist instrumentation empowers each DesignSpace designer with system control, manual communication with collaborating designers, and use of dexterous design skills. Users may use dexterous interaction to compose spatialized MIDI music, create colorful 3D designs, communicate in a manual language, and modify the design environment, in addition to issuing pre-trained, macro-type system commands using hand gestures. Linked stations locally maintain the environment and bidirectionally share their designer's uniquely-mapped interactions. Evolving from traditional CAD tools, DesignSpace does not require the designer to channel design interaction through a command interface, and attempts to put creativity back in the hands of the designer. Unlike "immersive" virtual environment systems, DesignSpace does not limit designers from using familiar physical physical design tools. DesignSpace brings computer design media into the design studio, much like paper or clay may lie on a table, while extending the experience to remote collaborators.



Several CDR projects form the basis for DesignSpace: Talking Glove (Kramer and Leifer) an instrumented glove and recognition algorithm for dynamically mapping human hand poses into a digital command stream, Cut Plane (Edwards, Kessler, and Leifer) a 3D CAD workstation interaction concept, Virtual Hand (Chapin and Kramer) a dynamic hand model driven by the instrumented glove developed for Talking Glove, TeleSign (Chapin, Kramer, Macken, Haas, and Leifer), a collaborative design effort between CDR and the Center for the Study of Language and Information, leveraged from the Talking

Product specification must be flexible and change with every new discovery that arises throughout the design process. In order to responsibly attack a problem, designers should question every spec that is provided to ensure that it isn't based on assumptions or preconceptions.

— Holtorf

At first engineers don't see the need for "designers," but once we perform our magic on their designs, I enjoy watching the appreciation grow.

— William Chapin

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You can't walk into a team meeting around here and decide that some people are designers and some are support people. It is almost like the process take precedent over the background and training.

— Rick Robinson

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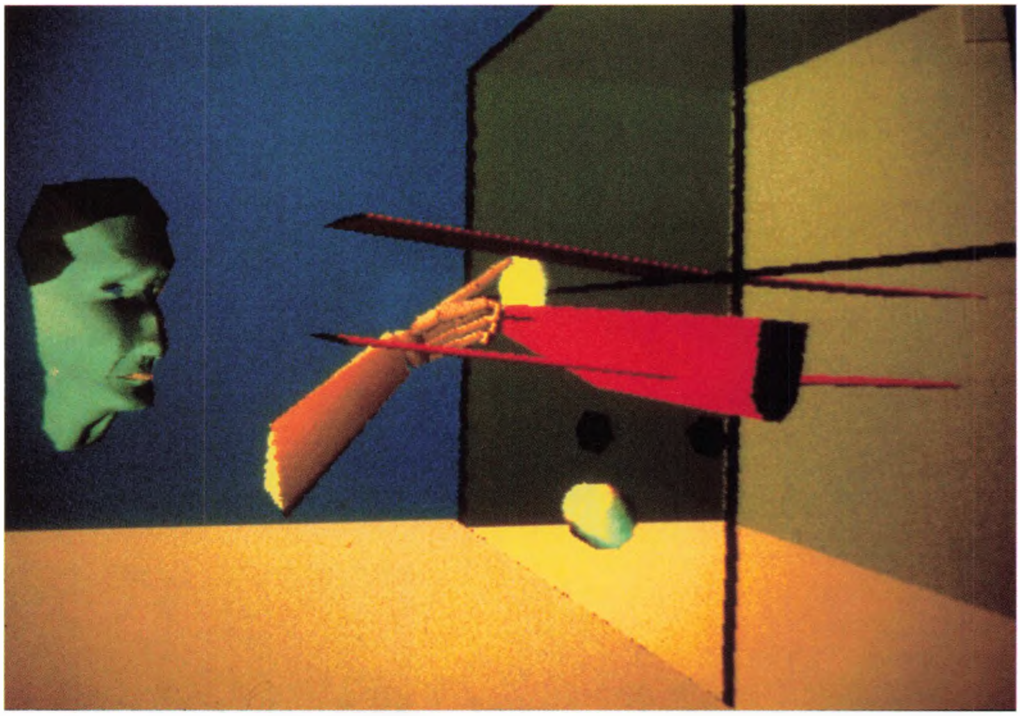
We find that some people want to know "the rules"



Glove and Virtual Hand projects to develop a locally maintained, shared virtual environment for visual expression and manual communication, without video bandwidth. DesignSpace is a joint effort to promote creative, collaborative computer assisted design.

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Apple Adjustable Keyboard

Stephen Peart, Vent Design

Process and Design Collaboration

Collaboration is typically defined as working jointly with others. Although artistic productions or expressions are often attributed to a single individual, design is just one of many disciplines that greatly benefits from interfacing with others. The practice of collaboration can yield very powerful solutions.

Is there a difference between collaboration and communication? Does collaboration mean just communicating well? Collaboration hints at the existence of a team at the inception of a program, with a wish to combine several disciplines. A true team exists from the beginning; it is not a team that shops and drops skills at various stages of a project. In product development, for example, a core team should consist of the necessary creative and technical players that incept and complete the project.

To be effective, teams do not have to be large in numbers. Small groups, including designers, engineers, and mangers, unhindered by large committee influence, are very potent producers—generating and responding in very short periods of time.

This practice requires large amounts of commitment and selflessness. For the product process mutual understanding of acute disciplinary skills is vital in order to assist the communication of new ideas. In other words, collaboration needs to go further than just working jointly with others. It also involves respect and patience for all skill-bases involved in any given project. In reality this tends to be easier in theory than in practice, since different companies hold certain activities more precious than others. Designers and "design-thinking" can be a useful balance to avoid over-focusing on certain disciplines.

Is this why some products are more outstanding than others? Companies with successful products contain engineers, marketers, and leaders who have open minds toward design and technology; they enjoy the experience that true collaboration can bring to a program. Unfortunately, those companies that do not seem to be quite numerous.

When a balanced approach is embraced, one can materialize a product of remarkable nature. This aspect is passed on to the maker and end user as a product vitality that can be enjoyed by all.

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- Raymond Riley, Industrial Design Manager

Vent Design:
- Stephen Peart, Principal Designer

...of good design (as if these were a quantifiable entity) so that they can bypass a rigorous design process and achieve a quick fix.

— Peter Spreenberg

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Cross-disciplinary skills are time-consuming to teach. But, to appreciate their necessity one needs only to experience the results of a development effort when they are absent.

— Stephen Peart

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Design and problem solving are synonymous.

— William Chapin

The Design Process for Information Products

Aaron Marcus,

Aaron Marcus and Associates, Inc.

Design is part science, part art, with a good bit of business skill and ethical sensitivity thrown in.

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An important challenge for designers is to convince product development groups that the functional requirements and specification documents, and the workflow and task specification documents, while both important, do not necessarily constitute a mental model of the product embodied in the visible appearance of and interaction with the product.

The Nature of Design

In the computer world, "design" means many things. Hardware engineers think of themselves as designers. Software engineers, or programmers, call themselves designers and speak of their work as designs. Some human factors specialists think of themselves as designers. Even cognitive scientists sometimes call their work "design."

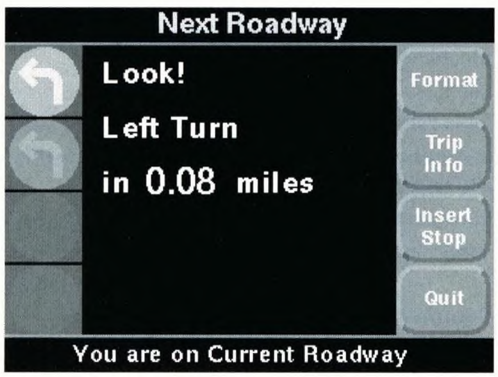

Figure 1

In our business, which includes user interface design, electronic document design, and interactive multimedia design, design means information-oriented, systematic, industrial graphic design. A graphic designer is a master of applied visual semiotics, a skilled professional who can communicate wisdom about structures and processes, as well as emotional values, effectively through visible language. The designer is the chief analyst and synthesizer of metaphors, mental models, navigation, look, and feel in computer-based products that provide users with information about the world or about the product, whether they are used as a professional tools or for entertainment. Design is part science, part art, with a good bit of business skill and ethical sensitivity thrown in.

Collaborative Design Teams

The designer of information-intensive products must be a team player. Real-world projects demand that the designer work amiably and productively with other disciplines. In our user interface design projects, for example, we almost always work as consultants or designers with professionals from these and other disciplines: software engineering, product marketing, hardware engineering, industrial design, human factors, cognitive science, anthropology, technical writing, and content experts.

If we work as consultants, we evaluate existing requirements or specifications documents, prototypes, user interface design manuals, usability testing materials, existing products, users, or the client's design process. Our deliverables are primarily videotaped discussions and reports. If we work as designers, we determine precise, accurate, concise versions of metaphors, mental models, navigation, look, and feel. These components can be defined as the following:

- Metaphors: fundamental terms, images, and concepts.
- Mental Model: essential organization of data, functions, tasks, and roles embodied in word lists and abstract screens.
- Navigation: movement through the model via menus, windows, dialogue boxes, and control panels.
- Look: appearance characteristics, including detailed specifications for typography, color, symbols, animation, sequencing, acoustic cues, and the design of specific tables, charts, maps, diagrams, and illustrations. These may or may not be required to comply with the constraints of commercial graphical user interfaces (GUIs).
- Feel: interaction techniques, including detailed specifications for selection, tradeoff of input styles, and characteristics of output devices.

As designers, not consultants, we deliver pixels on disks, or files with scripts that embody the actual components of the working user interfaces, documents, presentations, or multimedia displays, as well as design-specification documents.

Design Skills for Cross-disciplinary Development Teams

To work effectively with interdisciplinary product development teams, designers need to be able to draw, think, write, and talk. Specifically, they come with the following skills:

- Fluency with information-oriented, systematic graphic design tasks, such as systems analysis, programmatic design, grid development, design of pictogram/ideogram sets, and chart/map/diagram design.
- Intermediate or expert-level fluency with graphics editing, word processing, and multimedia editing applications.
- Ability to explain design decisions cogently and

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to write descriptions, explanations, and specifications of work, not just shape the images, select the colors, etc.

- Comfort with technical terms and concepts, ability to meet software engineers and content experts halfway. The more we can speak the clients' and/or the customers' language, the better chance we have to be selected to assist them and to be able to analyze their needs effectively.

The Design Process

Although every design project is unique in its origins and process, the general procedure we find across most vertical markets is the following:

- Marketing specialists gather competitive information and customer needs.
- Marketing and engineering specialists prepare documents on requirements and functional specifications.
- Based on available information, graphic designers specializing in user interface design prepare initially brief, then detailed, simulations of primary screens (and associated hardware) depicting essential components of metaphors, metal models, navigation, look, and feel, and then prepare initial documents describing guidelines or specifications.
- Software engineers program prototypes using graphical user interface (GUI) building tools.
- Human factors specialists evaluate prototypes and conduct usability tests.
- Technical writers complete and refine the documents describing and explaining the product, presentation, or project.

An important challenge for designers is to convince product development groups that the functional requirements and specification documents, and the workflow and task specification documents, while both important, do not necessarily constitute a mental model of the product embodied in the visible appearance of and interaction with the product.

For example, in user interfaces, the functional requirements and the task sequences may be described in terms that do not mention specific menu structures and dialogue box contents. The challenge for the user interface designer is to construct a simulation or initial prototype that merges the requirements expressed in both the builder's view and the user's view of what is needed. After simulations and prototypes emerge, they can be evaluated by builders and users, with the final product continuing to evolve and change over a sequence of prototyping. Today's tools allow this cyclic evolution of design. In effect, the product design is never done; when the time runs out, the best version thus far is shipped.

Product Development Team Structure

Ideally, a development group would use designers side-by-side with engineers, human factors specialists, and representatives of other disciplines, whether for a research laboratory or product development department. Typically, neither engineers or human factors specialists have sufficient background or skill in both inventing and refining metaphors, mental models, navigation, look, and feel. Many of the research projects become limited to incremental leaps because the input of experienced designers of graphics and interaction is lacking. Likewise in development groups, the pace of progress and the quality of decision-making is unnecessarily limited because of the skill set among traditional developers.

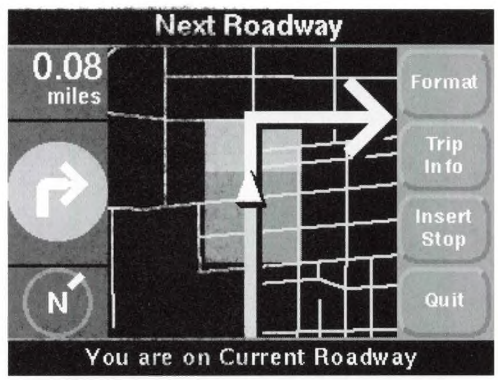

Figure 2

Figure 1 & 2: *The figures show typical screens from the user interface designs developed by Aaron Marcus and Associates, Inc., for Motorola Corporation's intelligent vehicle navigation system being developed by the Group. AM+A became involved at an early stage, combined early prototypes into a revised best version, helped refine the mental model, and determined detaled look and feel long before actual code was written for the working protoypes now being evaluated. AM+A's current and former staff members who assisted on the project include Grant Letz, Greg Galle, Todd Blank, and Sandra Ragan. Figures courtesy of Motorola Corporation and © Copyright 1992 Motorola Corporation.*

When we work with our clients, we ask them if they want evolutionary or revolutionary solutions. Revolutionary ones may be more difficult or even impossible to implement given current building/production tools. Naturally, the product development groups often opt for the evolutionary approaches; they have deadlines to meet, or are already behind. Having worked with both, there does not seem to be a great difference between the kinds of fundamental needs of the research laboratory as opposed to a product development department. It is a matter of the distance in time and breadth of conceptual horizons, which may or may not translate to budgets and available people.

Project Initiation

We find that user interface development projects may be driven by either marketing or engineering staff acting as product managers. Product managers or someone on their staffs usually are aware that they lack certain exper-

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Figure 3 & 4: *Culturally diverse products indicate the need for designers to become involved at an early stage in exploring the possible differentiation of products for particular markets. This figure shows a prototype demonstrating cultual diversity applied to the content of a typical GUI's Print dialogue box. An English-Speaking European adult intellectual might prefer suave prose, a restrained treatment of information density, and a classical approach to font selection (e.g., the use of serif type in axial symmetric layouts, similar to those found in elegant bronze European building identification signs).*

tise, but sometimes they aren't aware of what specialized expertise they need or where to go for help. Sometimes they are behind in their schedules because their staff has spent too much time haggling about design issues without resolving them, resulting in "analysis paralysis" as a systems-analysis consultant recently called the phenomenon. Many user interface projects are still driven predominantly by engineering. They often lack sufficient marketing information about typical user needs, desires, and habits.

In our document design projects, marketing managers almost invariably initiate and drive the projects. They usually have a much better understanding of and commitment to usability testing. Our interactive multimedia projects are usually much more sensitive to market conditions, also. Software engineers are viewed as one of many valuable contributors to the success of product development.

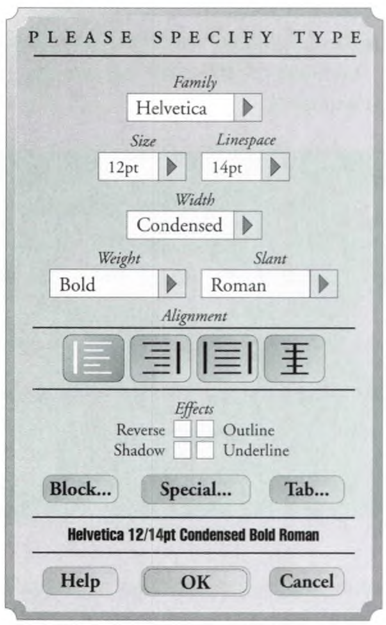

Figure 3

For the past ten years, I have been advising my tutorial classes that designers should be called in at the earliest possible moment, even for strategic planning and product definition phases. Our actual arrival time varies greatly.

In a current consumer product development, we are being called in to help our client communicate advanced, novel functionality through the metaphors, mental model, navigation, look, and feel of an advanced personal communication product. Although the client already has commissioned detailed industrial design of the product's case, the actual functioning of the product as a communication device is still being determined! In an unusual turn of events, we have been asked to write and illustrate a draft user's manual in order to envision the final product, then our client will implement a prototype based on the user's manual, exactly the opposite of what usually happens.

Programmers and the Development Process

Since programmers are often in the driver's seat, they are usually called in either before or just after marketing personnel get involved. Only in rare cases are they called in late in the process. Programmers and marketers need to understand better the value of designers in preparing rapid simulations (i.e., smart fakes) of products by whatever means available so that they can be quickly evaluated by potential users. These simulations may not be scripted prototypes. Often today's prototyping tools are limited in what they can do. The evaluations of the simulations can be used as a basis for adjusting assumptions about metaphors, mental model, navigation, look, or feel in later working prototypes and the alpha and beta versions of the products. As products respond to cultural diversity in the market place, this kind of approach will be increasingly necessary.

Users and the Development Process?

Shockingly, in some of our projects, our clients never do call in users. That isn't necessarily a recipe for a disaster if professional graphic designers are involved in the development process: for most of my professional life, I've understood ourselves to serve as stand-ins for the users. Increasingly, however, we work as designers to prepare prototypes that are then evaluated by users. We have also prepared questionnaires to better help our clients assess user response in focus groups during preliminary, alpha-, or beta-phase product development phases.

Development Process Results

In some cases, the development process has worked extremely well. Because of unusual circumstances for a project we did with ARPA's software-visualization project, we had the opportunity to work with users during three years of prototype development. Our research colleagues were not only researchers and builders of prototypes, but typical users, as well. We were an ideal, efficient team. When we finally came to test our recommended conventions through independent human factors evaluation, we were pleased to learn that novice programmers improved their comprehension of code by 20 %

simply from the way we had designed the typography and layout.

In many other situations, the development process does not work so well. One of the most frequent sources of frustration is that our clients will ask us to design simulations, prototypes, or templates, then implement some distorted or incomplete version of what we recommended, and we never have an opportunity to review the implementation before it is shipped. Our more sophisticated clients recognize the procedural problem, but sometimes budget limitations prevent even the most fortunate of them from undertaking the appropriate steps.

How others View Design

I recall in 1980 that an artificial intelligence resarcher once came out of her research lab cubicle exclaiming in amazement that she had just learned about the existence of typographers. "Imagine," she said, "there are people who just sit and design letters all day!" About that same time, another computer graphics researcher asked me what I thought about style in computer graphics. I thought she meant the difference between, say Bauhaus style and Art Nouveau. "No," she explained, "I mean the difference between dotted lines and dashed lines."

Software engineers, hardware engineers, cognitive scientists, and some marketing managers have sometimes viewed our work as cosmetic improvement, last-minute band-aids to cover up original or earlier mistakes. The involvement of designers currently may be an unplanned expense and delay in schedule. However, clients are gradually recognizing the payoff of involving designers.

Designers can plan, analyze, design, document, evaluate, and train in the areas of user interfaces, documents, and interactive multimedia. Sometimes they may have to emphasize only icon design, brochure design, or other look-and-feel activities just to be able to get a foot in the door and to convince clients that their assistance goes much deeper than the surface cosmetic beauty of our charts, icons, maps, and diagrams.

For approximately half a century, the computer has been thought of as a data processing device. Recent technology developments are changing the public's perception of the computer: the use of graphical user interfaces, the incorporation of CD-ROMs, the use of multimedia, and the combination of traditional computation functions with the communication functions of electronic devices like the telephone, fax, television, cable, pagers, and radio are challenging our expectations.

Today, the computer is moving from the business-office desktop work-device for clerical, manager, or engineer staff into hand-held consumer communication devices. The nature of many traditional electronic products is beginning to blur as telephones acquire display screens, television sets become two-way, interactive communication terminals, and computers acquire telephone and video capabilities. Companies are re-aligning themselves to bring to market devices called personal digital assistants, personal information products, and more.

Tomorrow, that is, within this decade, the international marketplace will be flooded with information-related products competing to provide users with large amounts of data and sophisticated new functions. Much of this data and many of these functions may never have been available to the average consumer, or the configuration of traditional data and functions may be novel and unfamiliar. What impact does this have on the average consumer?

User interfaces, electronic documents, and interactive multimedia, no matter how sophisticated technologically, do not solve the essential task of communicating an information product's data and functions. Designers must be involved to direct a high-quality, integrated approach to analyzing and designing the underlying concepts, organization, navigation, presentation, and interaction. Principles from systematic, information-oriented design can provide guidance for simple, clear, consistent solutions that will continue to benefit increasingly diverse information

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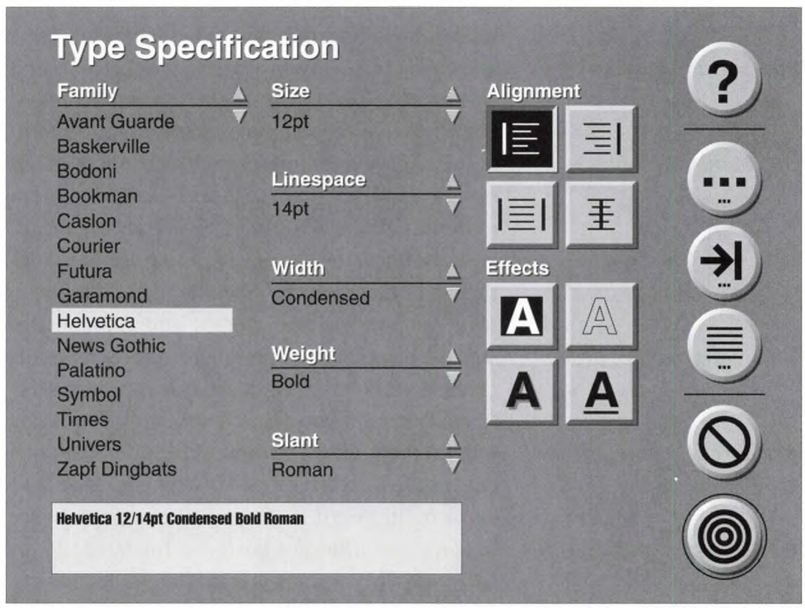

Figure 4

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— Aaron Marcus

products for an increasingly diverse international user community.

What is the role of the designer in bringing these products to market? The industry has matured. Graphic designers now sit side-by-side with programmerss to develop cooperatively the information products of the next generation. Information-oriented, systematic graphic design has come a long way since the late 1960s when designers first became involved with computers.

Biography

Aaron Marcus is President of Aaron Marcus and Associates, Inc. (AM&A), an Emeryville, CA design, consulting, and product development firm that researches, designs, and consults on metaphors, semiotics, and visible languages for user interfaces, multimedia documents, and knowledge visualization. He has worked on and written about user interface design for 25 years. Marcus has given tutorials about effective communication in computer graphics at most major design and computer conferences and at corporate sites since 1971 and is the author or co-author of several books, including Human Factors and Typography for More Readable Programs (with Ronald Baecker, 1990) and Graphic Design for Electronic Documents and User Interfaces (1992). In 1992, Marcus received the National Computer Graphics Association's Industry Achievement Award for his contributions to computer graphics. In 1993, ID Magazine awarded his firm an award in its annual competition for AM&A's user interface design of the Motorola in-car navigation device. Aaron Marcus received a BA in physics from Princeton University (1965), and a BFA and MFA in graphic design from Yale University Art School (1968). He has taught on the faculty of Princeton University, the Hebrew University/Jerusalem, and the University of California/Berkeley.

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Interview with RitaSue Siegel

RitaSue Siegel is the founder (1969) and chairperson of RitaSue Siegel Associates, the leading recruiting and executive search company, worldwide, for design management talent for every type of product, and for consulting services on design organizational development. An industrial designer by training, Siegel is a frequent lecturer and author whose writings include American Graphic Design, Thirty Years of Imagery, "Design, Of Course I Know What That Is," as well as articles in The New York Times, Communications Arts, and internationally recognized trade media.

RitaSue, you have recruited and placed more designers and design managers and have advised more corporations about good design than perhaps anyone else in the world. Give me some examples of what you think is good design and what are the common elements that makes them so good.

You may not agree with my choices: the Miata, the VW bug, the XK 120 Jaguar, the Walkman concept that was the mother of many different types of children, the songs of Rogers and Hammerstien, the movie Dark Passage, the original wrinkled-toed Reeboks for aerobics, Oreo cookies, a book called The Tao of Physics, Prozac, and the Apple Powerbook.

What do they have in common?

The answer has something to do with magic, with imagination, with invention, with motivation, with stick-to-it-tive-ness, with belief in one's ideas, with belief in the ideas of others, with comfort with the abstract and ambiguity, with the ability to implement and deliver on promises, with respectability.

The answer also has something to do with good sales and marketing people, good advertising, display and packaging, good word of mouth, quality production, distribution and availability, and all those specialists who work together, so the product can be delivered to the customer with pride and caring at an acceptable price.

From my experience, the pride and caring came from the top of the company, or a persuasive individual or small group at any level who is motivated to not give up until products get better. A great product is often the result of the single-minded devotion of an individual or small group inside a company. Another attribute of good design is the element of surprise. The great product starts out by being slightly ahead of its time—but is found to be perfectly right for the time by a part of the audience who gets comfortable with it real quick. An audience that either falls in love with the creation and must have it, or sees having it as an element necessary to their survival—whether it's true or not is irrelevant. Its success grows as acceptance trickles down or out. All the great products I mentioned are different from those that came before them, in a unique and special way. In addition, they answer a question of desire...a question their designer may have had, such as:

Why can't we have a sports car like the good old days?

Why can't we have a cheap, mass-produced car that everyone can afford?

Why can't we have a tape player we can easily carry around?

How come they don't do this?

How come they don't do that?

There's something very human about the fact that a large portion of the population is uncomfortable with what doesn't look familiar or that is new, and in contrast, there is always a portion of the population that "gets it" immediately.

But that phenomena is just another part of the equation/process of developing great products we have to accept and work with. Great products strike a universal cord. People respond to them with a smile. Responding and smiling are two very important parts of the process. Great products are going to bring pleasure to the person who looks at them, works with them, or buys them. Somehow people can sense that. A good designer will be at the heart of this equation or process. Like a great inspiring teacher, a wonderful parent, a helpful neighbor, or big brother/sister, one person can make a great impact. The working together of people with different types of experience toward a common goal just intensifies the impact.

Today, when technology and TQM have reached a point where almost any organization can learn how to produce impeccable products with great efficiency, design is becoming a critical element to enhancing a company's competitive position. In my book, just loving the way something looks and feels is as much a "function" as miles per gallon or top speed.

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A great product is often the result of the single-minded devotion of an individual or small group inside a company.

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Another attribute of good design is the element of surprise. The great product starts out by being slightly ahead of its time—but is found to be perfectly right for the time by a part of the audience who gets comfortable with it real quick.

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Great products strike a universal cord. People respond to them with a smile.

— RitaSue Seigel

Interview with Bill Moggridge

There is a basic way of thinking that I call "creative soup" that is shared by all the people trained in subjective disciplines. It is a learning-by-doing process.

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The subconscious is much better at recognizing difficult things that are hard to understand.

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Designers are good at synthesizing requirements and taking notice of them at a subconscious level.

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The missing link, between human factors and soft-

Bill Moggridge is responsible for developing IDEO's international product development services and for formulating strategic new directions for the company. He trained in industrial design in London, and later founded his company there in 1969 for development of consumer and business equipment. His first interest is in designing products for people to use with satisfaction and enjoyment, and he is also active in design education through the London Business School, the Royal College of Art, and Stanford University. In 1988 he was appointed a Royal Designer for Industry by the Royal Society of Arts.

What are the primary skills a designer needs today to be part of a cross-disciplinary development team? Are those skills being taught in traditional design education?

There is a basic way of thinking that I call "creative soup" that is shared by all the people trained in subjective disciplines, such as artists, poets, creative writers, and designers. It is a learning-by-doing process. I think that is quite different from the academic approach to learning, where things are much more ordered and intellectual, where you try to use the conscious level of your mind rather than the subconscious (which is the creative soup level). It is often difficult to get people together from both ways of thinking. It is hardly surprising that people have a difficult time communicating. The ways they think and the focus of their lives are so different. I think the skills that are missing are those things that I call "hooks." The training we have as designers is very specialized and disciplined-oriented; we don't have much given to us through education in the way of hooks that will enable us to successfully connect to other members of the team. We need to develop hooks to other disciplines and for understanding ways people go about their lives, in order to understand the ways they think.

What are the primary skills that the subconscious thinker brings to a team?

The subconscious is much better at recognizing difficult things that are hard to understand...so much goes on in the brain that we don't know about having to do with body language, sense of look, etc. You can sum that up with the word "synthesis." Designers are good at synthesizing requirements and taking notice of them at a subconscious level. Anything to do with qualitative and subjective aspects of the product—you are more likely to be good at understanding them by feeling rather than understanding them through thinking in a conscious way. Designers are good at understanding the qualitative and subjective parts, the emotional parts of your mind. The conscious mind is good at understanding what is on the surface.

Typically, at what stage are you brought into the development process?

We approach projects differently for different clients. IDEO is large, with more than 150 people in the company. We have developed a service over the past few years we call "Innovation Strategy" that helps people decide what they want to do with the product in the first place. It is not just in the beginning of the design process, but before the beginning of the process. There is a gap in the development process. First the product is defined by a "brief" (product spec), and often times the designer is constrained by that brief. You first have to look at the question "where does the brief come from?" to see if its basis is a good one. In most cases the product brief comes from senior people saying "let's do this product next." We believe that designers are good at this process and can help management define the product. Innovation Strategy goes through a series of four steps that help define the product more clearly. The number of clients asking us to engage in this process is still pretty small. We started in 1983 with the Innovative Strategy process with Xerox.

Are you considered a creative director or educator? What is your role in the process?

I think the terms educator and creative director are intertwined. I still think of myself as a designer. The work I have been doing in recent years hasn't been drawing-board design of objects, but rather the designing of processes, really, trying to figure out what's next and how to do it. I am using design techniques to do that and trying to discover by "learning-by-doing." In order to be a useful contributor to a design group, you have to first discover new ways of doing things, then let people take it over and do it themselves. We often use workshops for communication to get teams together and learn each others' disciplines.

When you define your work to others (engineers, marketing people, etc.), what is their definition of a designer—what do they think designers do?

I usually divide it into the technical and engineering design and the human contribution; the difference being the starting point. The engineers start from performance and come toward the solution from that end; while the human factors specialists start from the human side and come to the solution from there. They usually cross over and shake hands in the middle. I also tend to describe what we do in a process context; this is what we do and how we do it. One of the things that differentiates IDEO is that we are about half engineers and half designers. We often go in as an engineering company, a lively version of an engineering firm, and for this we are often taken more seriously. It is really too bad that we have to have the moniker of engineer to be heard by some people, but that is often the case. Communicating with diverse people goes back to the idea of "hooks" really, getting enough knowledge and a sympathetic point of view to be collaborative instead of offensive. Designers have always been successful at that.

How might that differ from human factors and those coming from psychology and anthropology?

If you take the human factors side, you get the people professionally trained in psychology, anthropology, and human behavior, those who typically attend SIGCHI. The missing link between human factors and software, is the design side of things, those people who are concerned with the artistic and subjective contribution. And that is why we call this by a different name; we call it "interaction design" as opposed to "user interface design." The Royal College of Art has a post-graduate course that deals with this area of education that Gillian Crampton-Smith is heading up. There seems to be no specific parallel to this in the States, but perhaps IIT is doing a similar program.

What are the primary assets that a "visual designer" (graphic, industrial, spatial) brings to the development process?

I think the term "visual design" is a mistake; I would like to challenge that. I think that there is this thing called Visual Interface Design (VID), a term coined by Doris Wells Papanek. That is definitely something that is needed, and it makes an important contribution. But people interpret that to mean that the only contribution of the design is the output component of the display: the appearance of the information, the fonts, graphical representation, and so on.

The contribution that I would like to see interaction designers getting their minds around is VID that includes the physical input components (keyboard, mouse, buttons, and so on) and also its behavior: the animation, the other senses (touch, hearing, smell—though we haven't had smell input as yet). However, what is also vitally important are the paths and trails, the navigation, the way people think about things, the conceptual models, and how they find their way around. How the appearance and the electronic components are designed to improve that relationship are all essential to the final result. You don't get high-quality solutions unless you integrate the (graphic) design of the system with the verbal scripting of the information. That is why I rebel against the idea of VID being separate.

You can do VID as a separate task in some instances, like the design of fonts. But in most cases there is a real danger in the solution being very narrow. The visual interface representation is only one component in the overall behavior. We have to understand how people think, where they are coming from, where they are going, and how they will be using the system. In a way these issues are more difficult to grasp and more difficult to define and design.

In conclusion, what are some other issues that you would like to bring up?

It is worth it to go back to the process of Innovation Strategy and define the four steps in this process:

- Understand: Getting to understand what the thing is all about.
- Observe: This is the more difficult part. It is less normal and less typical in development process than you might expect. We've evolved techniques of looking at people and understanding how they do things. It has been around in all design research in the past. Good designers have always said "Well, let's go find out what someone really does with this sort of thing." But it is also related to market research, except that it is not quantitative. We go and look at people using the equivalent products in today's world to get a very first-hand experience.
- Visualize: It is important to get a feel for the differences between designing for "yourself" and designing for the wide variety of users who will actually be using the product. The trick is also to avoid being stuck in "yesterday's" observations. So we have developed ways of lifting them into the future using scenarios and storyboards that tell a story. This keeps the relationship in the real world, on a more humane level. It keeps the design in the real world, not design fantasy. This connection to the observation with scenarios and visualization is very important.
- Evaluate and Refine: This of course is part of every design process and quite iterative. The evaluate stage involves taking the product back to customers and asking how they feel about it. We often find that they make comments that were not predicted. The process is very user-oriented and focused on the way users handle everyday things.

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Designing a great team for a single project is hard, but quite doable. Finding ways to provide a general environment which enables different teams to work effectively, providing teams resources as required, is a tougher task.

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A good team needs both rules to divide responsibilities and flexibilities to blur the lines when necessary. One has lots of crossover on the general team player level, but not typically very much at the craft level…

Interview with Kristina Hooper Woolsey

Kristina Hooper Woolsey was trained as a cognitive scientist, and has extended this perspective into the areas of picture recognition, imagery, and visual technology. She was on the faculty at the University of California at Santa Cruz, and was a visiting professor at the Massachusetts Institute of Technology. She was director of research at the Atari Sunnyvale Research Lab, director of the Apple Computer Multimedia Lab, and is now a distinguished scientist at Apple Computer. Along with Sue Ann Ambron, she is co-editor of Interactive Multimedia, and Learning with Interactive Multimedia, from Microsoft Press.

What do you feel is the structure of the ideal development team and the ideal development environment?

The main balance is between project teams and general environment management. The goal is to set forth key teams on a project—a senior designer and two to four other central people, depending on the requirements of the project—and then provide flexible access to extended resources as required.

The trick is to do this using hierarchies where they are best utilized, but providing flexibility where it is most important. One needs clarity of "command" and no ambiguity in some cases, where quick decisions need to be made or where primary directions are established. At the same time, ambiguity is important in a project for a certain amount of time. One has to build a system that allows for both these things to happen at once.

In summary: designing a great team for a single project is hard, but quite do-able. Finding ways to provide a general environment that enables different teams to work effectively, providing the teams resources as required, is a tougher task.

Would that be different for a research lab as opposed to a product development department with the given requirement to design and manufacture products?

Again, a balance between research and production is key to success in multimedia design, in my opinion. One can accomplish this in a number of ways. One can have a number of projects ongoing 'next to' each other, where some are more researchy and others more production oriented. It is also possible to have each project have a number of phases—including an early preproduction/research phase that is acknowledged fully (e.g., not just getting a project going as quickly as possible), and then a production phase that follows.

In any case, it is critical to note that the goals of each kind of activity are fundamentally different. In research, the generation of many ideas is key as are many false starts, reconsiderations, arguments, divergencies, and a thorough consideration of impractical alternatives. In production, one has to continually be clear what one wants to accomplish, and be good at pruning out alternatives. One also has to have systems in place to quickly make decisions without regret.

Interestingly, but not so surprising, most people typically thrive in one situation but not the other. It is important, for example, that neither research or production get all the glory, as it is easy to err in each direction...similarly, particularly since production eats up resources so quickly, it is important to make sure both classes of activities get appropriate resources — that will typically not be equal (research typically needs much less money, though is more sensitive to other nuances (e.g., maintenance of self esteem) which sometimes requires money).

What role does each person play in the team? Where are the overlaps and where are the distinct lines between them? What are their primary skills that they contribute to the development effort?

There are two general classes of skills for a team, not unlike a baseball team in my opinion (interestingly, many disagree with me). People need to be general team players, they have to work hard at everything they do, they need general experience and skills to bring to the task, they need to play for the benefit of the overall product activity. They also have to have some particular crafts to contribute. That is, be a good first base player or center fielder or pitcher, including graphics, programming, video production, management, interaction design, and interface design. People who write offer a range of crafts—they are good utility infielders, while other excel in only one arena.

The trick in building a team is to balance these two kinds of skills and to find ways with individuals to find compatibilities that match the requirements of a particular project. Knowing, incidentally, that the product of an exercise and its apparent requirements will change greatly depending on the team one assigns. Another trick is to find leadership within each team and a good mechanism to have the team relate to its external world (e.g., clients, research directors, production supervisors, etc.).

In addition, one needs mechanisms to draw particular crafts not present on a core team into the mix as needed (e.g., spot illustrators, sound production). The masters of these crafts are then often not on core teams, though are critical for the work.

On a more general note, a good team needs both rules to divide responsibilities and flexibilities to blur the lines when necessary (e.g., the infielders need to know when they are to catch a fly in contrast to the outfielders, but if something wierd happens everyone needs to know how to cover for each other). And one has lots of crossover on the general team player level, but not typically very much at the craft level.

What are the primary skills that a designer needs today to be part of a cross-disciplinary team?

A sense of humor, a tolerance of ambiguity, and a respect for one's peers. In addition, one needs a fundamental craft to contribute to a production activity, and some experience with both abstract and logistical issues.

Are those skills being taught in traditional design education? What is missing and how can they be acquired?

I don't think they are in the multimedia design realm, because it is not being taught anywhere right now that I know of. General design training is important for multimedia designers but I'm not sure where anyone can get this.

The Rhode Island School of Design does many things right, as does NYU, and the Illinois Institute of Design, but I find that most people 'learn on the job' and benefit most from experience and a good solid liberal arts education coupled with some crafts training.

What we are all missing are general environments that encourage this development over extended periods of time. Workshops simply don't cut it, most academic institutions don't provide enough hands-on training, and most commercial operations are currently set up to discourage any conceptual training.

My recommendation to people is to find a great project and get on it. Learn from people. See what you are good at. Volunteer if you have to.

Hopefully, we can become more systematic about all of this. I personally recommend that all kids in all schools from kindergarten on up get basic crafts training in things like drawing, modeling, imagining, communicating, rendering, and programming, as well as working on a number of design projects every year in all aspects of the curriculum so they come to know the design method. Then when people graduate they will all be ready for general design work, just like they are ready to write paragraphs. Some professionals can then emerge who want to do this task all the time (e.g., the great novelists emerge), while others incorporate the skill in whatever they love to do. Or what they are doing to make a living.

How is a product "spec'd" in terms of conception and definition? What I mean by this is: is a product spec written and locked into place before prototyping, or does the product evolved by continual re-evaluation and change? In each case how does the designer's role change?

One needs a good starting place, and a set of expectations, to even get anything reasonable going. I think there is then a substantial period of time where a spec is evolved, from inspiration, accident, and lengthy considerations. As you go into production at least one person needs a very solid idea of what this spec really is (and what parts of it are really negotiable details) and what kinds of resource constraints are relevant. Then this person (or group sometimes) can make good judgements about when things should change and bear the responsibility for the repercussions of the change. (Note: sometimes better ideas need to be rejected to complete projects.)

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The hardest part from the designer's standpoint is to make your clients understand that design is not an arbitrary decision.

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Since visuals can often be misunderstood and open things up to interpretation, it is very important to get it right. If not, we have a miscommunication.

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Human factors specialists by themselves cannot design a product. Programmers can't do it by themselves and designers cannot do that either by them-

Interview with Norm Cox

Norm Cox is an independent designer and consultant involved in the visual design of interfaces for numerous leading-edge clients. A graduate of Louisiana State University in architecture, he was responsible for the design of the interface graphics on the renowned Xerox Star Professional Workstation. He is named on many design patents, and was the recipient of the 1992 IBM Thomas J. Watson Jr. Award for Design Excellence.

What are the problems facing designers today?

One of the biggest problems is that with anything that has to do with the visual and interactive, like visual or color choices, everyone will have an opinion about how something looks—it either piques their interest, or they don't like it. The hardest part from the designer's standpoint is to make your clients understand that design is not an arbitrary decision, it is not an aesthetic judgment, it is not subjective; it is very much objective, purposeful and reasoned discipline.

The design communicator is really in a quandary, having to educate his/her clients that design can be value-added to a product line. Design is something that is functional and is added to the product line.

Is there a definition of a designer?

You can define a designer as a stylist, a babysitter, a teacher, or a mentor, with all sorts of roles, depending upon the people they are dealing with. The designer has to be not only knowledgeable about the business, be a teacher, and be very tactful. There are many hats we wear, and sometimes it has nothing to do with design. You deal with executives saying that there is no way to quantify the results of design with product sales. You know that it is an important part for usability, for product acceptance, for the market perception of how the products works. Because it is not measurable, it is a hard concept to sell.

Let's go back to the Xerox work that you did when you first started at PARC. How did it all begin in terms of design influence?

It has to do with having a number of people who recognized the value in having designers be a part of the development from the beginning. The first name that comes to mind is Charles Irby. He managed the group that was developing STAR under David Liddle. Charles has a design background, even though he was a computer scientist. He was very appreciative of good design. At the time, we didn't know how big to make windows or how to begin to make icons. There was no precedent—we were setting the precedent. We did a lot of testing of user preferences and a lot of human factor type testing. We found out that good design did make a difference, and it helped people perceive the product and how usable it was. The system met with a lot of good press, but unfortunately it didn't sell well; but, it set itself as the benchmark of graphic interface for everyone to follow.

Were you the only designer in the group, or were there others involved?

It was very much a collaborative effort. I came into it from a purely design standpoint—we didn't call it interactive design. The terms "user interface" and "user friendly" were the buzz words. Other people had other standpoints.

Did you feel that having a designer as an equal part of the team was something new in product development?

Yes, very much so. Designers were traditionally pigeon-holed as industrial designers, graphic designers, or in the print media. Most technology development was being done by computer scientists with no visual background. Now all of sudden the information being presented was extremely visual.

This was not traditional graphic design. You cannot just put any graphic designer onto a project and assume that will help the product. It is not just cosmetics. We as designers are looking for solutions, not just to make something look nice. We are looking for product acceptance and product usability, to see if it is ordered or structured correctly. If we can do something visually, it can help this happen.

Do you feel that a designer's role is to help plan the functionality and usability of a product?

Yes I do, very much. Designers do many things and contribute in many ways. We play an important role as interpreters. Visuals can often be misunderstood, opening things up to a variety of interpretations—it is very important to get it right.

What we are trying to do as designers right now is to get involved in the early stages of the product's development cycle and design it with error controls in mind.

What is your role as a consultant-designer? You have opportunities to talk with different people at different levels of the companies with which you work. Are you a designer, an educator, a innovator? What?

All of the above. Like I said, we wear many hats. We go around to many facilities and talk about the role of designers and why they are needed in the product development cycle. Often it is to the executive level to get them attuned to this discipline. Other times it to the people doing the coding. We are also at the real design level, influencing the way a product looks and the way it is laid out. I do both specification and actual design.

What kind of resistance are you getting from the executives?

For the most part we get very good support from the executive levels. Where we get more resistance is from the lower echelon, from the worker-bees who are more schedule-minded. It is too much work, there is a code freeze in x-number of weeks, it is too difficult to do now.

Why can't the upper level filter this message down to the lower levels? Is it the middle managers having trouble here?

That is why we have annual design reviews at IBM, where we present the design directions in which the company should be going and how they should be competitive in the marketplace. It is almost always visually oriented. The intent is to get the upper levels to understand the issues and drive the issues downward.

Unfortunately it is still schedule-driven for the most part. It's a juggling act to have the best visual design. If it takes you three years to get the product out you might miss your window of opportunity.

This is an interesting dilemma. If the companies hired designers in the beginning of the development effort, they would not have to back-peddle to establish the design excellence after a major part of the development had already happened. That would make the project better and less costly to produce. The clear choice is to have the designers from the beginning. Why are they not? With most big companies, it is like jumping on a moving train. They are in the middle of the process and it is difficult to put designers into the product development cycle. Very few people are like Charles Irby and make them an integral part from the beginning. Places where that happens are usually in the smaller companies who call us in the beginning. They want human factors specialists and designers from the start. When you have a large company the size of IBM with so many things going on in so many places it is difficult to get in on the ground floor of many products and continue to work with them on an extended basis. What typically happens is that you become a person who goes in and critiques what is being done, reviews the projects, and tells them what should be done. Unfortunately you wind up telling programmers how to fix things. They don't know the reasoning behind it nor do they have the talent to do it really well. It is particularly frustrating because you know what is wrong with it but you can't fix it in a one-day review. Unless designers get in on the ground floor, the chances of you having a significant influence are pretty slim. The further it is along in the project cycle the less flexibility you have to make changes and to improve it, and the less people are willing to change because they have a lot invested by that point.

So how do we change the process to include designers in the product development from the beginning?

It has to become an awareness that you have to have industrial designers involved and that you have to have designers involved in interaction design. They think that team members need to be marketing people, programmers, and human factors specialists testing it after it is all done. My feeling is that it is all backwards. You really need human factors specialists in the early stages to define functionality and usability. Human factors specialists have also gotten a bad rap as people who test the design once the product is already complete. They can make more of a contribution from the early stages and help define what is functional and possible.

What about the confusion that human factors is just another term for design? I am sure you have run into that as well.

Yes I have. Human factors specialists by themselves cannot design a product. Programmers can't do it by themselves and designers cannot do it by themselves either. It is very much a collaborative effort. One of the problems is that interface design is a very new discipline and not very well defined and practiced. You cannot really go to school to learn interaction design. Most design schools are still teaching design in a traditional manner of industrial design and graphic design.

Closing comments

The fortunate part of this process is once you get someone on your side, you have them forever. Unfortunately programmers think that what designers do is to put some cosmetics on the product. You have to convince them that the contribution of designers leads to a cohesive and coherent product and product line. From the user point of view they feel it "looks nice, it feels good." Unfortunately, many products look and feel like they were designed by nine different people, and usually they were. Good design leads to a unified look and feel, one that helps the process along and the product to sell.

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— Norm Cox

The design influence must be an equal partner from the beginning.

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Designers have this incredible skill of integrating information and presenting this information, they will often end up in a leadership role.

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People are learning that technology alone will not create a sustainable and competitive advantage.

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Thinking of all sides of an issue is a necessity. In doing a drawing of an artifact you are thinking of all sides.

Interview with Earl Powell

Since 1985, Earl N. Powell has been the president of the Design Management Institute, the leading international organization dedicated to improving the management and utilization of design. Before the Institute, Mr. Powell was director of Industrial Design and Human Factors for GenRad, Inc. Prior to joining GenRad, he was an academic administrator and instructor at both Boston University and Rhode Island School of Design. Powell received his Bachelor of Fine Arts degree in industrial design from the University of Illinois, and Master of Fine Arts and Master of Art degrees from the University of Wisconsin.

What skills must a designer have today?

From the point of view of a design manager, which is quite different from that of a designer, I think that they are not really different from those that design managers needed years ago.

If you want to talk about a designer and the artifacts that a designer designs, the shaping of the physical form is a key skill. That appearance of a product must both please and inform. That means that perceptually there are fundamentals that are still needed.

The tools we use to design are changing; but hopefully the designer leaving school have a level of fluency in pleasing and informing. Once they have that originality, the tools will help. I think that we are talking about fundamental issues, the tools can get in the way.

When you refer to "please" and "inform," am I right in assuming that you are not making a distinction between 2D, 3D, spatial design, or the design of virtual space?

No, I am not. I think it is so difficult to learn how to please and inform, that the more difficult the tools, the more difficult it is to teach these concepts. For instance, I feel that life drawing is one of the best ways to teach certain dynamics and assumptions. It is about learning to see and what appearance is all about. It is reconstructing your assumptions about your world. With seeing, where we have always noticed what the world is all about, we tend to take things for granted and not notice things after a while. We build vocabulary through these exercises and that allows people to see all sides of the problem, all sides of something that is trying to be understood through paper and pencils.

What do we have to know as a designers today to work in a world that requires knowledge of volume, graphics, space, and the virtual?

It is just information taking different forms. The designer can relate to all of this, look at all sides, and have the processing power to integrate that information into a design, a solution, or perhaps an artifact. For example, a doorknob has a set of information clues that inform someone about the way it works, the direction to pull the door, and its function.

Are you saying that the differences between 2D, 3D, space, and the virtual don't matter; that you don't have to be trained in each of these to contribute to them?

The process of making judgments (of these disciplines) I think is taught at some basic design level, and that does not require any special tool. Unless you get basics and the abilitiy to make such judgements, the best tools in the world will not give you the ability to solve these problems.

But don't the tools change the way you conceptualize your work and the ways we think. What do you think has changed because of the tools?

I think the tools allow much more direct contact. There is a more fluid dialog with the process and in making decisions. The middle manager might very well disappear because their primary function is to move information around. Eighty percent of the cost of development is concentrated in the conceptual phase. If the tools can offer more effective ways of relating the information to others along the way, it is critical that we use those tools.

What is the design management point of view?

There are two different sets of responsibilities. The designer is responsible for shaping the look and feel of the artifact. The manager is responsible for a series of decisions that develop and position the resource of design within the organization.

Do you agree that among the most important issues facing design management is to position design in the top layer of the product development instead of much later downstream?

The design influence must be an equal partner from the beginning. Designers have this incredible ability to integrate and present information, and they often end up in a leadership role. We are still struggling to get companies to understand this, however.

There is no one simple answer to making this happen. The shifts in the economy will result in having many services being sought from an outside position. We will likely find this to be a golden age for consultants. One of the ways that this will happen will be through the tools we use; the computer, for the most part, is allowing this to happen.

There are two things happening: companies are being down-sized, but they are much more productive. There are advantages and disadvantages to all of this. We are in the throws of massive restructuring of the way we do our work.

Another thing going on is that people are learning that technology alone will not create a sustainable and competitive advantage. A lot of it has to do with how close you are to the customer's needs and how committed you are to delighting the customer. To meet both their conscious needs and their latent needs is very, very important. We can't just cosmetically redesign things as fast as we can. We must consider being responsible in terms of resources and design.

What is responsible design? It is abroad set of conditions and issues. It is satisfying customers and taking care of all the stake-holders, including the employees, the stockholders, and the people who dispose of all the extra "stuff." That is one of the special things about a designer—the sense that they are there not just to make it pretty, but to make it something that a person can use that enhances their lives. It has to improve their lives.

Is it the obligation of designers to champion these ideas and ideals? And how do you do that?

We need designers in the top product planning positions in corporations. Thinking about all sides of an issue is a necessity. In doing a drawing of an artifact you are thinking of all sides; which is really another way of managing it. That is why people (like designers) who are trained in thinking of all sides of a problem make excellent managers. Design includes visualizing, but it is conceptualizing more than just visualizing. It is getting your arms around the problems.

There is another thing that is a barrier and a capability at the same time. When a designer does a drawing, it is not only a visualization of the idea but an artifact of the process and the steps that happened along the way. To the people sitting around the table, it is typically thought of as an artistic depiction, and then immediately judged on how accurate it is, not on its conceptual information.

It goes back to the cliche "A picture is worth a thousand words." Change that to: "This drawing embodies a thousand decisions" and you suddenly change the mindset you have in looking at the drawing. A drawing communicates both information and potential decisions. Most people look at it as information and as an artistic depiction; those assumptions are wrong. They look at the drawing as something that represents the object realistically. They do not see it as a method of expressing essential information about visual styling as well as process and production. This is a barrier in many ways. It goes back to the value we put on the activity of visualization. Drawing and visualization are not thought of as intellectual thinking, they are not valued.

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Thinking of all sides of a problem is really managing it. It is visualizing, but it is conceptualizing more than just visualizing.

• • •

We can't just cosmetically redesign things as fast as we can. What is this in terms of responsible resources and responsible design.

• • •

It goes back to the value we put on the activity of visualization. Drawing and visualization are not thought of as intellectual thinking, they are not valued.

— Earl Powell

Designers combine skills of analysis and structured conceptualization with intuition and the ability to visualize abstractions. This unique blend results in a special kind of innovation.

• • •

One of the designer's traditional roles is to be the user's advocate. Making products "user friendly" makes them approachable, comprehensible, satisfying to operate and promotes a sense of competency in the user, which enhances the product and increased sales. A comprehensible

Interview with Katherine McCoy

Katherine McCoy is co-chairperson of the Department of Design at Cranbrook Academy of Art and partner of McCoy & McCoy Associates. Her design practice emphasizes interior design, graphic design, and marketing for cultural, educational and corporate clients. She writes frequently on design criticism and history, and has co-produced a television documentary on Japanese design. She is a fellow and past president of the Industrial Designers Society of America, and past vice president of the American Institute of Graphic Arts. She recently completed the design of Cranbrook Design: The New Discourse, a book published by Rizzoli International.

What role do designers play in the development of today's great and successful products?

Designers make their biggest contribution when they are brought in at the beginning of the product development process, ideally before a particular product is focused on as part of the strategic planning of the company's product line concept and marketing concept.

One of the most brilliant product designs might be the SONY Walkman where designers innovated or visualized an entirely new product type. There was no existing market data to suggest that such a product would be successful or that there was an existing market for it. The designers connected the entire range of their design skills to conceive this new product concept based on their understanding of people's lifestyles, values, activities, and the popular culture. The designers recognized the potential for a new way of listening to music based on recreational and fitness activities and the contemporary need for acoustical privacy. The Walkman, a tape recorder that did not record but only played back, became a brilliant solution to many existing needs that nobody had before identified.

Rather than just introduce yet another product version to compete in an already existing market, companies can go much further by creating new product types, even creating new lifestyle activities. Designers are consumers themselves and participants in the everyday culture. They integrate that knowledge with their professional design, business, marketing, and technical expertise.

Let me ask you to expand on that a bit more, because I think anybody on the product development team might say, "We live within the culture. Why can't we make the same contribution as the designer?" What makes the designer so special?

Designers combine skills of analysis and structured conceptualization with intuition and the ability to visualize abstractions. This unique blend results in a special kind of innovation.

What other roles do you feel designers are playing?

One of the designer's traditional roles is to be the user's advocate. This requires an expertise in the field of ergonomics, not just physical ergonomics, but psychological and perceptual ergonomics as well. Making products "user friendly" makes them approachable, comprehensible, and satisfying to operate, and promotes a sense of competency in the user, which enhances the product and increased sales. A comprehensible product will also be more likely to be operated correctly and safely. There is also a psychological dimension and a cultural dimension of ergonomics. Designers imbued in products communicate values that resonate with the user's personal and social value systems, so that products fit into consumer life patterns more appropriately. Interpreting culture is very important. Designers are trained in the history of our culture, in the history of science, literature, and art. Designers are also the advocates for the environment. The life cycle of a product is the equation between its resource consumption and its life expectancy, its disposability, and recycle-ability. The designer is able to find new connections to reduce the environmental impact of products, creating a better product and a bottom line, as well. Environmental responsibility is good business. Smart products require the designer to be an interpreter of psychological ergonomics. Products are becoming highly complex in their operation and many of their services are dematerializing to become information. Industrial designers need to understand visual communication principals to help their users navigate the conceptual interface of a product display and its use sequences.

Do you feel that designers' roles are changing?

The designer is becoming a key player in corporate strategy and the product development process. Business is altering the traditional linear product development process where designers were only brought in late in the process. A more holistic strategic process utilizes interdisciplinary teams that work concurrently and more fluidly. The technical expertise of the designer, the form-giving expertise of the designer, and the marketing expertise of the designer are major aspects of design.

The designer is also a cultural interpreter, skilled in bringing personal values, societal values, environmental values, and cultural values to the product process. The world looks to the United States for the incredible richness of our popular culture. If designers bring their almost anthropological understanding of poplar culture to the process, the product that they make will have much more resonance in the marketplace.

Katherine, what primary skills do you think designers need to be able to create these "resonate" products?

A perpetual curiosity, an alertness, a participation in the culture, an attitude of continual learning and self-education. The designer is the interpreter of many disparate facts and conditions needed to bring a product concept together. The formalized skills that the designer must have include continually updated knowledge of technological processes—from industrial technology and fabrication to complex computer concepts, the mature ability to bring form to concept, basic engineering, business theory, and marketing skills and strategies. The ideal designer might have both an MBA and a masters in anthropology, as well as excellent conventional design training. Designers need to be extremely well-educated people, both formally and informally, with thorough liberal arts and sciences education. At the same time designers must be comfortable in the business community.

Are these skills being taught today?

No one program embodies the ideal industrial design training, although there are some that do very well. It is wiser for an aspiring industrial designer to have four years of undergraduate university education in which they would have a thorough liberal arts and sciences training along with business, marketing, introductory engineering, and introductory art history, design history, and problem solving methodologies. Following that would be an extended professional masters design program of at least three years. Undergraduate art schools have very limited academics and business courses.

What about practitioners who are out of school—how can they acquire some of these skills?

A number of designers have completed MBA programs, allowing them more mobility and comfort within the business community. Education is a self-initiated life-long process. Every designer should be constantly reading a wide range of cultural materials, not just professional information. I'd like to see lots of designers get anthropology degrees. Anthropology has everything to tell us about our role in society. When anthropologists 2,000 years from now dig up our trash dumps, they will be "reading" a wealth of implications about our culture from the products that we have designed. Designers make culture. We should know more about culture.

From your perspective, as your graduates assume their roles as the designers and interpreters of culture, are they responding to society's changing view of the quality of life? And, if so, how is it effecting their work with smarter products and environmental issues?

Industrial designers need to read philosophy, sociology, anthropology, and environmental writing. Everything applies; the challenge is to bend the ideas of many disciplines to our particular media and situations. A designer is a generalist who can draw from a universe of sources and focus it. The nature of design is the focusing of diversity to the problem of the moment, to extrapolate what is appropriate and bring it to closure. Designers contribute an interdisciplinary tolerance of a wide range of culture—the engineering culture, the marketing culture, the bottom line culture, the culture of the philosopher, the art historian, and the anthropologist. Designers must be incredibly flexible, speaking many different languages.

Every time you said "industrial designer" I have had this feeling that you're really saying "designer" in a much broader sense. Do you feel that the design professions are blending?

There will always be certain types of designers who are very focused, and many will stay in conventional areas of design. The field of industrial design is changing because the technology, the economy, and the culture are changing, and the environmental situation is critical. If a large part of the technology is information and communication, more and more product services are dematerialized into information rather than concrete physical functions. The term industrial designer relates to hard physical forms. The mechanical aspects of products seem to be decreasing to the size of a silicon chip. Since it was coined in the 1920s, the term "industrial" designer has always been somewhat misleading, but it is increasingly inappropriate. "Industrial design" is an anachronistic term in a post-industrial era.

Maybe we ought to change our name to post-industrial designers?

The terms "post-modern" or "post-industrial" relinquishes the obligation to actually define and comprehend our present condition. We are only defining ourselves as not what we were before.

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product will also be more likely to be operated correctly and safely.

• • •

Designers are also the advocates for the environment.

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Smart products require the designer to be an interpreter of psychological ergonomics.

• • •

Industrial designers need to understand visual communication principals to help their users navigate the conceptual interface of a product display and its use sequences.

— Katherine McCoy

Electronic Theater

Electronic Theater Introduction

Welcome to the SIGGRAPH 93 Electronic Theater. The availability and accessability of technology continues to impact the level of sophisticated animations that are submitted each year, and this year is no exception. University projects, motion platform rides, commercial advertising and feature films have all benefited from the application of computer graphics to animate everything from skeletons to waterfalls, and mathematics to operas.

Welcome to the visual world—may it continue to delight and enlighten us all.

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Electronic Theater Committee

- Jamie Thompson, Chair, TIVOLI Systems, Inc.
- Brent Heustess, Administrative Assistant
- Joe Corcoran, Administrative Assistant
- Linda Branagan, CONVEX Computer Corporation
- Huguette Chesnais, Consultant
- Gina Coniglio, Consultant
- John Hart, Washington State University
- Jim Hillin, Digital Domain
- Johnie Hugh Horn, Independent
- Jean Kim, Magic Box Productions, Inc.
- Gray Lorig, Barking Trout Productions
- Jonathan Luskin, Industrial Light & Magic
- Ladd McPartland, Sony Pictures Imageworks
- Lucy Petrovich, Savannah College of Art and Design
- Lynn Pocock-Williams, Consultant
- Sally Rosenthal, Magic Box Productions, Inc.
- Steve Sarafian, Sony Advanced Systems, Business and Professional Group, Sony Corporation of America
- Joel Welling, Pittsburgh Supercomputer Center

Electronic Theater Jury

- Char Davies, SOFTIMAGE Inc.
- John Grimes, Institute of Design, Illinois Institute of Technology
- Nelson L. Max, Lawrence Livermore National Laboratory

The SIGGRAPH 93 Electronic Theater owes its success to the extraordinary efforts of the individuals who worked on each piece. Additionally, the efforts of the following people have made an incalculable difference in the quality of this year's show. A heartfelt thank you goes out to:

- Mark Resch, Bob Judd, Molly Morgan Kuhns, Debbie Buuck, Ann Redelfs, Mo Viele, Enrique Godreau III, Steve Cunningham, Thomas E. Linehan, Jeff McCord, John Grimes, Char Davies, Nelson Max, Sylvie Reuff, Nancy St. John, Brave Combo, Catherine Tate, Alain Chesnais, Mark Shoemaker, Kent Fuka, Jeff Sartain, Jim Thompson, Kiva and Otto, Jean Benson, Sax Benson, Julie Benson, Kara Benson, Leigh Ann Thompson, Mike Thompson, Charisse Castagnoli, Joe Corcoran, Judy Brown, Mr. Mike, Alice O'Toole, Steve Crume, John Posey
- University of Texas at Dallas
- Sony Corporation of America
- The SIGGRAPH 93 Electronic Theater Committee
- The SIGGRAPH 93 Conference Committee
- AVW Audio Visual, Inc.
- Smith, Bucklin & Associates
- Hall-Erickson, Inc.
- Andrews Bartlett Exposition Services
- SOFTIMAGE Inc.
- Lawrence Livermore National Laboratory
- Institute of Design, Illinois Institute of Technology

Evening Show Opening: SIGGRAPH 93 Anijam

This collection 12 animations represents techniques from all areas of computer graphics, incluing character animation, ray tracing, algorithms, and scientific visualization from a number of animators around the globe.

Contact

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Producer

Jim Hillin

Contributors

Music: Paul Haslinger
Sound: John Luskin, Joe Letteri
Sound Post: Westlake Audi
Digital Post: MetroLight Studios

Special Thanks

• • • • •

MetroLight Studios
Animation Director: Tim Johnson
Pacific Data Images
With help from PDI's Character Animation Group

• • • • •

Artist Noriaki Kaneko
With support from everyone at HD/CG New York

• • • • •

Animator: James Tooley
Story Consultant: Burny Mattinson

• • • • •

Animator: Alan Edwards
Produced at Thomson Digital Image, Paris

• • • • •

Director/Designer: Diane Piepol
Storyboards: Karen Ballard
Technical Assistance: Andrew Doucette, Mitchell Rothzeid, Liza Keith, Donna Tracy, Mary Nelson, Brian Bowman, Jim Hillin, Antoine Durr, DJ Desjardin
Technical Services: Richard Hollander, Video Image; Dave Kervinen, CIS Hollywood
Stock Footage: Shields Archival

• • • • •

Animation, Software: Henry Preston, Cassidy Curtis
Modeling: Susanna Richards, Xaos, Inc.
Thanks to all the Agents of Xaos.

• • • • •

Animation Scientist: Eliot Smyrl
Modeling: Eliot Smyrl, Don Schreiter, Yael Milo, Galyn Susman
Concept Development: Andrew Stanton, Pete Doctor, Jeff Pidgeon
Music: Louie Armstrong and his Hot House Five
Produced at: Pixar

• • • • •

Design, Programming, Animation: Andy Kopra
Rendered with: Pixar's PhotoRealtistic RenderMan
Produced at: Video Image Associates, Los Angeles

• • • • •

Idea, Realization: Daniele Colajacomo
At: Rhythm & Hues Inc.
Software: Rhythm & Hues Inc., Greg Ercolano
Thanks to: Rhythm & Hues Inc., MetroLight Studios, Homer & Associates, VisionArt, Chiara Perin, Greg Ercolano, and all the friends who have contributed their comments and suggestions.

• • • • •

Animator: Darnell Williams
Technical Assistance: Jay Sloat
Inspiration: Rosa Farre
Produced at: Magic Box Productions, Inc.

• • • • •

Animator: Dave Novak, Windlight Studios
Technical Assistance: Scott Dyer, Eric Flaherty, Ron Pitts, Dale Hughes, Martha Kurtz, Frank Wuts, Heuton Dailey Monson

• • • • •

Director: Joe Francis
Producer: Tammy Walters
Animators: David Horsley, Mark Voelpel, Sylvain Moreau, David Isyomen, Clay Budin, Sherry Hsieh, Rachel Cohen, Kyeng-Im Chung
Off-line Editor: J.P. Morgan
Digital Post Editors: Burtis Scott, Mark Casey
Voice Over: Dana Thrush
Produced at: R. Greenberg Associates, New York

Evening Show Title Plates

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Animated slates announce each entry in the Evening Show.

ABCSystem

Automated Building Construction System (ABCSystem) developed by OBAYASHI Corporation includes a new concept for building construction in which several kinds of robots work harmoniously to complete a task. Visual aids required for interested parties to understand ABCSystem. Computer graphics animation is the most appropriate task for this requirement.

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Producers

Executive Producers: Teruo Okawa, Kiyoshi Izumi (OBAYASHI Corporation)
Producers: Osamu Uchida (Iwanami Production, Inc.), Tetsuro Mori, Katsuyoshi Higashiyama, Isao Watanabe (OBAYASHI Corporation)

Contributors

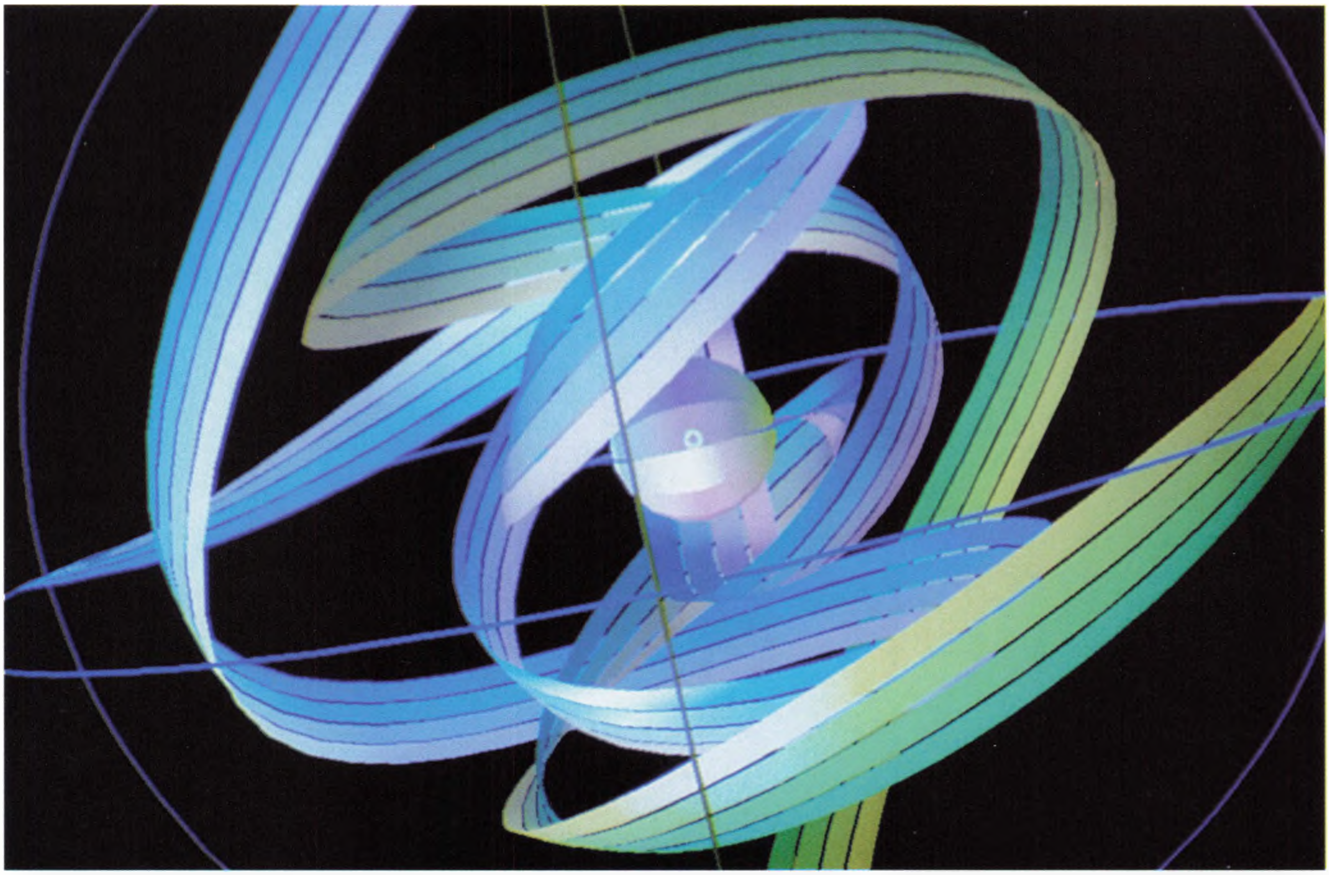
Architectural Design: Architectural and Engineering Division, OBAYASHI Corporation
Technical Development for ABCSystem: Project Team for ABCSystem, OBAYASHI Corporation: Director: Kei Horikoshi
Camera: Masayoshi Kato
Music: O.K.K.
Narration: Angus Waycott
Director: Hiroyuki Ota
Technical Director: Toshio Nagafune
Production Support: Mikie Takekoshi
CG Designers: Akiko Nagase, Chika Hoshi, Tomoko Hamada, Hiromitsu Kaneko, Hiroyuki Nakane, Kazuya Kondo

Special Thanks
NIHON I-TEC K.K., Yokogawa-Hewlett- Packard, Ltd.

Sponsor
OBAYASHI Corporation

Hardware
InterAct3260, InterPro6280, HP9000/380VRX, IRIS420VGX, etc.

Software
MicroStation, VPX, EXPLORE, proprietary



Air on the Dirac Strings

A quantum mechanical system involving electrons is not brought back into exact coincidence with itself after it is rotated 360 degrees, while it is brought back into coincidence with itself after it is rotated 720 degrees. How can we visualize such a situation?

Contact

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Electronic Visualization Laboratory, University of Illinois at Chicago

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George Francis, Mathematics Department, University of Illinois at Urbana-Champaign (UIUC)
Louis Kauffman, Mathematics Department, University of Illinois at Chicago (UIC); Daniel Sandin, Electronic Visualization Laboratory and Art Department, University of Illinois at Chicago
Computer graphics: Chris Hartman, UIUC Mathematics Department, John Hart, Washington State University EECS Department
Dance: Jan Heyn-Cubacub
Music: Sumit Das, UIC Electronic Visualization Laboratory
Video: Dana Plepys, UIC Electronic Visualization Laboratory
Produced at: Electronic Visualization Laboratory, University of Illinois at Chicago

Special Thanks

Thomas A. DeFanti, Electronic Visualization Laboratory, UIC
Larry Smarr, National Center for Supercomputing Applications, UIUC
Donna Cox, Renaissance Experimental Laboratory, UIUC; Randy Hudson, Alan Millman, Maggie Rawlings, Electronic Visualization Laboratory, UIC
Tony Baylis, Bob Patterson
National Center for Supercomputing Applications, UIUC

Hardware

Silicon Graphics, AT&T Pixel Machine

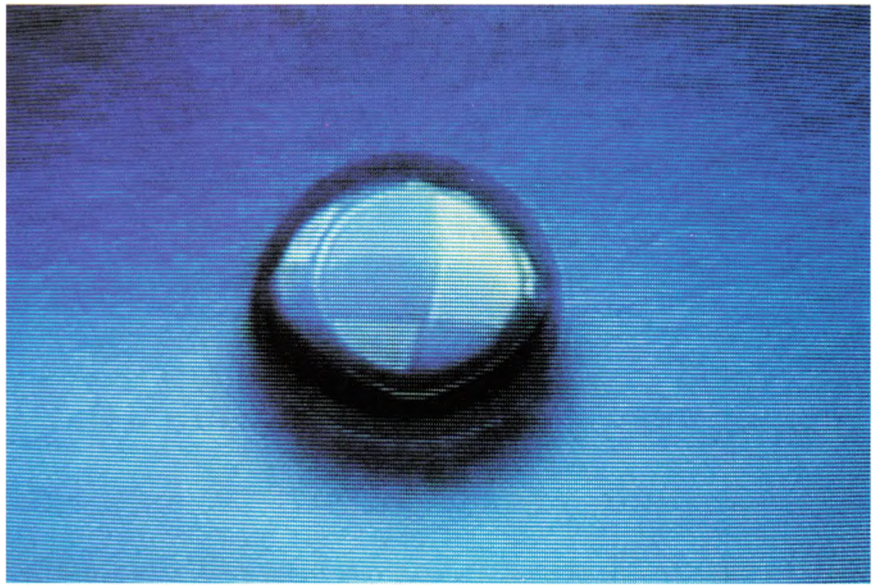
Software

C, GL, Raylib

Copyright

Artificial Life Metropolice "Cell"

Cell expresses a new 3D cell automaton model that was developed for Artificial Life.



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Producer
Yoichiro Kawaguchi

Contributors
Artist: Yoichiro Kawaguchi
Assisted by: Shu Wako, Toki Takahashi, Kumiko Kushiyama, Shinji Sasada

Hardware
Silicon Graphics Iris

Software
Improved 3D cell automation algorithm by Yochiro Kawaguchi

Copyright

CAA-Coca-Cola Polar Bears

A group of animated polar bears are sitting watching the Aurora Borealis, drinking Coca-cola because Coke is "ALWAYS cool."

Contact

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Producers
Producer: Teresa Cheng
Executive Producer: Lois Anderson
Assistant Producer: Jean Tom

Contributors
Animation Director: Henry Anderson
Head Technical Director: Kevin Barnhill
Technical Director: Peter Farson, Suponwich Somsaman, Pauline Ts'o
Animators: Raffaella Filipponi, Nancy Kato, Todd Shifflett, *Larry Weinberg Modeling Manager:* Keith Hunter
Modeler: Erica Cassetti, Howard Gersh
Production Manager: Maria Rodriguez
Editor: Rick Ross
Assistant Editor: Joe Yanuzzi Software Support: Keith Goldfarb, Steve Gray, Richard Moster, Paul Newell, Harold Zatz
Production Company: Sierra Hotel Productions Agency: Creative Artists Agency, Inc.
Client: Coca-Cola

Hardware
Silicon Graphics

Software
Proprietary

Copyright

CGI Work in "Aladdin"

This is a section of film that used computer-generated imagery for the magic carpet, the tiger-head cave, the 3D lava, and the cave walls for the "havoc" chase sequence.

Contact

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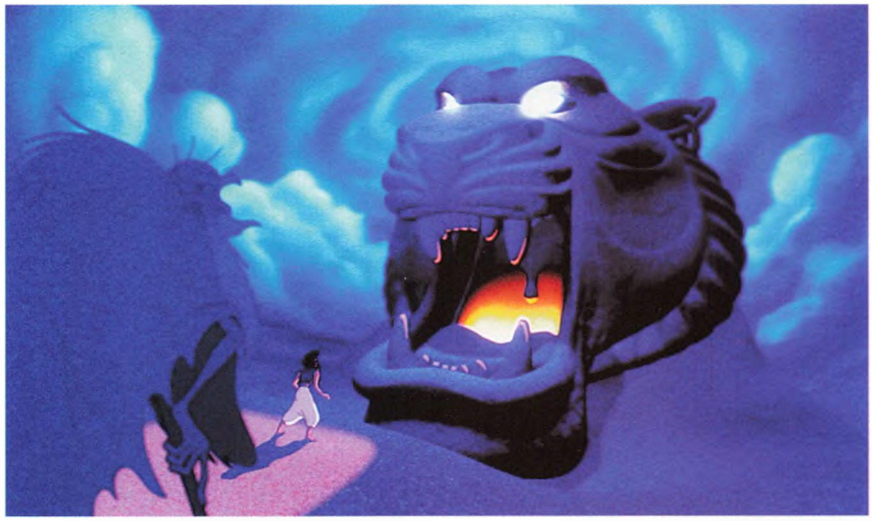
Producer

Walt Disney Feature Animation

Contributors

CGI Department, as part of Disney Feature Animation staff



Hardware/Software

A combination of hardware and software is used by the people in the CGI group as they create visuals for the feature animation.

Copyright

The Dangers of Glitziness and Other Visualization Faux Pas

In The Dangers of Glitziness and other Visualization Faux Pas, or "What's wrong with this visualization?," we take a light-hearted look at various pitfalls of scientific visualization. From over-used "glitziness" to unintelligible narration, from data enhancement to erroneous interpolation: VIS-O-MATIC does it all automagically.

Contact

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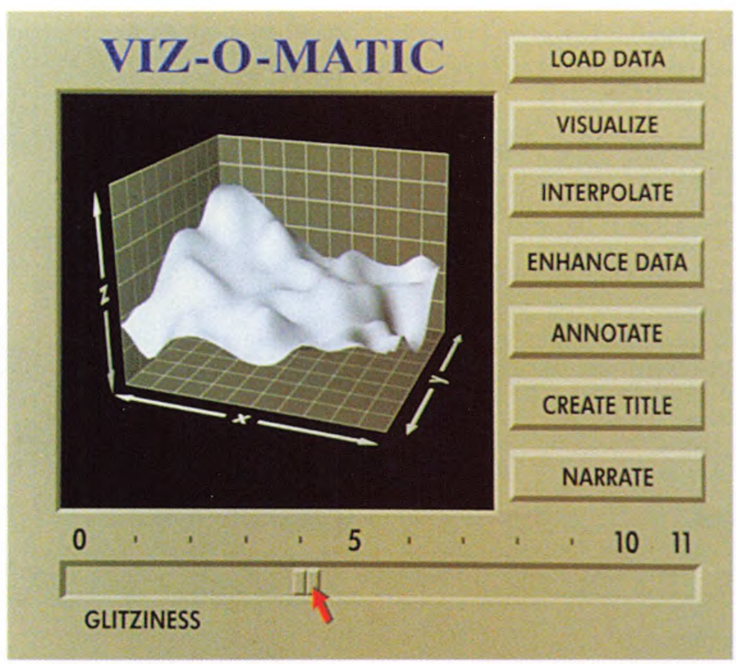
Producer

Wayne Lytle

Hardware

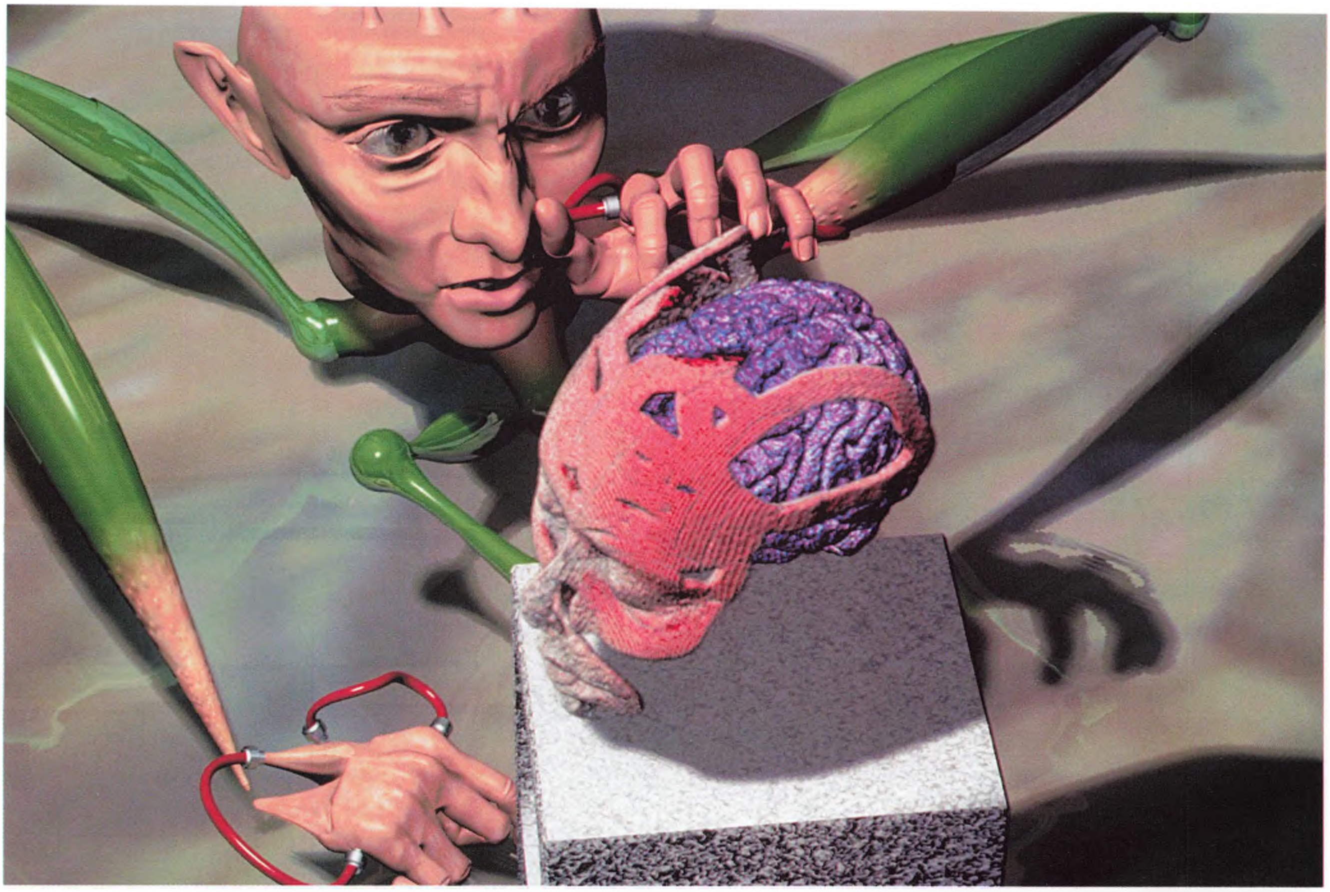
IBM RISC System 6000/560



Software

Motion: in-house choreographer
Object generation: in-house and Wavefront
Rendering: Wavefront

Copyright



Data Driven: The Story of Franz K.

This piece is a presentation testbed to evaluate and test data representation techniques in the context of human character animation. These techniques include volume-filling rendering, dense particle systems, audio mapping, and human facial expression mapping.

Contact

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Producer

North Carolina Supercomputing Center (a division of MCNC)

Contributors

Director, Animator: Christopher Landreth; Visualization *Development:* Dave Bock, Tom Palmer (Cray Research Inc.)
Sound, Sonification: Robin Bargar
System Administration: Rich Misenheimer
Computational Data: Jeff Knerr (smoke transport simulations), William Katz (Neurosurgical Visualization Lab, University of Virginia) (voxel head data), Gottfreid Meyer-Kress (chaotic facial animation data).
Post-produced by: The National Center for Supercomputing Applications.
Editor: Robert Patterson
Titles: Lynn Gephardt;
Audio Post Production: Jay Rosenstein
Narrator: Vivian Chelette
Character animation software courtesy of: SOFTIMAGE Inc.

Special Thanks

Donna Cox, Vince Jurgens, Ray Idaszak, Todd Seeman

Sponsor

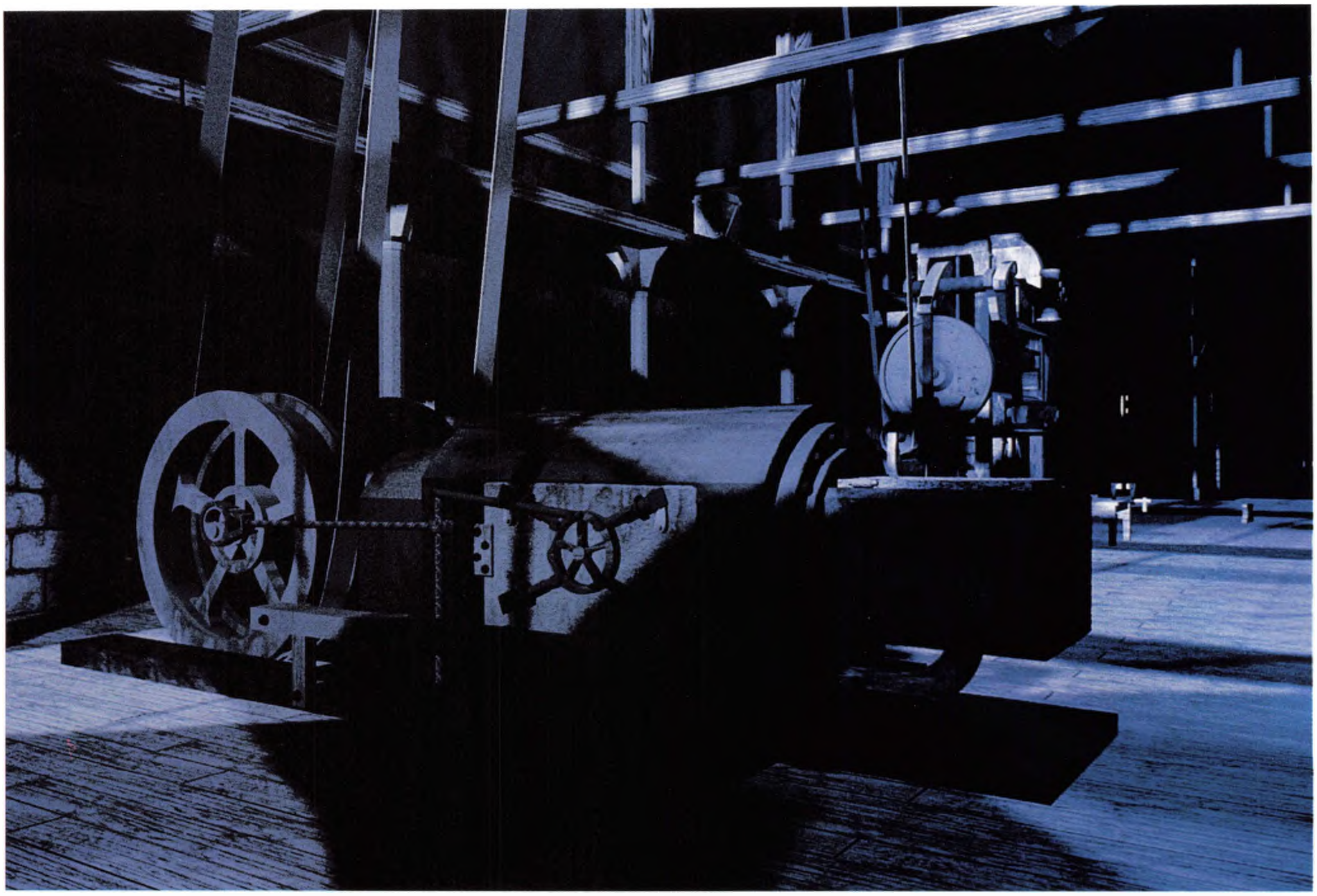
North Carolina Supercomputing Center (a division of MCNC)

Hardware

Silicon Graphics 310 VGXT, 240 GTX, Personal Irises, Indigo Elans

Software

SOFTIMAGE Inc. 4D Creative Environment, NCSA particle modeler and renderer, NCSA voxel modeler and renderer.



Deus ex Machine

A steam engine comes briefly to life and drives a warehouse full of Victorian belt-driven machines in this student production. Kinematic and dynamic simulations guarantee that the motions of the machines are physically correct.

Contact

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Producer

Brian Guenter

Contributors

Director: Wayne Wooten; Animation: Mary Ann Frogge, Wayne Wooten
Modeling: Jack Freeman, Mary Ann Frogge, Lonnie Harvel, Tom Meyer, Heather Pritchett, Scott Robertson
Cinematography: Tom McGill, Scott Robertson, Jerome Solomon
Original Soundtrack: Jack Freeman
Particle Stream: Steve Cover
Story Board: Paul Chaney

Special Thanks

Jim Foley, Ray Haleblian, Jessica Hodgins, MMTL, Technical Industries

Sponsor

Jim Foley, GVU Lab, Georgia Tech

Hardware

Silicon Graphics Reality engine

Software

Wavefront, RenderMan, SD-fast, in-house animation software

Copyright

Devil's Mine

Simulation of a tip truck that is going down into a mine.

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Co-producers
Little Big One, Showscan, Club Media D'Investissement, Euro Media Garantie

Contributors
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Live Action Director: Peter Szondy
Production Designer: Ray Spencer
Animation: Jos Claessen, Toon Roebben
Executive Producers: Jean-Pierre Dauzun, Peter Beale, Peter Henton
Sound Designer: Yves Renard, Pierre Lebecque
Sound Mixers: Yves Renard, Thomas Gaudert
Sound Recording Studio: Studio l'Equipe
Production Supervisor: Caroline Van Iseghem
Special Effects R&D: Vincent Paesmans
Junior Animators: Michel Denis, Christine Salomon
Shooting Supervisor: Paul-Francois Fontigny
Shooting Operator: Filip Vangeffelen
Production Assistant:: Carmen Sanchez
Post-Production Coordinators: Jean-Luc Bonhomme, Manu Maindiaux

Hardware
Silicon Graphics

Software
TDI Explore; Nefertiti High Definition Paint System from LBO; Specific programs developed by LBO's R&D department

Dino-Morph: Super Mario Bros

Dino-Morph Super Mario Brothers is a 3D morph of a dinosaur into three evolutionary stages that utilizes the fluidity of metaballs.

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Producer
Roland Joffe

Contributors
Hirofumi Ito, Jean Kim,
Noriaki Kaneko, Hiro Miyoshi

Sponsor
Lightmotive Fatman

Hardware
Silicon Graphics

Software
Proprietary Metaballs

Doom and the Dog

A light-hearted romp into the void, starring dozens of corpses, two naggy broads, and a good-natured dog.

Contact
Wright Dagget
403 B Cross
College Station, TX 77840
409.846.5943
409.845.4491 fax
wright@archone.tamu.edu

Producer
Wright Dagget and Texas A&M University Visualization Laboratory

Hardware
Silicon Graphics

Software
Advanced Visualizer

Copyright
1993 Wright Dagget

Dr. Scratch

Dr. Scratch is a god of destruction, tearing down the rain forest and leaving deserts in his wake.

Contact
Chris Walker
Mr. Film
228 Main Street, Suite 12
Venice, CA 90291
310.396.0146
310.396.5065 fax

Producer
Ted Hamilton

Contributors
Director: Chris Walker
Voice Talent: Ice-T
Lyrics, Music: Kirk Cameron
Chief Science Officer: Frank F. Little
Art Direction: Sharon Compton
Animation: Geoff Fennell, Pietro Bonomi
Special Effects Animation: Habib Zargarpour
Modeling: Kit Percy, Ken Cope, Goeff Fennell, Pietro Bonomi, Steph Greenberg
Original Model Provided by: Viewpoint
Hi-tech Guru: Macky Beheshti
Assistant Direction: Aaron Slavin
Lip Sync: Chris Walker

Software
Proprietary, Pixar's RenderMan

Enertopia

This single-eye perspective from a steroscopic 70mm film animation was created for the KEPCO Pavilion at EXPO '93 in Taejon, Korea. The dynamic effects programming expresses "energy" through richly-varied animation sequences, including a Big Bang simulation, the dramatization of the birth of man's energy consciousness, and an exciting glimpse of "Enertopia," the energy alternative metropolis of the future.

Contact
Lisa Sontag
Angel Studios
5962 La Place Court, Suite 100
Carlsbad, CA 92008
619.929.0700
619.929.0719 fax

Producers
Wayne Lehrer, Ock-Ju Noh

Contributors
Production: Supertek Productions
Director: Wayne Lehrer
Production Designer: Peter Lloyd
Concept Designer (The City): Ron Cobb
Storyboards (Big Bang): Michael Gibson
Animation, Angel Studios: Harry K. Benham III, Diego Angel, Brad Hunt, Michael Limber, Jill Hunt, Scott Vye, Janice Squire, Peter Megow, Steve Rotenberg, Lisa Sontag, Suzy Garlinger
Composer/Sound Effects: Harald Kloser, Thomas Schobel

Sponsor
Korea Electric Power Company

Hardware
Silicon Graphics Workstations

Software
SCENIX proprietary, RenderMan, Wavefront

Flow

This animation combines water mesh dynamics and interacting particle systems to simulate fluid flow. 3D paint techniques were used to model terrain.

Contact
Gavin Miller
Apple Computer Inc.
MS 301-3J
1 Infinite Loop
Cupertino, CA 95014
408.974.0186
408.862.5520 fax
gspm@apple.com

Producer
Apple Computer

Contributors
Gavin Miller, Ned Greene

Hardware
Silicon Graphics Crimson workstations, Apple Macintosh Quadra 900

Software
In-house rendering and simulation software by: Gavin Miller and Michael Kass
Modeling software by: Ned Greene

Fruit Tracing

A new interval-based collision detection algorithm finds multiple contact points between surfaces. Described in the SIGGRAPH 93 Conference Proceedings, the algorithm applies to both volume and surface data. By spraying fruits from a cannon at a mystery dataset ("fruit tracing"), we show many colliding surfaces to demonstate the technique's practicality.

Contact
John Snyder
Caltech
350-74
Pasadena, CA 91125
818.397.2820
818.793.9544 fax
snyder@egg.gg.caltech.edu

Producer
Caltech Graphics Group

Contributors
John Snyder, Al Barr, Bena Currin, Preston Pfarner, Adam Woodbury, David Laidlaw, Matthew Avalos, Cindy Ball, Kurt Fleischer, Bruce Bell, Jeff Goldsmith, Allen Corcorran, Mark Montague, Dan Fain, Sandra Reyna, Don Marks, Pete Wenzel, Erik Winfree (Caltech), Jose Jiminez (Huntington MRI Center)

Sponsors
NSF/DARPA STC for Computer Graphics and Scientific Visualization (NSF ASC-89-20219)
Additional support was provided by: Apple, DEC, Hewlett-Packard, and IBM

Hardware
HP 9000/700, IBM RS6000, DEC 3000 Model 500S AXP Server, Apple Macintosh

Software
Custom modeling and rendering software

Gas Planet

Contact
Monica Corbin
Pacific Data Images
650 North Bronson Avenue
Suite 400W
Los Angeles, CA 90004
213.960.4042
213.960.4051 fax

Producer
Pacific Data Images, Sunnyvale, CA

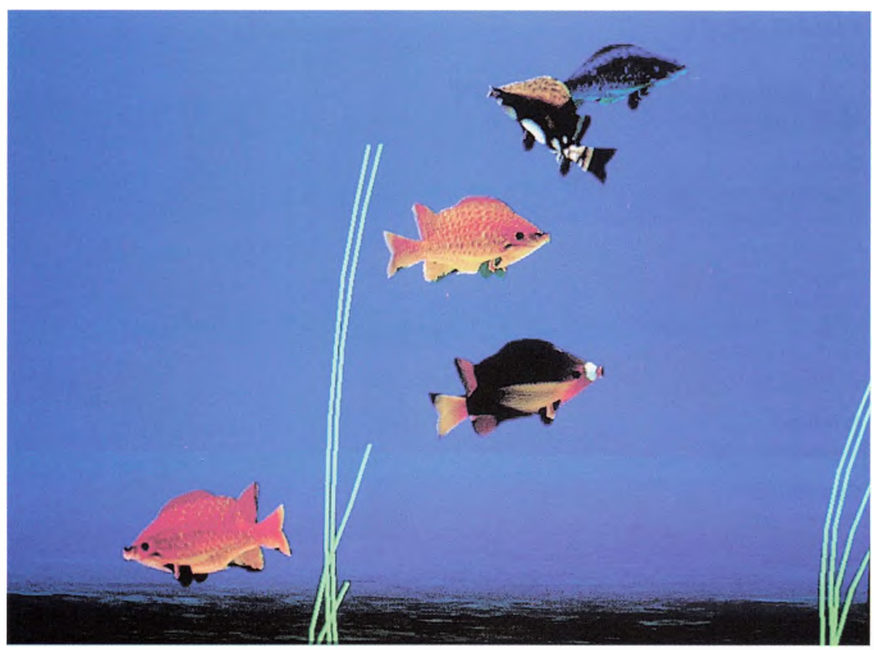
Contributors
Produced with the support of: The Character Animation Group
Executive Producer: Carl Rosendahl
Director: Eric Darnell
Art/Technical Director: Michael T. Collery
Sound: Eric Darnell, Tim Johnson
Sound Editing: Noel McGuinn, Mark Sorensen
Editorial: Kelly Tartan
Film Recording: Tom Martinek
Digital Opticals: Les Dittert

Hardware
Silicon Graphics Personal Iris

Software
Proprietary

Copyright
1992 PDI

Go Fish!



Realistic tropical fish swim in a physics-based aqautic world in accordance with simplified hydrodynamics. The hungry fish, which locomote using controlled muscle power, navigate around obstacles in search of food. A hapless fish is hooked by a fiendish surface dweller.

Contact
Demetri Terzopoulos
Computer Science, University of Toronto
10 King's College Road
Toronto, Ontario
Canada M55 1A4
416.978.7777
416.978.1455 fax
dt@cs.toronto.edu

Producers
Sherry Xiaoyuan Tu, Demetri Terzopoulos, Eugene Fiume

Contributors
Production Assistance: Michael McCool, Michiel van de Panne
Modeling Assistance: Yuencheng Lee, Keith Waters, Hong Qin

Sponsor
Information Technology Research Center, Ontario and NSERC, Canada

Hardware
Silicon Graphics 4D series

Software
In-house physics-based animation

Copyright
1993 Sherry Tu, Demetri Terzopoulos, Eugene Fiume

GOKU

This pilot is an experiment in real-time puppet animation and detailed background settings. Designed for the HDTV medium, GOKU depicts the future of computer-generated backgrounds for the simulation ride industry in addition to real-time characters for the broadcast industry. Proprietary translators were written to fully utilize the most efficient elements of several software packages.

Contact
Jean H. Kim
Magic Box Productions, Inc.
345 N. Maple Drive
Beverly Hills, CA 90210
310.550.0243
310.550.7226 fax

Producers
Hirofumi Ito, Jean Kim

Contributors
Hanging Gardens of Babylon: Atsushi Satoh
Pyramid: Debbie Pashkoff
Technical: Neoglyphiks, Inc., Todd Allendorf

Sponsor
G7 Project

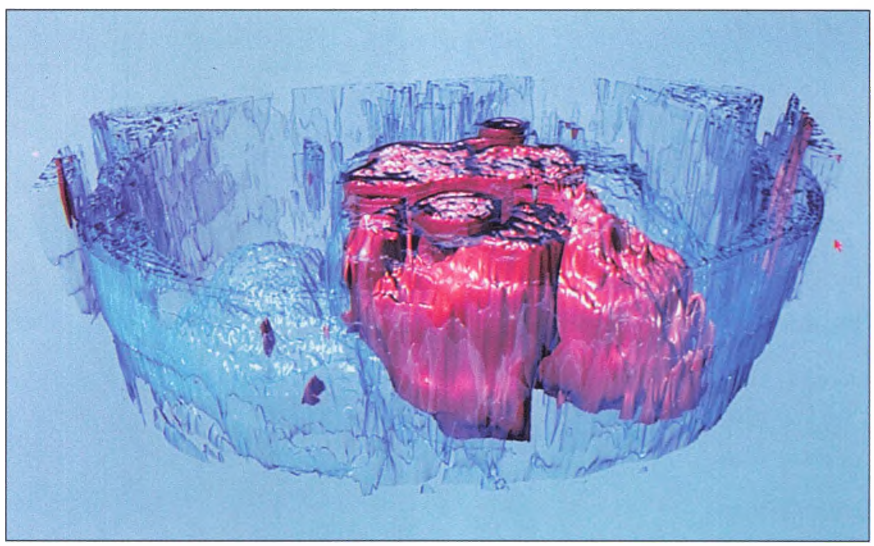
Hardware
Silicon Graphics Indigo 4000,
Reality Engine, HDTV Recording

Software
TDI Explore

Copyright
G7 Project

Heart Beat

Visualizing a live heart beat from 4D MRI-scanned images.



Contact
Tsuyoshi Yamamoto
Hokkaido University Computing Center
N-11, W-5
Sapporo
Japan 060
81.11.716.2111, ext. 2969
81.11.737.6812 fax
yamamoto@cc.hokudai.ac.jp

Producer
Tsuyoshi Yamamoto

Contributors
Tsuyoshi Yamamoto

Hardware
Personal IRIS 4d/30TG

Software
In house

Copyright
Tsuyoshi Yamamoto, Hokkaido University

IGI (Intergaractic Interface)

Our IGI is an image for the ride simulator of an eight-seater named "Conceptor," which is open to the public at the Fujita head office in Tokyo. You can experience the process of design production using a computer, through the medium of a designer's consciousness.

Contact

Katsuyuki Sugimura
LINKS Corporation
2-14-1 Higashi-Gotanda
Shinagawa-Ku, Tokyo 141
Japan
813.5420.5310
813.5420.5330 fax

Producer

Katsuyuki Sugimura (LINKS Corporation)

Contributors

Executive Producer: Kimihiro Abe (Fujita Corporation)
Co-Producer: Kuniyasu Baba (Kunix Corporation)
In association with: Masaya Fukuyama (Imagica Corporation)
Production: LINKS Corporation
Director: Takahiko Akiyama
Planning: Takahiko Akiyama, Yla Okudaira (Yla-Tech Co., Ltd.), Shin Saito (TAF Co., Ltd.), Hiroyasu Sakaguchi (Imagica Corporation)
CG Designers: Ryuichi Snow, Shoko Kitamura, Kouichi Hirata, Sanae Nakanishi, Mitsunori Kataama, Michiko Kanno, Hiroyuki Seshita, Takahiro Takenaka
CG Software Designers: Kouichi Noguchi, Ken Ohtani, Michiru Tanaka
Production Assistant:: Keiichi Abe, Hiroshi Kamohara
CG in association with: Taizi Okuzawa (Buildup Co., Ltd.), Turu Ikeuchi (Buildup Co., Ltd.)
Digital Transfer Operators: Isao Ikawa (Imagica Corporation), Mansanori Nishi (Imagica Corporation)
Photographic Department:: Multibox Production, Inc.
Set Coordination: Buildup Co., Ltd
Sound Producer/Music Director: James Shimoji (Mr. Music Inc.)
Sound Mixer: Yoshito Nagashima (Cricket Studio Inc.)
Sound Effects: Rackyo Group, Inc.
Music Composer: James Shimoji, Toshio Nakagawa

Special Thanks

Junya Okabe (Buildup Co., Ltd.) ,Fumihiro Nonomura, Yoshikazu Inui

Sponsor

Fujita Corporation

Hardware

Silicon Graphics Iris 4D, Sony R-NEWS, LINKS-2 (original, custom made)

Software

Proprietary

JORAM

Choreography of a human-like figure.

Contact
Irit Rosen
Prof. Bosschastraat 40
2628 HN
Delft, Pays Bas
Holland
31.20.623.3493
31.20.675.1626 fax

Producers
Irit Rosen, Freark Broersma

Contributors
Realization: Irit Rosen, Freark Broersma
Music: Harry Kappen

Hardware
Apollo

Software
IL/Poda/Magic Theater (extensions developed by the artists)

Copyright
Irit Rosen and Freark Broersma

JuJu Shampoo

In today's busy world, even a shrunken head has a hard time keeping her hair shiny and clean.

Contact
Dobbie G. Schiff
MetroLight Studios
5724 West 3rd Street, Suite 400
Los Angeles, CA 90036
213.932.0400
213.932.8440 fax

Producer
MetroLight Studios

Contributors
Director: Steve Martino
Producer: Jim Wheelock
Technical Director/Modeler: Alan Ridenour
Technical Director/Animator: Jeff Hayes
Animator/Technical Director: Jerry Weil
Illustrator: Cliff Iwai
Hair Software: Rob Rosenblum, Caroline Allen
Paint Box: Jennifer Law
Production Manager: Jini Dayaneni
Post-production Supervisor: Ken Wiatrak
Music: Roy Ravio
Voice over: Gerry McIntyre
Sound Design: Thomas Bitz
Music Mix: 3rd Street Sound

Hardware
Solbourne 5-604s, Silicon Graphics 4D workstation, A60 and A66 Abekas

Software
MetroLight proprietary software, Wavefront Preview

Copyright
MetroLight Studios

"Jurassic Park" Visual Effects

Excerpts from the motion picture "Jurassic Park" illustrating the full-motion, computer-generated dinosaurs and visual effects created by Industrial Light & Magic.

Contact

Douglas Kay
Industrial Light & Magic
P.O. Box 2459
San Rafael, CA 94912
415.258.2000
415.454.4768 fax

Producer

Industrial Light and Magic

Contributors

Senior Visual Effects Supervisor: Dennis Muren, A.S.C.
Co-Visual Effects Supervisor: Mark A.Z. Dippc
Visual Effects Producer: Janet Healy
Lead Computer Graphics Supervisor: Stefen M. Fangmeier
Computer Graphics Supervisors: Alex Seiden, George Murphy
ILM General Manager: Jim Morris
Computer Graphics Animators: Eric Armstrong, Steve Spaz Williams, Steve Price, James Satoru Straus, Geoff Campbell, Don Waller
Computer Graphics Artists: Jean M. Cunningham, Carl N. Frederick, Thomas L. Hutchinson, Joe Letteri, Jeffrey B. Light, James D. Mitchell, Joseph Pasquale, Ellen Poon, Stephen Rosenbaum, John Schlag, Tien Truong, Wade Howie
Executive in Charge of Production: Patricia Blau
Supervisor of Software and Digital Technology: Thomas A. Williams
Computer Graphics Software Developers: Michael J. Natkin, Zoran Kacic-Alesic, Brian Knep, Eric Enderton, John Horn, Paul Ashdown
Visual Effects Coordinator: Judith Weaver
Visual Effects Art Director: TyRuben Ellingson
Visual Effects Editor: Michael Gleason
Scanning Supervisor: Joshua Pines
Optical Supervisor: John Ellis
Plate Photography Camera Assistant: Patrick McArdle
ILM Plate Producer: Mark Miller
Digital Artists: Carolyn Ensle Rendu, David Carson, Sandy Houston, Barbara Brennan, Lisa Drostova, Bart Giovannetti, Rita E. Zimmerman, Kathleen Beeler, Greg Maloney
Computer Graphics Camera Matchmoves: Patrick T. Myers, Charlie Clavadetscher
Computer Graphics Technical Assistants: Steve Molin, Joel Aron, Edwin Dunkley, Michael Conte, Curt I. Miyashiro, Patrick Neary
Scanning Operators: Randall K. Bean, George Gambetta, Mike Ellis
Computer Graphics System Support: Ken Beyer, Linda J. Siegel, Jay Lenci
Video Engineers: Fred Meyers, Gary Meyer
Computer Graphics Coordinators: Ginger Theisen, Nancy Jill Luckoff
CG Department Production Manager: Gail Currey
CG Department Operations Manager: John Andrew Berton, Jr; Senior CG Department Manager: Douglas Scott Kay
Visual Effects Camera Operators: Pat Turner, Terry Chostner
Additional Plate Photography: Scott Farrar
Camera Assistants: Robert Hill, Jeff Greeley
Matte Artists: Christopher Evans, Yusei Uesugi
Assistant Editor: Roberto McGrath
Negative Cutter: Louis Rivera
Projectionist: Timothy A. Greenwood
Editorial Coordinator: David Tanaka
Chief Model Makers: Barbara Affonso, Steve Gawley, Christopher Reed, Lorne Peterson, Ira Keeler
Stage Technicians: Pat Fitzsimmons, Robert Finley, Jr., Timothy Morgan, William Barr
Optical Camera Operators: Keith L. Johnson, James C. Lim
Optical Line-up: John D. Whisnant, Kristen Trattner
Optical Lab Technician: Tim Geideman
Optical and Scanning Coordinator: Lisa Vaughn
Camera Engineers: Duncan Sutherland, Mike Bolles
Production Accountant: Pamela Kaye
Courier Coordinator: Jerry Simonsen
Production Assistant:: Tina Matthics

Hardware

Silicon Graphics Power, Indigo and Personal Iris series workstations, ILM Proprietary film scanner, Management Graphics solitaire film recorder

Software

Softimage animation software, Alias modelling software, Pixar Renderman rendering software, Parallax painting software, and ILM Proprietary animation, modelling, rendering, and compositing software

Copyright

1993 Universal Pictures, Amblin Entertainment Production

Kelloggs "Reloj"

To graphically communicate that All Bran "helps keep you regular," Kelloggs has developed a campaign in which inanimate objects become constipated—and then use All Bran to help recover and function normally.

Contact
Ralph J. Guggenheim
Pixar
1001 W. Cutting Boulevard
Richmond, CA 94804
510.215.3413
510.236.0388 fax
ralph@pixar.com

Producer
Karen Robert Jackson

Contributors
(For Pixar)
Animation/Art Director: Galyn Susman
Technical Director: Galyn Susman
Creative Director: John Lasseter
Executive Producer: Ralph Guggenheim
Technical Contributor: Tom Porter
Output: Don Conway, Craig Good
Sound Effects/Music: Scott Chandler (Skywalker Sound)
Video Post: Western Images
(For Leo Burnett/Mexico)
Producer: Gilberto Amezquita
Creative Director: Lourdes Lamasney
Art Director: Martha Soler
Client Rep: J.P. Villalobos

Hardware
Silicon Graphics workstations/Abekas A60

Software
Pixar menv modeling and animation software

Copyright

Lakme

Extract of a 52-minute TV special, "Opera Imaginaire," presenting 12 great opera arias. The hands mime beauties and dangers hidden in the jungle, illustrating the duet of two female voices.

Contact
Roulin Pascal
PascaVision
4 Place du 18 Juin 1940
Paris 75006
France
33.1.42932627
33.1.45440407 fax

Producer
PascaVision, Paris/London

Contributors
Director: Pascal Roulin
Animation: Estelle Chedebois
Images: Violaine Jansenns
Computer Graphics: ExMachina

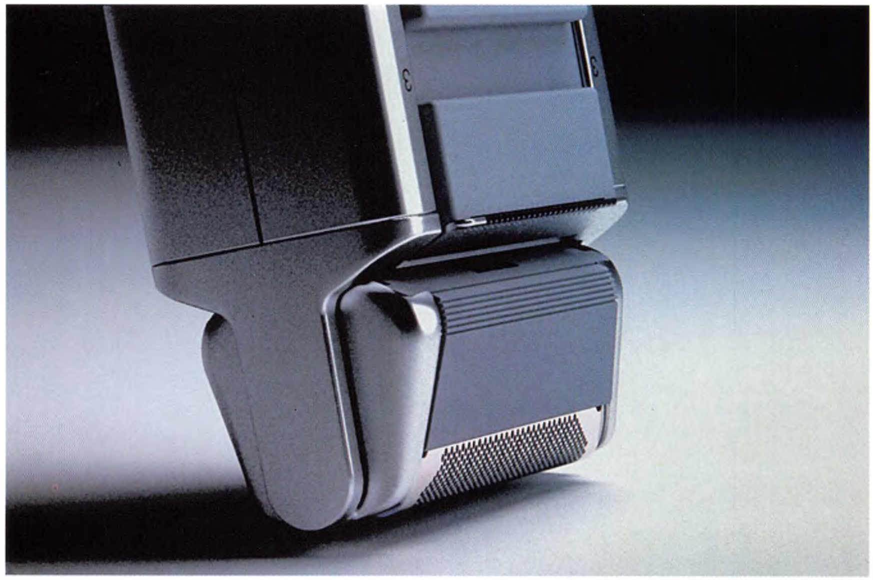
Sponsor
CNC The Media Investment Club

Hardware
Silicon Graphics

Software
APPIA, Explore (Animation, Rendering)

Copyright

Last Word



Blue Sky modeled, lit, and animated a computer-generated Braun Shaver that shaves off the spot's copy as it is read by the announcer. The computer-generated scenes are sandwiched between live-action shots of a hand holding a real shaver at the head and tail of the spot. The result is a spot where the viewer cannot tell that the CGI shaver is not real.

Contact
Alison Brown
Blue Sky Productions, Inc.
100 Executive Boulevard
Ossining, NY 10562
914.941.5260
914.923.9058 fax

Producer
Alison Brown

Contributors
Director: Chris Wedge
Technical Director: Oliver Rockwell
Modeler/Animator: John Kahrs
Technical Support: Trevor Thomson
CGI Studio Architecture: Michael Ferraro
Rendering Software: Carl Ludwig
CSG Modeling Software: Eugene Troubetzkoy
President: David Brown
Live-action Inserts: Phil Marco Productions, Inc.
Editor: The Big Picture
Music: Elias and Associates

Sponsor
Lowe & Partners: Andy Weber, Steve Oman, Harold Karp

Hardware
Sun SPARC 2, Silicon Graphics Iris

Software
CGI Studio, SOFTIMAGE Inc.

Legacy

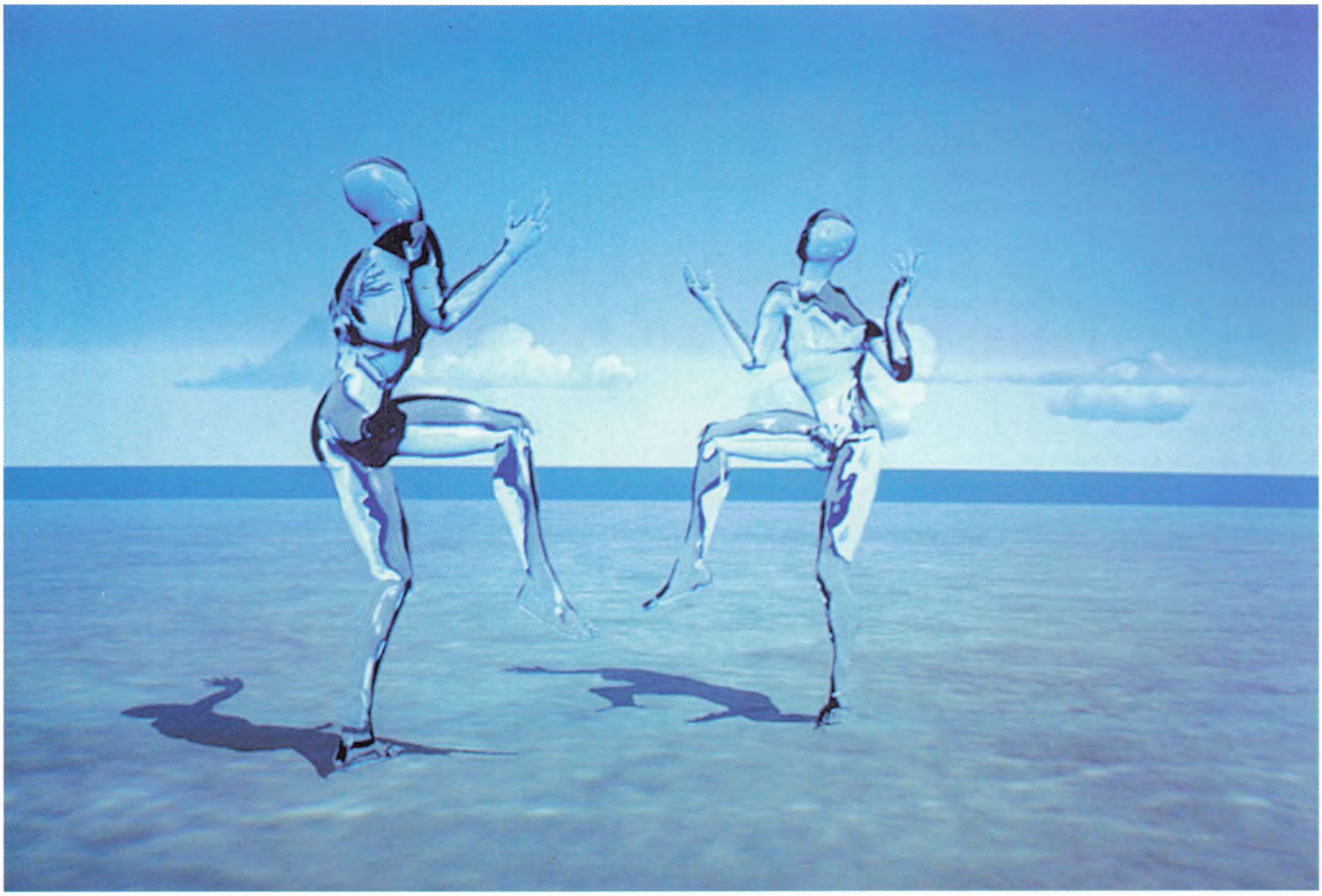
Legacy is about continuation and connection—continuation of artistic forms and cultural forms, and a connection between the past and present, between us and our ancestors. Legacy is about storytelling and is a recognition that all current social forms are rooted in the past.

Contact
Darrin Butts
6200 Franklin, Apt. 403
Hollywood, CA 900028
213.851.6500
213.851.5505 fax
darrin@rythm.com

Producer
Darrin Butts

Hardware
Silicon Graphics Workstations

Software
SOFTIMAGE Creative Environment



Luxor Dream Sequence

This piece utilizes motion capture and ray tracing to depict a dream sequence in one of the attractions at Circus Circus Enterprises' new hotel, Luxor, in Las Vegas. The dream explores the universal life-force that pervades the universe.

Contact

Jeff Kleiser
Kleiser-Walczak Construction Co.
8105 Mullholland Highway
Hollywood, CA 90088
213.467.3563
213.467.3583 fax

Producer

Kleiser-Walczak Construction Co. for The Trumbull Co./Circus Circus Enterprise

Contributors

Directors: Doug Trumbull, Arish Fyzee, The Trubell Co.
Animation Directors: Jeff Kleiser, Diana Walczak
Software/Animation: Frank Vitz, Lisa Reynolds
Animation: Derry Frost
Project Producer: Jeffrey A. Diamond
Line Producer: Michael Van Himbergen
Modeling: Patsy Frost, Robin Frances, Sarah Jane King, Erika Walczak, Stevan del George, Nicholas Hoppe
Original Music: T. Baker Rowell
Design: Robert Taylor, Sonny King

Hardware

Silicon Graphics Crimson and Indigo, IBM POWER Visualization Luxor Dream Sequence #133 System

Software

Wavefront Technologies, Kleiser-Walczak proprietary. Frank Vitz Technical Consulting.

Luxor Excerpts

These excerpts from the Luxor attraction include material from a ride-film and computer-generated aircraft digitally composited over motion-controlled model photography.

Contact

Jeff Kleiser
Kleiser-Walczak Construction Co.
8105 Mullholland Highway
Hollywood, CA 90088
213.467.3563
213.467.3583 fax

Producer

Kleiser-Walczak Construction Co. for The Trumbull Co./Circus Circus Enterprises

Contributors

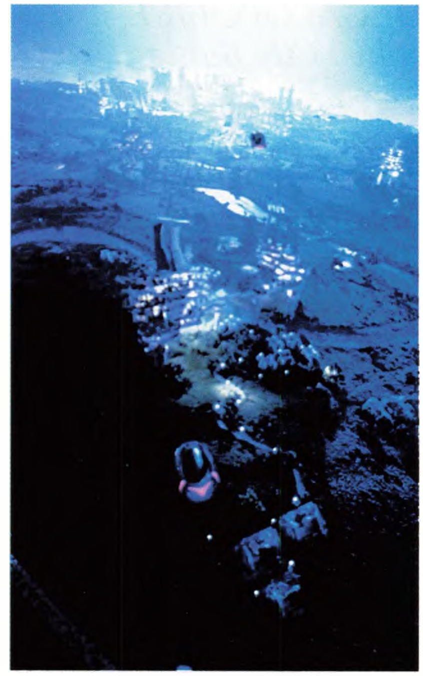
Directors: Doug Trumbull, Arish Fyzee
Animation Directors: Jeff Kleiser, Diana Walczak
Head Animators: Derry Frost, Ed Kramer
Animators: Randy Bauer, Patsy Frost, George Karl, Eileen O'Neill, Jeffery A. Williams
Project Producer: Jeffery A. Diamond
Line Producer: Michael Van Himbergen
Software: Frank Vitz, Lisa Reynolds
Digital Compositing: Joel Hynek, Serge Stretchinsky, Pam Auditore, Terrence Masson, John Gaeta, Joe Hall
Production Manager: Robert O'Haver
Production Coordinators: T. Baker Rowell, Robin Frances, Sarah Jane King, Corinne-Marie Coppola
Original Music: T. Baker Rowell

Hardware

Silicon Graphics Crimson and Indigo, IBM POWER Visualization System

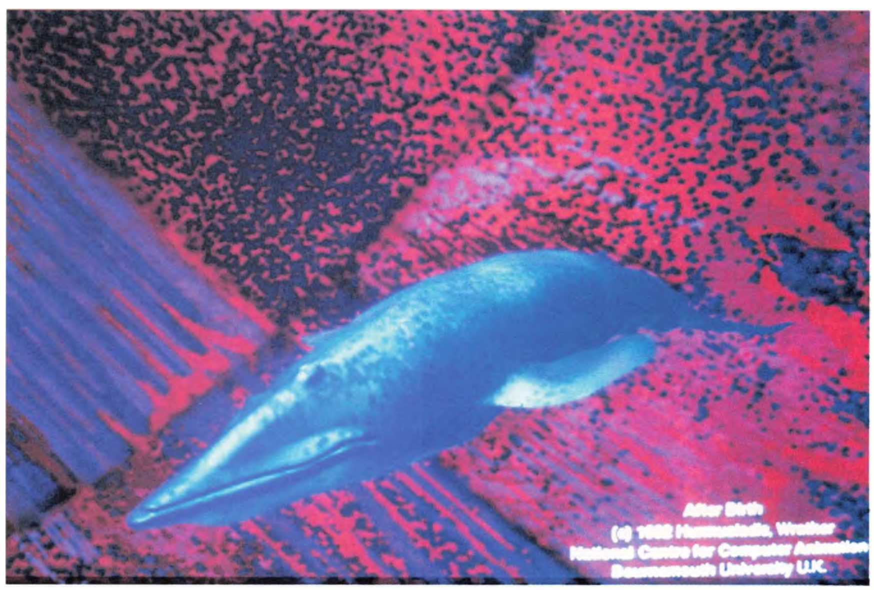
Software

Wavefront Technologies, Kleiser-Walczak proprietary
WILLY by Santa Barbara Studios



Manatees: The Last Generation?

The manatee images are part of an "edutainent" attraction for Sea World/Florida. The images are projected onto a 200-degree semi-circular screens along with effects projection of water. Includes dimensional rockwork and other film projection to create the illusion of being under water.



Contact

Kevin Biles
KBD Innovative Arts
13360 Beach Avenue
Marina del Rey, CA 90292
310.578.5452
310.578.5462 fax

Producer

KBD Innovative Arts

Contributors

Attraction Production Co.: KBD Innovative Art
Creative Director: Kevin Biles
Software Producer: Laurie Leinonen
CGI Producer: Dan Jex, Jex Productions
Art Director, Programming Supervisor: Tom Gericke, Campbell & Gericky, Inc.
Project Manager: JuliAnn Juras
Animation Production: Todd Kesterson, Digital Artworks
Visual Effects/Modeling: Erik Johnson, Paula Conn (Digitial Artworks), Steve Keele (Viewpoint)

Hardware

Silicon Graphics 4D-25G

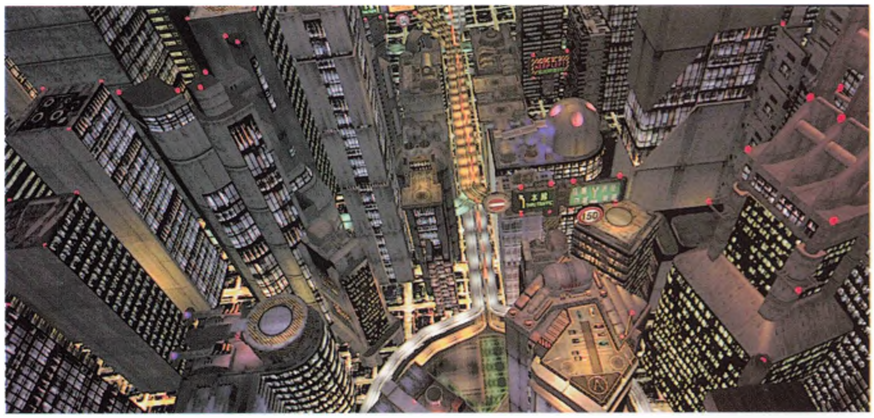
Software

SOFTIMAGE Inc.

Copyright

1993 Bush Entertainment Group

MEGALOPOLICE Tokyo City Battle



Software for SEGA's AS-1 four-axis hydraulic motion base. You are riding the latest generation of pursuit vehicle through the skyways of neo-Tokyo in the year 2154. Your mission: capture arch-eco-terrorist Brute Bombalez and his henchmen.

Contact
Tetsuya Mizuguchi
Sega Enterprises, Ltd.
1-2-12 Haneda
Ohta-ku
Tokyo 144
Japan
011.81.3.3743.7574
011.81.3.3743.5173 fax

Producer
SEGA Enterprises, Ltd.

Contributors
Line Producer/Story: Tetsyua Mizuguchi
Supervising Animators: Michael Arias, Jun Uriu
Modeling/Design/Animation: Go Kikuchi, Koji Ono
Art Direction: Yasuo Fujita
Art Direction/Vehicle Modeling: Buildiup Co., Ltd
Production Assistant: Koichi Ozaki
Sound Design: Mitchell Osias
Sound Engineering: Kiochi Namiki, Takenobu Mitsuyoshi
Motion Engineer: Hideaki Doi

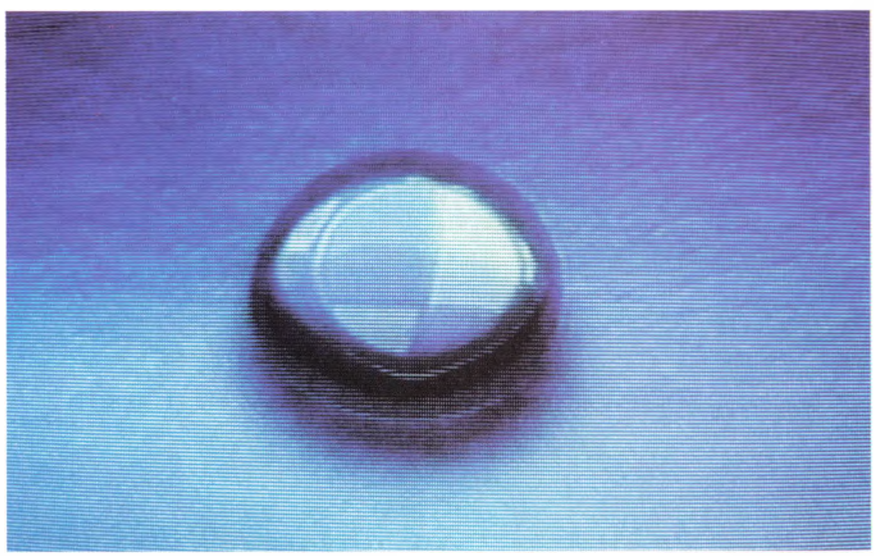
Special Thanks
Shinji Aramaki, Mamoru Ito, Koichi Ohata, Jun'ya Okabe, Atsuki Sato, Akihiro Tsuchiya, Rei Yumeng

Hardware
Silicon Graphics 4D35x3, Indigo XS24x1, Macintosh, IBM PC

Software
SOFTIMAGE Inc., Eddie, Photoshop, 3DStudio

Copyright
1993 SEGA Enterprises, Ltd.

Mercury



Carnes 1992 Gold Lion prize-winning commercial for BMW cars. Photo-realistic modeling and rendering, perfect combination of CAI and live action,with a very sensual feel on top. Tracking of hand-camera moves using artificial intelligent software. Stereoscopic digitalization of women's bodies via photogrammetry program written for this spot. Mercury drop completely computer generated and moved on computer-simulated bodies. Artificial mercury composited with live action footage.

Contact
Bela L. Brozsek
6470 Deep Dell Place
Hollywood, CA 90068
213.462.7080
213.465.9703 fax

Producer
Howard Bulkin

Contributors
Director: Keith Rose
Computer Animation: Bela L. Brozsek
Client: BMW

Hardware
Symbolics 3650

Software
Information International Owner's Software

Copyright
Bela L. Brozsek

Michelob Golden Draft "Evolution"

Evolution features a chimpanzee in a bar ordering a beer. As the chimp continues to drink his beer and chat, he becomes more and more human until the humorous finale when a female chimp sitting next to him says "I'll have what he's having." The spot combines live action and computer graphics.

Contact

Suzanne Datz
Rhythm & Hues Studios
910 N. Sycamore Avenue
Hollywood, CA 90038
213.851.6500
213.851.5505 fax
suze@rhythm.com

Producers

Producer: Doug Nichols
Executive Producer: Lois Anderson

Contributors

Client: Anheuser-Busch, Inc.
Agency: DDB Needham Worldwide
Prosthetics: The Character Shop
Animation Effects Company: Rhythm & Hues, Inc.
Live Action Director: Randy Roberts
Live Action Producer: Chris O'Brien
Animation Director: Larry Weinberg
Animators: Nancy Kato, Robert Lurye
Technical Director: Kevin Barnhill, Jennifer Pearce
In-house Editor: Rick Ross
Editorial: Szabo/Tohtz
Editor: Jack Tohtz

Hardware

Silicon Graphics

Software

Proprietary

Copyright

MINDBLENDER
Peter Gabriel

Peter Gabriel's *MINDBLENDER*, a motion-based simulation ride, presents an engaging HDTV experience through the music of Peter Gabriel and surrealistic computer animation. Image-processing techniques integrate live-action characters with exotically illustrated creatures, rhythmic 3D landscapes, and a dynamic POV for a fantastical motion-storybook effect.

Contact

Lisa Sontag
Angel Studios
5962 La Place Court, Suite 100
Carlsbad, CA 92008
619.929.0700
619.929.0719 fax

Producer

Executive Producers: Peter Gabriel, Real World
Danny Socolof, Planet Rock

Contributors

Music: Peter Gabriel
Production Company: Palomar Pictures
Director: Brett Leonard
Line Producer: Carl Wyant
Conceptual Designer, Illustrator: A.E. Bunker
Animation, Angel Studios: Harry K. Benham III, Diego Angel, Brad Hunt, Michael Limber, Jill Hunt, Scott Vye, Jim Polk, Janice Squire, Peter Megow, Steve Rotenberg, Mark Rotenberg, Jim McLeod, Lisa Sontag, Suzy Garlinger
Motion Theater, Technical Support: Iwerks
Hi-definition Video: HDLA and Rebo Studios

Hardware

Silicon Graphics Workstations

Software

SCENIX proprietary, RenderMan, Wavefront

Copyright

ODORO ODORO (The Mysterious Dance)

A new style of black comedy.

Contact
Jun Watanabe
LINKS Corporation
System Sales Division
2-14-1 Higashi-Gotanda
Shinagawa-Ku, Tokyo 141
Japan
813.5420.5311
813.5420.5312

Producer
Jun Watanabe

Contributors
Computer Graphics Creation: Jun Watanabe
Sound Creation, Orginal Music: Toshiyuki Mathumoto
Blur Effect Software: Michiru Tanaka
System Engineer: Tadahiko Kurachi

Hardware
Silicon Graphics (Iris Crimson, Iris 4D/35, Indigo)

Software
Personal LINKS (LINKS Corporation proprietary), MetaEditor (META Corporation Japan proprietary)

Oreo: Word Play

A clean, graphic, and playful pool of spots for a classic product. The challenge was to make the play-on-words humor read using only Oreo cookies and a white background.

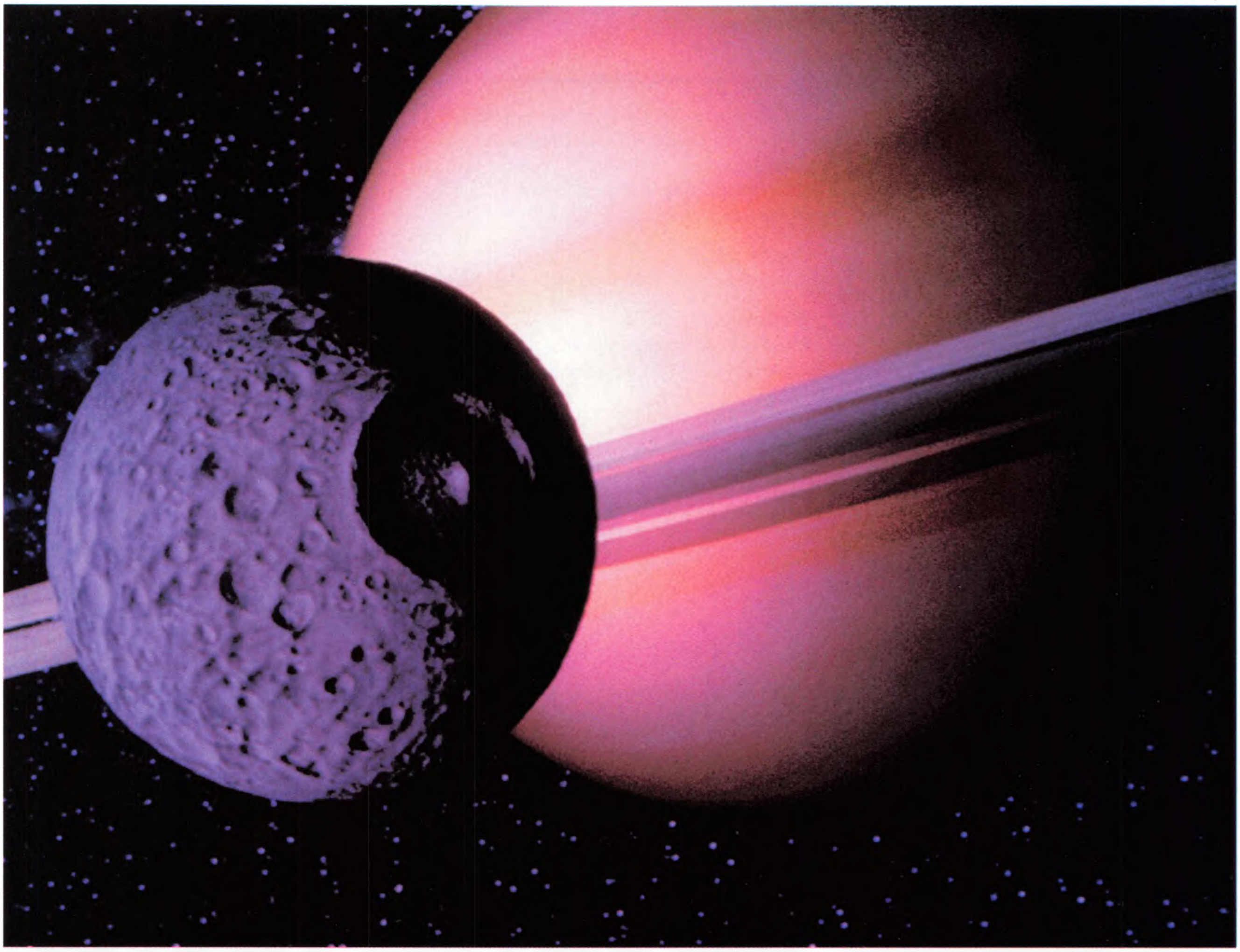
Contact
Chris Wallace
TOPIX Computer Graphics and Animation, Inc.
217 Richmond Street West, 2nd floor
Toronto, Ontario M5V 1W2
Canada
416.364.6444
416.364.2539 fax

Producer
Stephen Price

Contributors
Directors: Harold Harris, Ken Nielsen
Animators: Ken Nielsen, Doug Masters

Hardware
Silicon Graphics: Crimson, Indigo, Personal Iris

Software
SOFTIMAGE Inc., Wavefront



Other Worlds

A visually stunning and scientifically accurate short film tour of our solar system produced for the new "Where Next, Columbus?" exhibition at the National Air and Space Museum in Washington, D.C.

Contact

John H. Grower
Santa Barbara Studios
201 N. Salsipuedes Street
Suite 300
Santa Barbara, CA 93103
805.568.1902
805.568.3733 fax

Producers

Patricia Woodside, John Grower, Smithsonian Institution National Air and Space Museum

Contributors

Director: John Grower
Narration: Ricardo Montalban
Science Advisors: Dr. Eric De Jong, Dr. Ted Maxwell
Animation Director: Eric Guaglione
Animators: John Grower, Eric Guaglione, James Hourihan, William Kovacs, Ron Moreland, Mark Wendell
Art Directors: Wayne Kimbell, Bruce Jones, Michael Gibson
Music: Wayne Sabbak, James Wood
Script: Andrew Maclear
Planetary images provided by: Jet Propulsion Laboratory, NASA's Solar System Visualization Team, NASA's Center for Earth and Planetary Studies
USGS Astrogeology Branch: Wayne Lytle, Cornell Theory Center

Sponsor

IBM Corporation, Wavefront Technologies, Inc., NASA/Solar System Visualization Project, Digital Magic Inc., Sound Advice, United Airlines, Inc.

Hardware

IBM RS6000, Silicon Graphics Indigo Elan, Apple Quadra 950

Software

Wavefront TAV 3.0, Video Composer, Dynamation, Photoshop

Copyright

Pacific Data Images Montage

A montage of character animation and visual effects for commercials.

Contact
Monica Corbin
Pacific Data Images
650 North Bronson Avenue
Suite 400W
Los Angeles, CA 90004
213.960.4042
213.960.4051 fax

Producer
Pacific Data Images

Contributors
Executive Producer: Glenn Entis
Producers: Les Hunter, Tim Johnson, Brad Lewis
Directors: Ray Giarratana
Animation Director: Tim Johnson
Art Directors: Sharon Calahan, Eric Darnell
Computer Effects Director: Richard Chuang
Technical Directors: Andrew Adamson, Graham Walters
Animators: George Bruder, Rex Grignon, Tod Heapy, Raman Hui, Nick Ilyin, Glenn McQueen, Mike Necci, Janet Rentel, Wendy Rogers, Karen Schneider, Laurence Treweek, Don Venhaus, Dick Walsh
Assistant Animators: Dean Hadlock Tod Heapy
R&D: Cary Phillips
Video: Noel McGinn
Assistant Producer: Lucy Gorman
Production Coordinator: Terry Herrmann

Hardware
Silicon Graphics Personal Iris

Software
Proprietary

Copyright
1992 PDI

PDI "Toys" Visual Effects

A variety of computer-generated images, effects, and characters created with digital compositing and PDI's performance animation for film.

Contact
Monica Corbin
Pacific Data Images
650 North Bronson Avenue
Suite 400W
Los Angeles, CA 90004
213.960.4042
213.960.4051 fax

Producer
Pacific Data Images

Contributors
Executive Producers: Carl Rosendahl, John Swallow
Producer: Julie Gibson
Visual Effects Supervisor: Jamie Dixon
Technical Director: Graham Walters
Animator: Andrew Adamson
Production Manager: Barbara McCullough
Effects Editor: Kelly Tartan

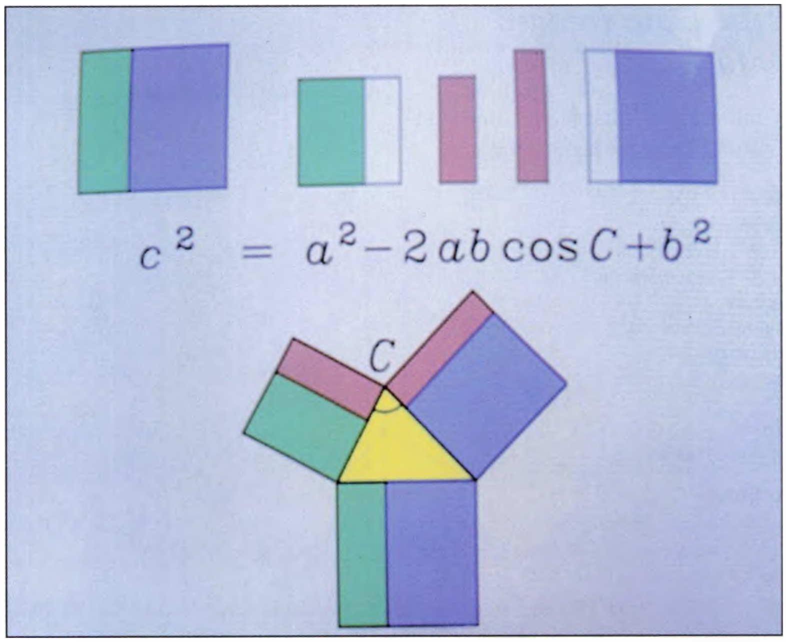
Hardware
Silicon Graphics Personal Iris

Software
Proprietary

Copyright
1992 20th Century Fox/Baltimore Pictures/Barry Levinson Films

Project MATHEMATICS! Polynomials & Sines & Cosines

Excerpts from three educational programs designed to help teach high school-level mathematics.



Contact
Jim Blinn
Project MATHEMATICS!
305 S. Hill
Pasadena, CA 91106
818.356.3758
818.356.3763 fax
blinn@caltech.edu

Producer
Jim Blinn

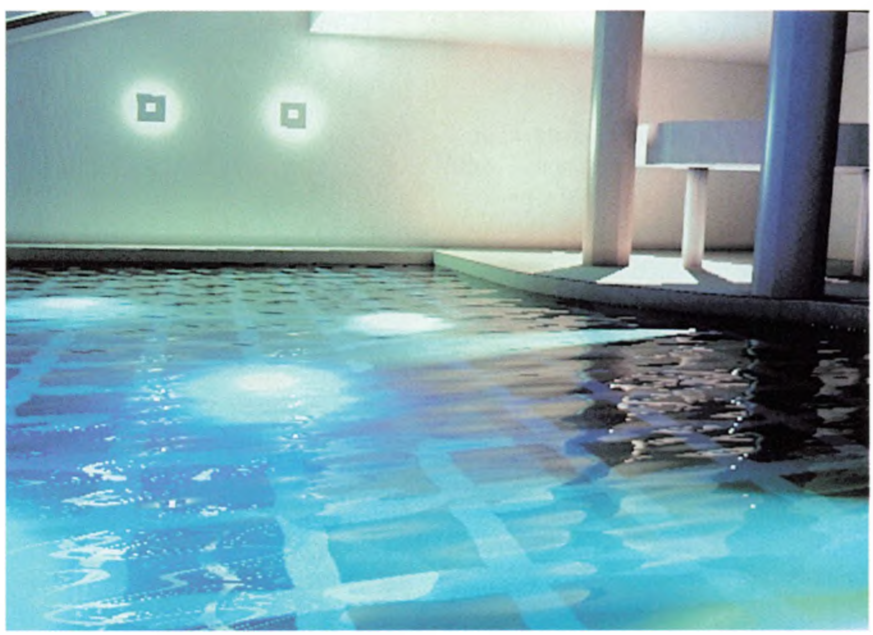
Sponsor
National Science Foundation

Hardware
PC Clones

Software
In-house animation system

Rhapsody in Light & Blue

To render photo-realistic images including a water region, many recent techniques based on optical phenomena are employed: reflection and refraction of light on water surfaces, scattering and absorption of light in water, and shadows cast on water surfaces.



Contact
Hideo Yamashita
Hiroshima University
1-4-1 Kagamiyama
Higashi-hiroshima
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81.824.22.7195 fax
yama@eml.hiroshima-u.ac.jp

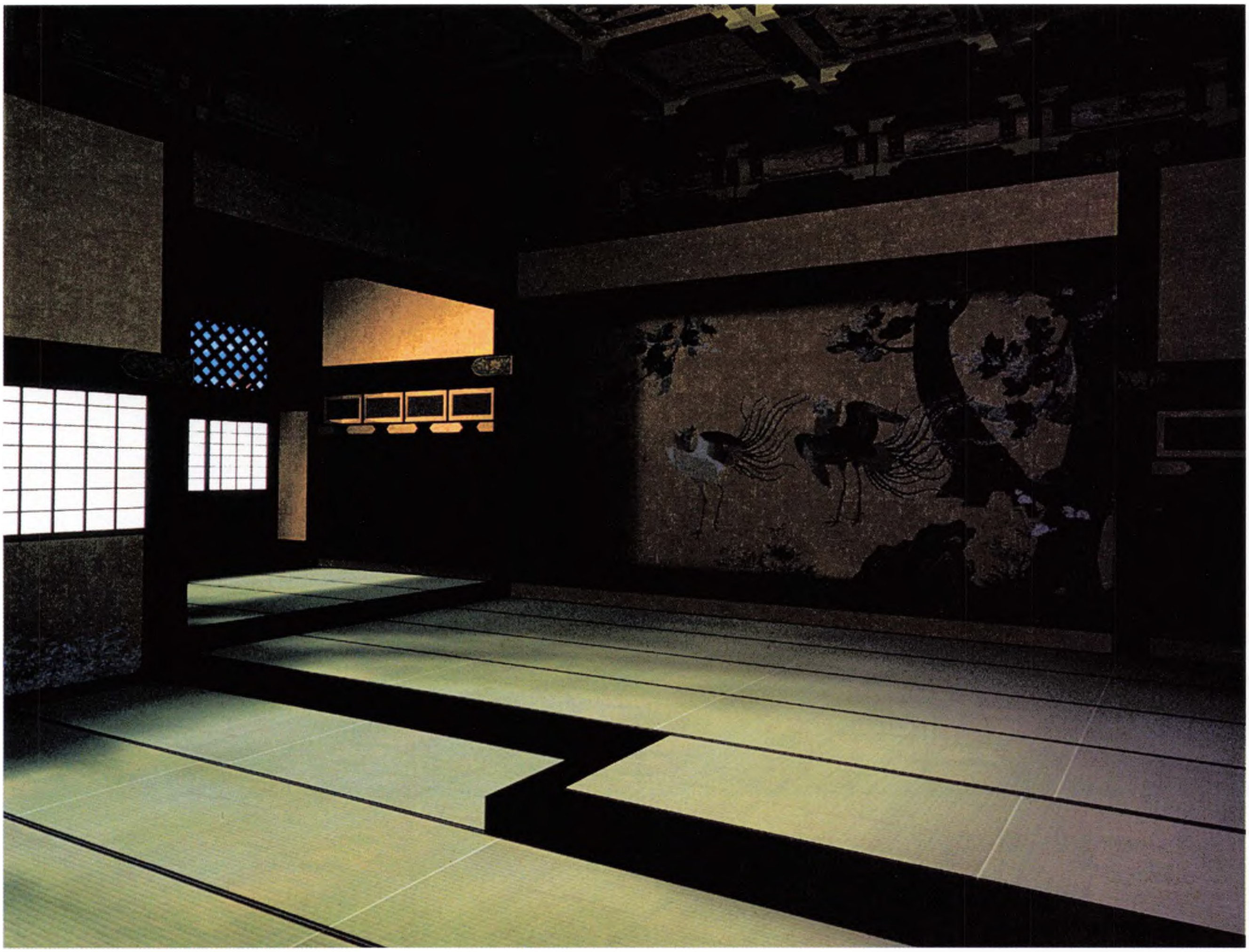
Producer
CG Research Group of Universities in Hiroshima

Contributors
Directors: Eihachiro Nakamae, Hideo Yamashita

Hardware
Silicon Graphics IRIS, NEC EWS

Software
In-house

Copyright
Eihachiro Nakamae



Sendai Castle

The Sendai Castle was built by Masamune Date, a famous daimyo in the early 17th century, but nothing remains today. The recent computer graphics technology has made it possible, based on the historical record, to picture the castle buildings and interior paintings as they were.

Contact
Yoshiyuki Hamano
CAD Center Corporation
1-7-16 Sendagaya
Shibuya-ku
Tokyo 151
Japan
81.3.3470.8701
81.3.3470.8705 fax

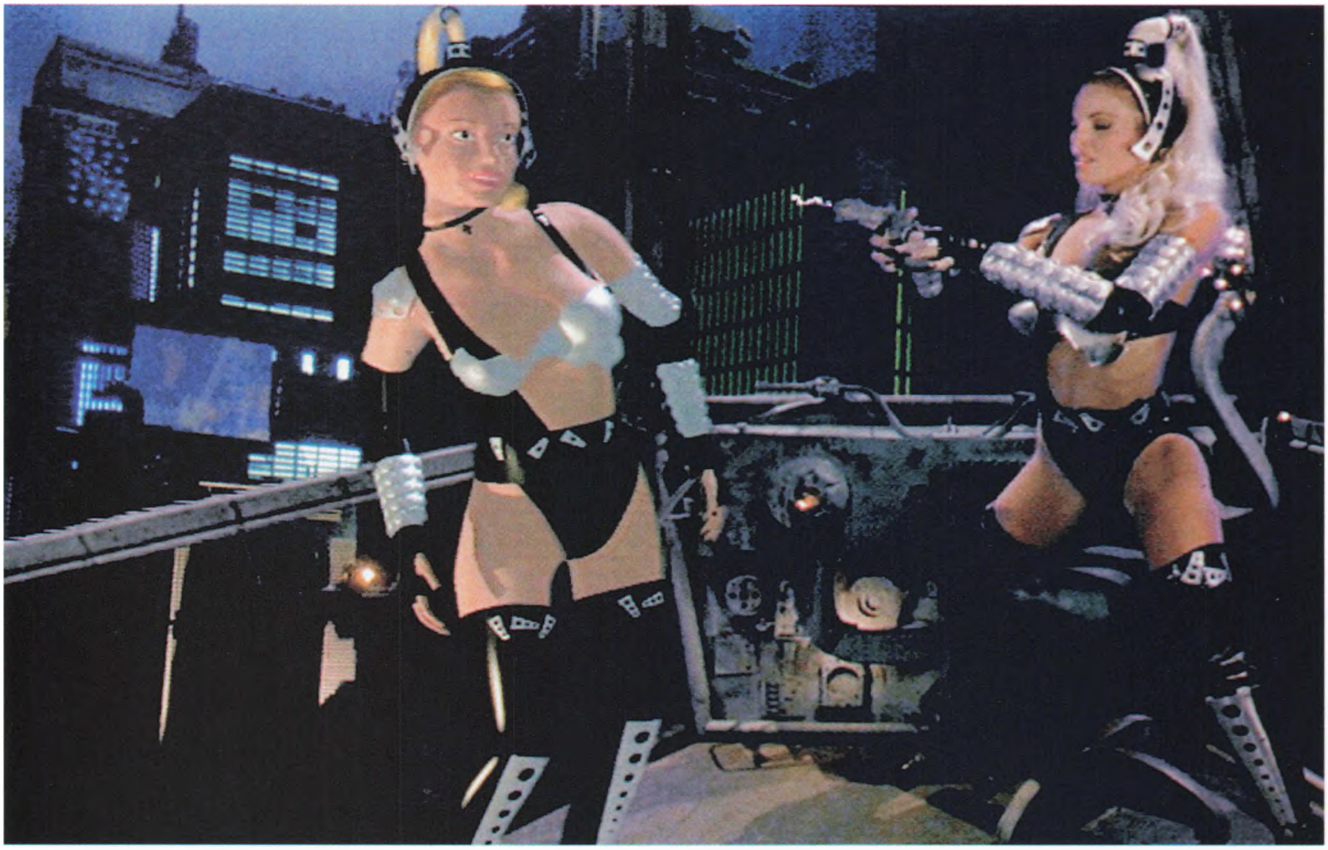
Producer
Yoshiyuki Hamano, CAD Center Corporation

Contributors
Nigou-Sei Architect & Associate Office, Day Plus, Inc., Gizmo, Inc., Chishaku-in, Daigo-ji Shingen Mission, Daikaku-ji, Hayashibara Museum of Art, Imperial Household, Juko-in, Kennin-ji, Matsushima-cho, Nagoya Castle, Ohsaki Hachiman-jinja, Onjo-ji, Takumi Satoh, Zuigan-ji, Sendai City Museum, Tokyo National Museum, Tokyo National University of Fine Arts and Music

Sponsor
Miyagiken Gokoku-Shrine

Hardware
Silicon Graphics Crimson R.E. (Animation), VAX (Modeling)

Software
QuBISM (Animation), GDS/SVS (Modeling)



Sister of Pain—Vince Neil

An example of a computer-animated character used in a music video. Most of the motion data was acquired using a real-time motion capture system. The data was then fed into SOFTIMAGE Inc., where the final animation and rendering took place.

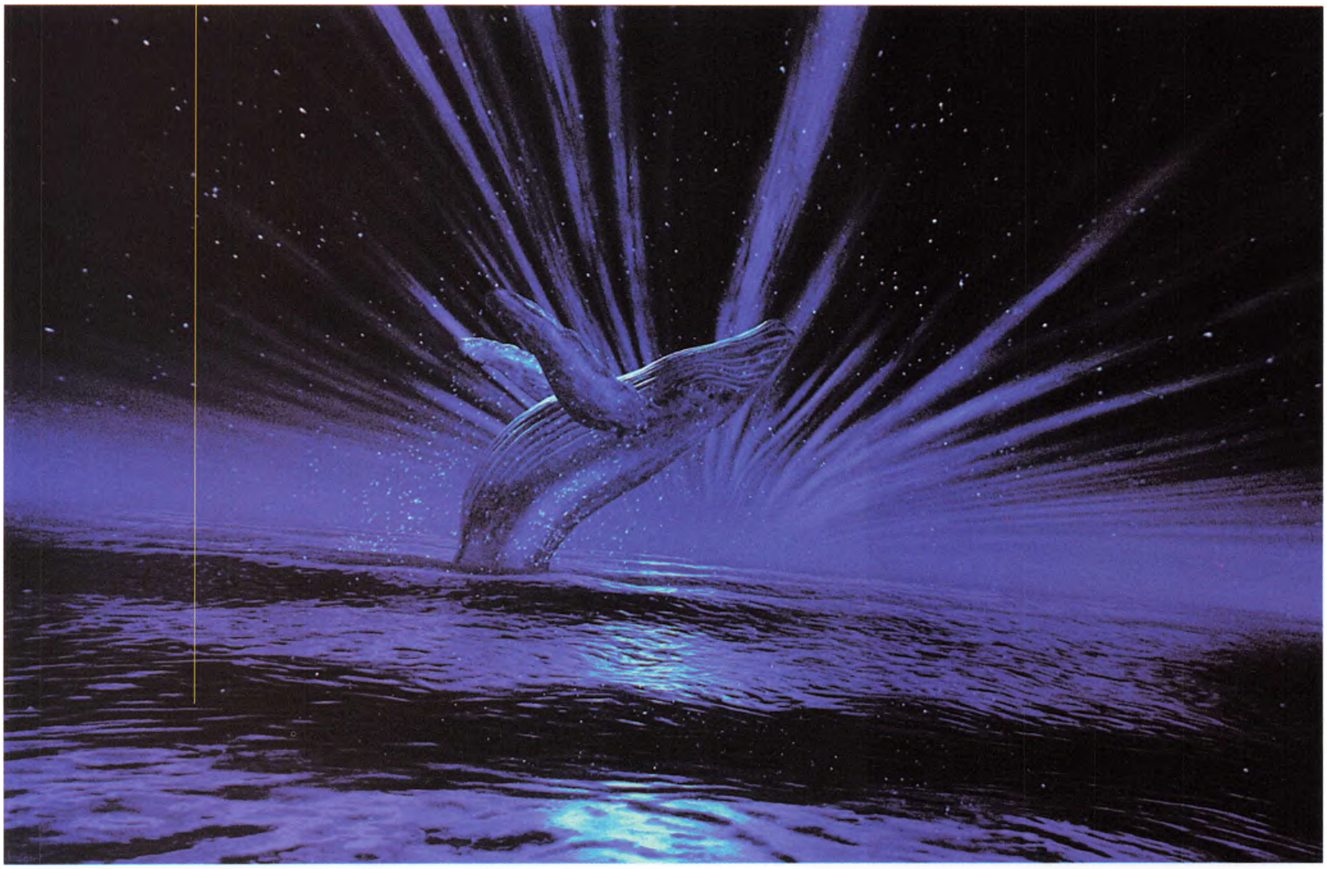
Contact
Peter Conn
Homer & Associates
1420 N. Beachwood Drive
Hollywood, CA 90028
213.462.4710
213.462.2109 fax

Producer/Director
Peter Conn

Contributors
Director of Computer Animation: Michael A. Kory
Additional Animation: Stephen Greenberg
Motion Capture: Superfluo
Digital Compositing: Peter Sternlicht, The Post Group

Hardware
Silicon Graphics

Software
SOFTIMAGE Inc.



StarQuest Adventure

StarQuest is a four-minute Omnimax motion-based ride film for the 1993 Korean World Expo, Taejon, Korea, to be shown in the Samsung Pavilion.

Contact

Dobbie G. Schiff
MetroLight Studios
5724 West 3rd Street, Suite 400
Los Angeles, CA 90036
213.932.0400
213.932.8440 fax

Producer

MetroLight Studios

Contributors

Produced by: MetroLight Studios for Landmark Entertainment
Executive VP in Charge of Production: Dobbie G. Schiff
CGI Director: Jon Townley
Executive Producer: Jim Wheelock
Producer: Mark Franco
Assistant Producer: Jane Stephan
Digital Effects Supervisor: Kelley Ray
Designer: Cliff Iwai
Modelers: Sean Cunningham (Aquatic), Mike Merrel (Pre-Historic) Alan Ridenour (Saturn), Con Pederson
Technical Directors: Scott Bendis (Vampire Binary), Steve Blakey (Saturn), Brian Bowman (Saturn), Cliff Bret, Chiara Perin, Yau Chen (EPB TD), Daniele Colojacomo (Pre-Historic), Aliza Corson (Aquatic), Sean Cunningham, Rosa Farre, Todd Gantzler (Caveman-Starman Morph), Jim Hillin (Pre-Historic), Gary Jackermak, George Karl, John McLaughlin (Saturn/Aquatic/Black Hole), Peter Meechan (Black Hole/Aquatic), Mike Merell, John Ornelas (Vampire Binary), Con Pederson, Sean Schur, Jerry Weil (Aquatic)
Resource Manager: Steve Klevett
Production Manager: Jini Dayaneni
Systems Administrator: Andy Chua
Systems/Software Support Greg Ercolano
Software Support: Rob Rosenblum, Yun-Chen Sung Film *Recorder:* Bill Kent
Offline Editor: Ron Reynolds
Technical Support: John "Bear" Bryant, Daniel Loeb
Client: Dream Quest Images

Hardware

Solbourne 5-604, Silicon Graphics 4D workstations, Abekas A60 and A66, Solitaire 8XP Film Recorder; Oxberry 8 Port Camera

Software

MetroLight proprietary software, Wavefront Preview, RenderMan, Alias 4.0

Steam—Peter Gabriel

This video incorporates a wide array of digital animation techniques, including 1.5 minutes of 3D computer graphics produced in five weeks. It runs the gamut from real time character animation, motion capture, particle systems, digital video post-production, and virtual environments.

Contact

Brad deGraf
Colossal Pictures
2800 Third Street
San Francisco, CA 94107
415.550.8772
415.824.0389 fax

Producer

Real World Productions in association with Colossal Pictures

Contributors

Director: Stephen Johnson
Producer: Prudence Fenton
Computer Animation Director: Brad deGraf
Fire, Water and Particle Scenes: Homer & Associates
Computer Animation Producer: Sally Syberg
Computer Animators: Marc Scaparro, Tim Waddy, Greg Maguire
Programmer: Eric Gregory
Creative Consultant: Rebecca Allen
Lip Sync: Rand Wetherwax
Cyberware Scanning: Pierre Haddad, Video System
For Colossal Pictures, Computer Animation Producer: Sally Syberg
Technical Support: Daniel X. Hannah
Digital Art Support: Marilyn Novell. For Homer & Associates
Computer Animation Supervisor: Peter Conn
Computer Animators: Michael Kory, Scott Kilburn
Programmer: John Adamczyk
Production Assistant: Jane Fitzgerald
Motion Capture: Superflo, Umberto Lazzari, Francesco Chiarini
Post Production: Complete Video, London
Misc. Post 3D Animation: Bruce Steele, Complete Video

Hardware

Silicon Graphics, IBM PC

Software

SOFTIMAGE Inc., Digital Arts, deGraf/Associates ALIVE, Homer & Associates Particles

Stereoscopic HDTV Room

Hall A, Anaheim Convention

This is an intimate debut of 3D HDTV at SIGGRAPH. Approximately 35 people at a time can experience several minutes of stereoscopic HDTV animations, which are longer versions of some of the monoscopically projected animations in the electronic theater evening show.

Stripe Box

Simple shapes float in the 3D space created by patterns of stripes, creating a highly dramatic visual effect.

Contact

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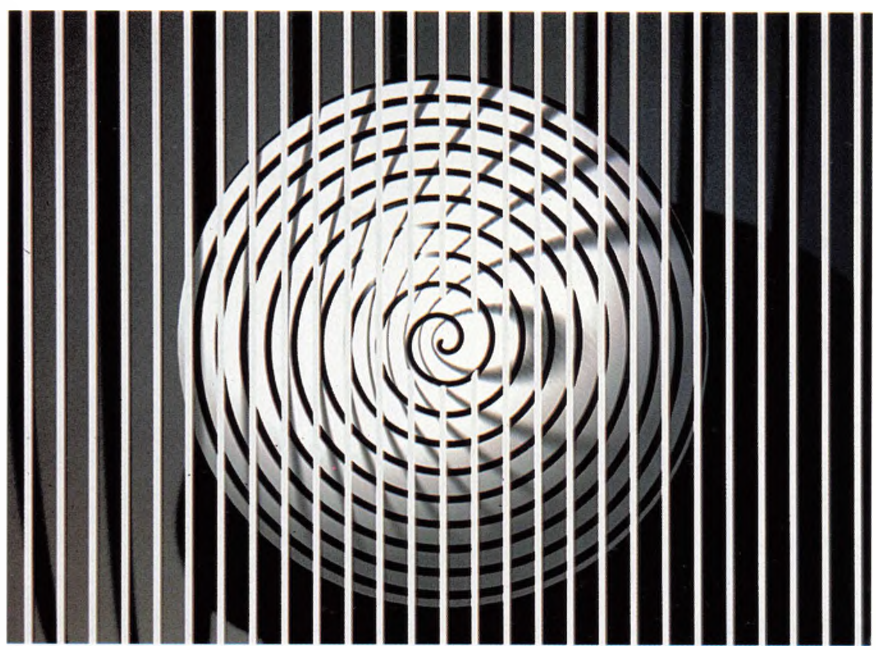
Taiyo Kikaku Co., Ltd.
2-26-3 Nishishimbashi
Minato-ku
Tokyo T105
Japan
03.3436.4540
03.3436.0175 fax

Hardware
Sony News-3870

Software
Original software

Copyright
Kazuma Morino/Taiyo Kikaku Co., Ltd.



Studies for The Garden

A film about how I made my latest computer animation, titled "The Garden," and how my water-drop perspective system works.

Contact
Tamas Waliczky
ZKM, Institut Fur Bildmedien
Gartenstrasse 71
Karlsruhe 1
Germany 76135
49.721.9340.405
49.721.9340.49 fax

Producer
Wallada Bioscop Ltd.

Contributors
Annamarie Waliczky, Anna Szepesi, Gyorgy Palos, Tibor Szemzö, Imre Kovats, Zoltan Csaszar, Pierre Dinouard, Thomas Krol

Sponsor
Zentrum Fur Kunst Medientechnologie, CIRAD Laboratoire du Modelisation, Montpeliar

Hardware
486 PC, Silicon Graphics VGX, Sony LVR 6000

Software
In-house software

"Thumbelina" Computer Animation Excerpts

Computer-generated scenes comprised of 3D sets, multi-plane, and 2D elements for this feature film.

Contact
Jan L. Carle
Don Bluth Ireland Ltd.
Phoenix House
Conyngham Road
Dublin 8
Ireland
353.679.5099

Producer
Don Bluth Ireland Ltd.

Contributors
Director of Computer Animation & Digital Imagery: Jan L. Carle
Senior Computer Animator: Greg Maguire
Computer Animator: Tom Miller
Technical Director: Christine Zing Chang

Hardware
Silicon Graphics Iris 4D/35, Solitaire Film Recorder

Software
SOFTIMAGE Inc., Don Bluth proprietary

Tyrannosaurus Rex: Reconstructed

After intensive study and research into dinosaur structure and movement, director Norieki Kaneko has created a surrealistic computer graphic image of a running Tyrannosaur. After fully developing the skeletal structure, the outer surface, including flesh and skin, was built around the bones. Based on this, one is able to observe not only the movement of the bone parts but the accurate movement of the muscles.

Contact

Noriaki Kaneko
HD/CG New York
34-12 36th St.
Astoria, NY 11106
718.361.1118
718.361.1758 fax

Producer

HD/CG New York

Contributors

Noriaki Kaneko, Motonori Sakakibara, Carol Hayden, Hiroyuki Miyoshi, Rob Zimmelman, Akira Miyoshi

Hardware

Silicon Graphics Power Series, Shima Seiki

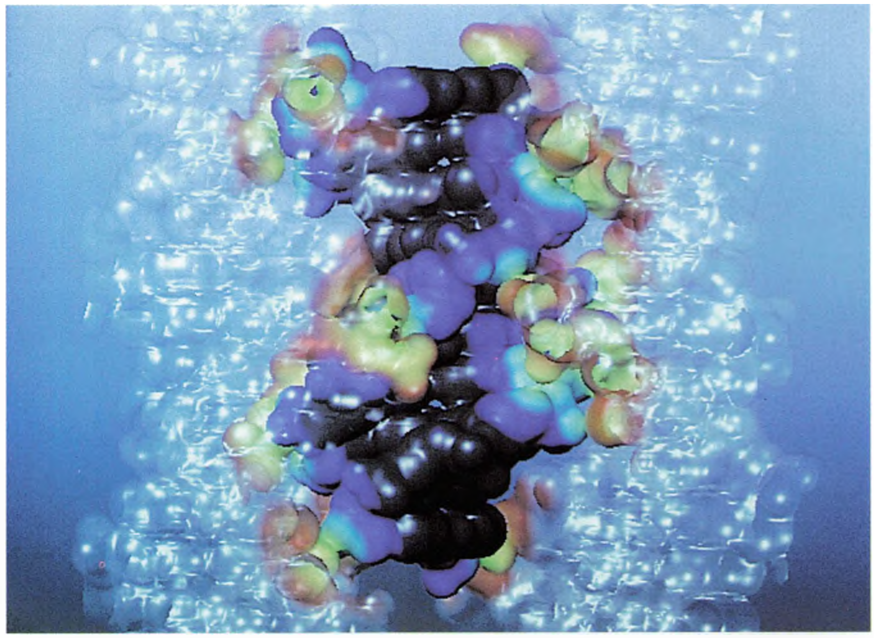
Software

Meta Editor, Aleph, Kinetica, Hi Trace

Copyright

Visualizing DNA Crystal Packing Interactions

Volume rendering and texture mapping are used to represent the molecular surface of crystalline DNA, and to show the location and proximity of crystal packing interactions.



Contact
Teresa Larsen
The Scripps Research Institute
10666 N. Torrey Pines Road
La Jolla, CA 92037
619.554.2526
619.554.6860 fax
larsen@scripps.edu

Producer
Teresa Larsen

Contributors
The Scripps Research Institute: David S. Goodsell, Arthur J. Olson
San Diego Supercomputer Center Advanced Scientific Visualization Laboratory: Richard E. Dickerson, Jordi R. Quintana, Kevin Landel, Rama Ramachandran, Harry Ammons, Jonathan Jenkins, Paul Lackey

Sponsors
Dickerson, UCLA; Olson, TSRI; Landel, SDSC

Hardware
Convex C240

Software
RMSVolume by D. S. Goodsell, The Scripps Research Institute

Walking Figure in Sight

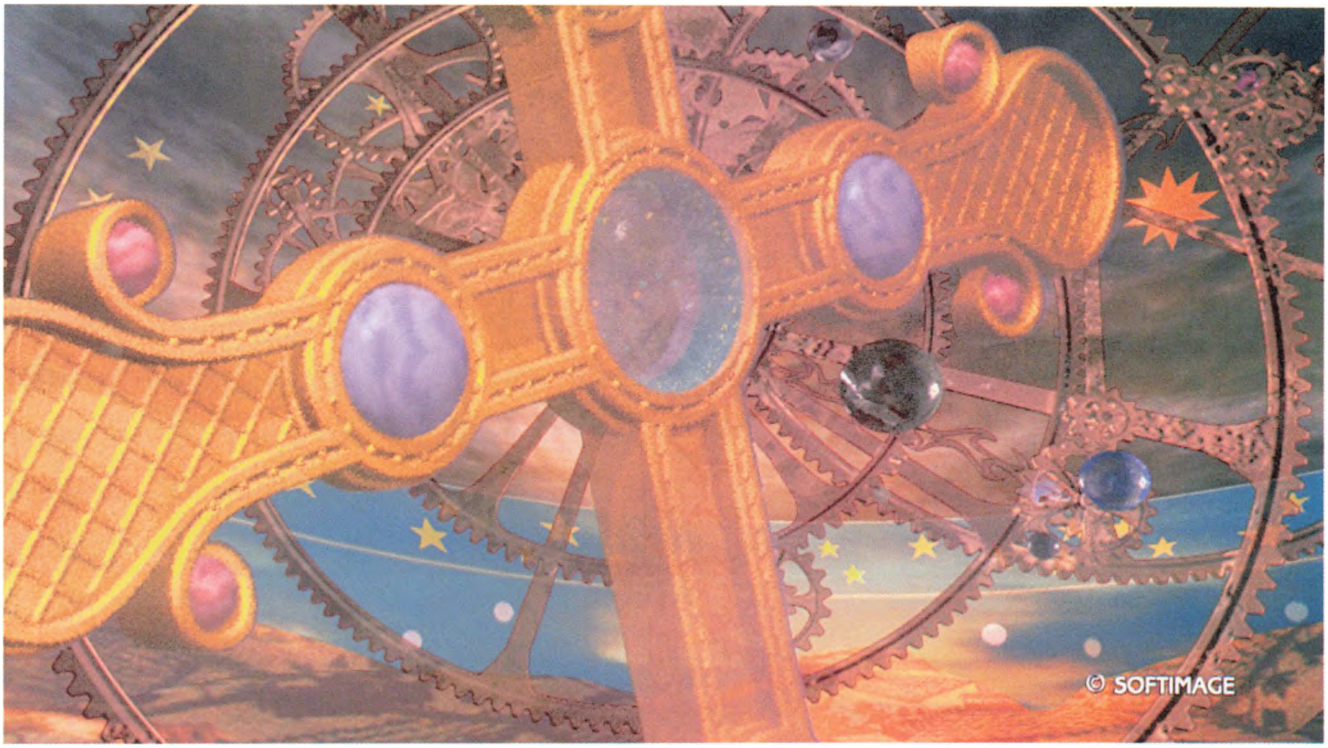
Yuji Furuta
Taiyo Kikaku Corporation
2-26-3, Nishishinbashi
Minato-ku
Tokyo 105
Japan
03.3436.4540
03.3436.0175 fax

Producer
Yuji Furuta

Hardware
NEWS 3870, Symbolics

Software
In house, Symbolics

Copyright
Yuji Furuta



West of Eden (Excerpt)

A poetic interpretation of how the Western world view has evolved. Excerpts from an eight-minute film.

Contact

Visual Research
SOFTIMAGE Inc.
3510, boul. St-Laurent
Suite 500
Montreal, Quebec H2X 2V2
Canada
514.845.1636
514.845.5676 fax

Producers

Pierre Gendron, Bloom Films; Daniel Langlois, SOFTIMAGE Inc.

Contributors

Direction, Visuals: Daniel Langlois
Direction, Music: Yves Laferriere
Art Direction: Char Davies
Animation: Georges Mauro
Film Recording: Marc Doyon, Sylvain Labrosse

Sponsors

Telefilm Canada, SOGIC, SOFTIMAGE Inc.

Hardware

Silicon Graphics

Software

SOFTIMAGE

Copyright

The World of Materials (Excerpt)

This sequence is part of a 13-minute computer-generated 70mm 3D film, "The World of Materials." Beginning with a particle collision, the sequence symbolizes the creation of our natural habitat. The tiger, symbol of Korea, is intrigued by the ball and leads the audience to learn about the importance of materials, today and in the future.

Contact
Anna-Karin Quinto
Ex Machina
22 Rue Hegesippe Moreau
Paris 75018 France
42.93.2627
42.93.5344 fax

Producer
Client: Pohang Iron and Steel
Produced by: ExMachina (Paris)

Contributors
Directed by: Jerzy Kular
Animation: Philippe Gluckman
Textures: Marc Bellan
Database: Cecile Picard, Franck Schmidt
Software Development: APPIA ExMachina (Paris) by Phil Brock, Madeline Jean, assisted by Steve Braggs

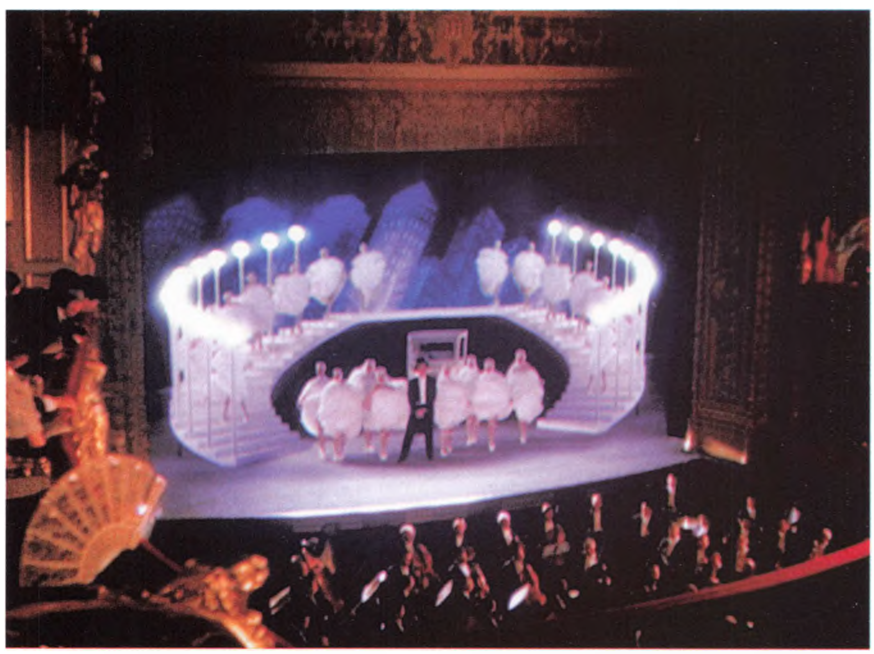
Hardware
Silicon Graphics

Software
APPIA from ExMachina, Explore of TDI

Copyright

Young Indiana Jones and the Scandal of 1920

Composite effects from the "Young Indiana Jones Chronicles," New York Movie of the Week, illustrating digital-matte artistry and digital compositing.



Contact
Andi Merrim
Industrial Light & Magic
P.O. Box 2459
San Rafael, CA 94912
415.258.2276
415.456.0833 fax

Producer
Lucasfilm

Contributors
Visual Effects Supervisor: Allison Smith-Murphy
Digital Matte Paintings: Industrial Light & Magic
Digital Matte Production Manager: Susan Colletta-Busalacchi
Digital Matte Artists: Yusei Uesugi, Paul Huston, Eric Chauvin
Post Production Facility: Western Images
Technical Director: Orin Green
Digital Effects Artists: Mark Holmes, Jimi Simmons, Jonathan Keeton, Christopher Wargin, Joe Brattesani
Editor: Alan Chimenti
Assistant Editor: Greg Gilmore

Hardware
Macintosh, Quantel Paintbox, Harry, Encore

Software
Photoshop, proprietary software

Copyright

ABCSystem

Automated Building Construction System (ABCSystem) developed by OBAYASHI Corporation includes a new concept for building construction in which several kinds of robots work harmoniously to complete a task. Visual aids required for interested parties to understand ABCSystem. Computer graphics animation is the most appropriate task for this requirement.

Contact
Hiroyuki Ota
Center of Information Systems
OBAYASHI Corporation
2-3, Kanda Tsukasa-cho
Chiyoda-ku
Tokyo 101
Japan
81.3.2392.1111 (ex 7084)
81.3.3219.9361 fax

Producers
Executive Producers: Teruo Okawa, Kiyoshi Izumi (OBAYASHI Corporation)
Producers: Osamu Uchida (Iwanami Production, Inc.), Tetsuro Mori, Katsuyoshi Higashiyama, Isao Watanabe (OBAYASHI Corporation)

Contributors
Architectural Design: Architectural and Engineering Division, OBAYASHI Corporation
Technical Development for ABCSystem: Project Team for ABCSystem, OBAYASHI Corporation
Director: Kei Horikoshi
Camera: Masayoshi Kato
Director: Hiroyuki Ota
Technical Director: Toshio Nagafune
Production Support: Mikie Takekoshi
CG Designers: Akiko Nagase, Chika Hoshi, Tomoko Hamada, Hiromitsu Kaneko, Hiroyuki Nakane, Kazuya Kondo

Special Thanks
NIHON I-TEC K.K., Yokogawa-Hewlett- Packard, Ltd.

Sponsor
OBAYASHI Corporation

Hardware
InterAct3260, InterPro6280, HP9000/380VRX, IRIS420VGX, etc.

Software
MicroStation, VPX, EXPLORE, proprietary

Copyright
OBAYASHI Corporation

Advanced Visualization for Transportation Engineering

4D Imaging is the visualization department of Parsons, Brinckerhoff, Quade and Douglas, the top transportation engineering company in the U.S. These are some samples of their work.

Contact
Ken Seaverns
4D Imaging
1660 Lincoln Street
Suite 2000
Denver, CO 80264
303.832.9097
303.832.9095 fax

Producer
Ken Seaverns, Doug Eberhard

Contributors
John Barden, Paul Newton, Rob MacLeod, Rod MacLeod, James Steele

Hardware
486 PC

Software
Topas, Tips

Copyright
Parsons, Brinckerhoff/4D Imaging

The Adventures of Korky, the Corkscrew

The Adventures of Korky is a character animation about a determined corkscrew (Korky) who wants to do his job right and by himself. The plot puts the character through different challenges until he finally gets an unexpected reward.

Contact
Carlos Saldanha
School of Visual Arts
115 W. 11th Street
Apt. 4R
New York, NY 10011
212.633.1387

Producer
Carlos Saldanha

Hardware
Silicon Graphics

Software
Alias 3.1.1

Air on the Dirac Strings

A quantum mechanical system involving electrons is not brought back into exact coincidence with itself after it is rotated 360 degrees, while it is brought back into coincidence with itself after it is rotated 720 degrees. How can we visualize such a situation?

Contact
Dan Sandin
Electronic Visualization Laboratory (M/C 154)
University of Illinois at Chicago
851 S. Morgan, Room 1120 SEO
Chicago, IL 60607-7053
312.996.3002
312.413.7585 fax

Producer
Electronic Visualization Laboratory, University of Illinois at Chicago

Contributors
George Francis, Mathematics Department, University of Illinois at Urbana-Champaign (UIUC)
Louis Kauffman, Mathematics Department, University of Illinois at Chicago (UIC)
Daniel Sandin, Electronic Visualization Laboratory and Art Department, University of Illinois at Chicago
Computer graphics: Chris Hartman, UIUC Mathematics Department, John Hart, Washington State University EECS Department
Dance: Jan Heyn-Cubacub
Music: Sumit Das, UIC Electronic Visualization Laboratory
Video: Dana Plepys, UIC Electronic Visualization Laboratory
Produced at: Electronic Visualization Laboratory, University of Illinois at Chicago

Special Thanks
Thomas A. DeFanti, Electronic Visualization Laboratory, UIC
Larry Smarr, National Center for Supercomputing Applications, UIUC
Donna Cox, Renaissance Experimental Laboratory, UIUC
Randy Hudson, Alan Millman, Maggie Rawlings, Electronic Visualization Laboratory, UIC
Tony Baylis, Bob Patterson
National Center for Supercomputing Applications, UIUC

Hardware
Silicon Graphics, AT&T Pixel Machine

Software
C, GL, Raylib

Copyright
1993 Sandin, Kauffman, Francis

air, water part 2

air, water part 2 is from a series of animated studies of the elements air and water. These animations are meant to be lyrical and evocative and create a sense of the eternal moment. Physically based modeling and deliberately simple rendering were used to create this work.

Contact
John Tonkin
236A Rundle Street
Adelaide 5000
SA
Australia
618.224.0265
Producer
John Tonkin

Contributors
Animation, Software: John Tonkin
Music: Tony Kastanos

Sponsor
Produced in association with the Australian Film Commission

Hardware
Commodore Amiga

Software
artist's software

Copyright
1993 John Tonkin

The Allegory of the Cave

This is the story of prisoners in a cave who perceive reality as a function of the cave they inhabit. Like all of us, they are attached to their perceptions and difficulty comes when they are faced with the possibility of a new reality.

Contact
Kirk. L. Kelley
Lamb & Company
650 3rd Avenue South, 17th Floor
Minneapolis, MN 55402
612.333.8666
612.333.9173 fax
llb0001@uc.msc.edu

Producer
Kirk L. Kelley

Hardware
Silicon Graphics VGX

Software
SOFTIMAGE Inc., Discreet Logic (Eddie), Wavefront Advanced Paint

Copyright
1991 Kirk L. Kelley

Animated Electronic Wiring Buck

Ford Alpha Simultaneous Engineering proposes to use visualization to troubleshoot engineering databases prior to building a prototype.

Contact
Tom Capizzi
Creative Industries
14661 Rotunda Drive
Dearborn, MI 48120
313.248.2865
313.248.2850 fax

Producer
Tom Capizzi

Contributors
Kevin Redding, John Ferguson

Sponsor
Creative Industries, Ford Motor Company

Hardware
Silicon Graphics

Software
Wavefront, Aries, Creative Industries proprietary

Copyright
Creative Industries, March 1993

Arcelik

Advertising picture about a Turkish company.

Contact
D. Pourcel
Gribouille
5 Boulevard E. Zola
Aix en Provence 13100
France
42.969200
42.969204 fax

Producer
Planete Spot

Hardware
Silicon Graphics

Software
SOFTIMAGE Inc.

The Art of Talking Pictures

This film explores making faces at a camera.

Contact
Peter Carl Litwinowicz
Apple Computer, Inc.
1 Infinite Loop, M.S. 301-3J
Cupertino, CA 95014
408.974.1752
408.862.5520 fax
litwinow@apple.com

Producer
Apple Computer, Inc.

Contributors
Software: Peter Litwinowicz

Hardware
Macintosh, Silicon Graphics Iris

Software
In-house software

Copyright
1993 Apple Computer, Inc.

Barry's Trip

Barry has just arrived in Anaheim for the big SIGGRAPH convention and he's ready for fun.

Contact
Joseph Shingelo
TELEZIGN
460 West 42nd Street
New York, NY 10036
212.564.8888
212.957.0691 fax

Producer
Joseph Shingelo

Contributors
National Sound, Inc.

Hardware
Silicon Graphics, Iris, Indigo R4000 Elan

Software
SOFTIMAGE Inc.

Biomechanics: Dynamics and Playback

In the Barcelona Olympic Games, video images of some trials were recorded, and inverse dynamic analyses were computed using data digitized from those videos. This video provides a short explanation of the process used to produce the final images. The images are playbacks of some trials. They were generated using virtual cameras, and dynamic results are superimposed on them.

Contact
Gorka Alvarez
CEIT (Centro de Estudios e Invest. Tecnicas de Guipuzcoa)
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San Sebastian E-20009
Spain
34.43.212800
34.43.213076 fax

Producers
Gorka Alvarez, Alejandro Garcia-Alonso

Contributors
Pavel Urban, Nicolas Serrano, Javier Garcia de Jalon
Music: Logos (from Geometry), Robert Rich, BMI

Sponsor
International Olympic Committee

Hardware
Silicon Graphics 4D/240 VGX

Software
Peak 5 (from Peak Performance Tech.), COMPAMM-SPORT (C.E.I.T)

Copyright
Public Domain

Brilliant Days

Brilliant Days brings viewers to a space that reflects modern structure and contemporary life in a surreal, ironic way. It is about mass media. It is about electronic civilizations. Most of all, it is about us.

Contact
Sherry Hsieh
Pratt Institute
35-04 28 Street
Astoria, NY 11106
212.239.6767, ext. 164

Producer
Sherry Hsieh

Hardware
Silicon Graphics

Software
Alias 3.1

Bunn Coffeemaker "In the Mood"

Open on a deserted restaurant kitchen, with the sultry tune, "I'm in the Mood for Love" in the background. Mama and Papa coffeemaker approach each other with interest. Kitchen appliances come to life and watch as Mama and Papa get together. Nine brewing cycles later we meet the offspring, the new Bunn Home Brewer.

Contact
Ralph J. Guggenheim
Pixar
1001 W. Cutting Boulevard
Richmond, CA 94804
510.215.3413
510.236.0388 fax
ralph@pixar.com

Producer
Karen Robert Jackson

Contributors
For Pixar: Animation/Art Director: Andrew Stanton
Technical Director: Galyn Susman
Creative Director: John Lasseter
Executive Producer: Ralph Guggenheim
Technical Contributors: Oren Jacob, Rick Sayre, Eliot Smyrl, Yael Milo
Animators: Andrew Schmidt, Pete Doctor, Jeff Pidgeon, Richard Quade
Layout: Craig Good
Output: Oren Jacob, Don Conway
Sound Effects/Music: John Hammers, Machine Head-Venice
Video Post: Tim Schaller, Pacific Video Resources. For McConnaughy Stein Schmidt Brown
Producer: Jon Wyville
Art Director: Tom McConnaughy
Copywriter: Jim Schmidt
Client Rep: Hy Bunn, President and CEO.

Hardware
Silicon Graphics workstations/Abekas A60

Software
Pixar menv modeling and animation software

Copyright
1993 Pixar

Carpet Stains

Carpet Stains was created by a diverse group of students at the Art Center College of Design. The mission was to create a significant computer animation in narrative form that provided a relevant message about the students' concerns for the environment.

Contact
Jennifer Steinkamp
Art Center College of Design
1700 Lida Street
Pasadena, CA 91103
818.584.5102
818.795.0819 fax

Producer
Paul Blinderman, Jennifer Steinkamp

Contributors
Max Chapman, Ian Hayden, Rom Impas, Eugene Jeong

Sponsor
Art Center College of Design, Digital Magic, Tektronix, Hollywood Digital

Hardware
Silicon Graphics, Apple

Software
Alias, Adobe, Xaos

Copyright
1993 Art Center College of Design

Center for Ecology Research and Training Flyby

This video is an architectural fly-by of the U.S. Environmental Protection Agency's proposed Center for Ecology Research and Training in Bay City, MI. The animation is a collaboration between the North Carolina Supercomputing Center and the U.S. Environmental Protection Agency.

Contact
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Martin Marietta Technical Services
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Producer
U.S. Environmental Protection Agency, North Carolina Supercomputing Center

Contributors
Chris Landreth, North Carolina Supercomputing Center
Acha Debela, North Carolina Central University
Theresa Rhyne, Martin Marietta Technical Services
Walter Shackelford, U.S. Environmental Protection Agency
Ed Williams, Microelectronics Center of North Carolina
Odell Associates, Inc.
Wavefront Advanced Visualizer
Silicon Graphics VGXT.

Special Thanks
Martin Marietta Technical Services, Microelectronics Center of North Carolina, North Carolina Supercomputing Center, Unisys Corporation

Sponsor
U.S. Environmental Protection Agency, North Carolina Supercomputing Center

Hardware
Silicon Graphics VGXT

Software
Wavefront Ad

Copyright
Public Domain

Climatology of Global Stratospheric Ozone (1979-1991)

A strategy for qualitative presentation of the long-term evolution of global atmospheric phenomena is applied to 13 years of daily spacecraft observations of the Earth's ozone layer. The resulting animation illustrates the dynamics of stratospheric ozone and the morphology of the seasonal Antarctic ozone depletion.

Contact
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lloyd@watson.ibm.comProducer
Lloyd A. Treinish

Contributors
Lloyd A. Treinish, IBM T. J. Watson Research Center

Hardware
IBM POWER Visualization System

Software
IBM Visualization Data Explorer

Copyright
IBM 1993. All rights reserved.

Cluny

The Cluny abbey was the most important building erected to the glory of God during the Middle Ages. It was destroyed after the French Revoltion, and we have "rebuilt" it.

Contact
Jean-Pierre Brindeau
IBM France
Tour Septentrion
La Defense 4
20, av. Andre Prothin
Paris La Defense 92081
France
011.331.4905.5581
011.331.4778.8007

Producer
ARC

Contributors
IBM France

Hardware
IBM RISC System/6000

Software
TD Image

Colorado Interstate Gas Campaign

In these four spots, natural gas as an efficient fuel becomes fun and informative.

Contact
Mike Ludlam
Windstar Studios
525 Communications Circle
Colorado Springs, CO 80905
719.635.0422
719.635.7119 fax

Producer
George Olsen, Praco Advertising

Contributors
Animation, Modeling, Programming: Mike Ludlam, Windstar Studios
Video Editing: Ken Koenig, Windstar Studios
Music: John Standish, City Tracks and Patterson, Walz and Fox

Hardware
Silicon Graphics, 4D70

Software
Wavefront, Windstar proprietary modeling, paint, and motion software

Computer Puppetry Demo Reel

Extracts from various Medialab productions using computer puppetry. All motion was generated in real time by puppeteers as shown in the video. Images were recorded in real time from the Silicon Graphics 480/VGX as the puppeteers performed, or rendered off line from recordings of puppeteer motions.

Contact
Jean-Frederic Samie
Medialab
104 Av. du President Kennedy
Paris 70016
France
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011.331.4430.4460 fax
sturman@dmi.ens.fr

Producer
Medialab

Sponsor
Canal+, Medialab

Hardware
Silicon Graphics 480/VGX

Software
Modeling: Alias, TDI
Animation: custom
Rendering: Silicon Graphics/VGX or TDI

Copyright
1993 Medialab

Countdown Contraption

This Countdown Contraption was inspired by Rube Goldberg and was designed as a fun leader for promotional demo-reels.

Contact
Bud Myrick
Henninger Video, Inc.
2601-A Wilson Boulevard
Arlington, VA 22201
703.243.3444
703.243.5697 fax

Producer
Bud Myrick

Contributors
Designer/Animator: Bud Myrick
Technical Animator: Jeff Henninger
Audio: Gary Jaye

Hardware
Silicon Graphics Iris 4D/35TG w/ Video Framer, Abeas A-60

Software
Vertigo Technologies Software for modeling, Wavefront TAV, Animation Rendering

Copyright
1992 Henninger Video, Inc.

Coup de Theâtre

As the curtain rises in the middle of the scene, different actors, fixed on a pedestal, successively animate.

Contact
Pascale Pasdeloup, Pascale Cazenave
AII/ ENSAD
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Paris 75005
France
43.26.36.35
40.46.81.54 fax

Producer
AII/ENSAD

Contributors
Pascale Pasdeloup, Pascale Cazenave

Hardware
Silicon Graphics Iris

Software
Explore (TDI)

Copyright
1992 Aii-ENSAD

Cybercrazed

Looking for some action, like a strange attraction, take me to your leader, find me a mind reader, see what's in the future, changes in the culture, life is an extension of the fourth dimension, cell rejuvenation, space migration, exopsychology, nanotechnology, megamulti-media, psychedelopedia, consciousness raised, cybercrazed.

Contact
Otto von Ruggins
Virtual Reality
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Brooklyn, NY 11204
718.259.8495
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Producer
Otto von Ruggins

Contributors
Vocalist: Marilyn Boteler

Hardware
Amigo 2000, Video Toaster, Kitchen Sync, DCTV, Sony EVO 9700

Software
Cinemorph, Vistapro, Fractalpro, Mathvision, Mandelmountains, DPaint

Copyright
1992

De Karnak A Louqsor: La Machine a Remonter le Temps

Simulation of the temples of Karnak at Louqsor.

Contact
Anna-Karin Quinto
EX Machina
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Paris, France 75018
42.93.26.27
42.93.53.44 fax

Producer
Annick Ouvrard

Contributors
Jacques Barsac, Pascal Vuong
Music: Jean Mallet

Hardware
Silicon Graphics

Software
TDI Explore, In-house software

Dimension "Intro"

Dimension is a cultural TV program that shows documentaries from all over the world on topics from science to ancient civilizations. The weekly show airs on Venezuelan television and is sponsored by Maraven, one of the local oil companies.

Contact
Daniel Benaim
Canal Uno Producciones
Av. principal Boleita Norte
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Caracas
Miranda
Venezuela
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582.238.5161 fax

Producer
Canal Uno Producciones

Contributors
Executive Producer: Daniel Benaim
Creative and Art Director: Teddy Thomas
Design: Marcelo Avila
Animation: Armando Aguirre, Daniel Perez, Alexis Salinas
Paint, Rotoscoping: Daniel Crespo

Sponsor
Maraven

Hardware
Silicon Graphics, Composium D F/X

Software
SOFTIMAGE Inc., Composium D F/X

The Donor Party

This documentary report examines the obstacles at the cutting edge of medical technology before the development of power tools.

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Apple Computer, Inc.
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Producer
Apple Computer

Contributors
Director, Animator: Laurence Arcadias
Title Sequence, Special Effects: Lance Williams
Software, Editing: Peter Litwinowicz
Radiosity Rendering, 3D Motion: Eric Chen
3D Modeling: Steve Rubin
Sound: Richard Millward
Voices: Scott Maddux

Sponsor
Apple Computer/Ministrery des Affaires Etrang res (France)

Hardware
Macintosh, Silicon Graphics Iris

Software
Inkwell (in-house), Photoshop, Protools

Copyright
Laurence Arcadias

Fantastic Dreams

This work explores creative use of 2D image synthesis and 3D rendering techniques. Both music and graphics are produced for this abstract animation art.

Contact
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The Media Studio, Inc.
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Japan 248
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81.467.32.7943 fax

Producer
Masa Inakage

Hardware
Silicon Graphics Personal IRIS 4D/30TG

Software
SESI Prisms, Xaos Tools Pandemonium

Copyright
1993 Masa Inakage

The First Political Speech

The First Political Speech was inspired by "words," charismatic, hypnotic, and sometimes humorous. The animation is our interpretation of a poem by Canadian writer Eli Mendol. The images depict a crowd of technological "robotniks," entranced by a speaker seen only through the motion of its shadow. The movements of the robotniks and the shadow figure were created in real time with the Life Forms system. Life Forms is a 3D movement composition system developed under the direction of Tom Calvert in the Computer Graphics Research Laboratory at Simon Fraser University. Walking sequences were generated automatically with Armin Bruderlin's interactive, procedural program for human locomotion (GAITOR).

Contact
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Producers
Sang Mah, Michaela Zabranska

Contributors
Director, Designer: Michaela Zabranska
Animation: Michaela Zabranska, Pam Forth, Jason Dowdeswell
Shadow Software: Phil Peterson, Troy Brooks, Chris Welman
Hand Software: Chor Guan Teo, Chris Welman
Voice: Michael Johal
Other Contributors: Kurtis Vanel, Sang Mah, Gordon Farrell, Frank Campbell, Armin Bruderlin, Leslie Bishko

Hardware
Silicon Graphics workstations

Software
Life Forms, Gaitor, Vertigo, other lab software

Copyright
Simon Fraser University

From Ruins to Reality

The Dresden Frauenkirche was destroyed by the fire-storm that followed the devastating air raids suffered by Dresden in February 1945. Using the few surviving photographs and drawings, a computer animation has been generated that recreates the original glory of the Frauenkirche;a virtual reality.

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Producer
Luc Genevriez

Contributors
Brian Collins, Dave Williams, Luc Genevriez, Pascal Nicot, Pierrick Brault, Xavier Coyere

Sponsor
IBM Corporation

Hardware
IBM RISC System/6000, IBM POWER Visualization System

Software
Catia, Nefertiti, Data Explorer, TDImage (Major Part)

Copyright
1993 IBM Corporation

Gasping for Air

In a late summer landscape where trees and grass grow amidst industrial decay, a rusted automobile muffler flounders in a stream, struggling for breath while a stainless steel kitchen pot flies playfully through the air. This piece is an expression of the desire for harmony within oneself and one's environment, and the play of tensions between the body and mind.

Contact
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604.291.3045 fax

Producer
Leslie Bishko

Contributors
Animation: Leslie Bishko
Sound: Leslie Bishko, Chris Van Dromme
Modeling: Steve Spencer
Animation: John Donkin, Steve Spencer
Image Processing: Jeff Light, Pete Carswell
Rendering: Scott Dyer
Special Purpose Software: Leslie Bishko, Matthew Lewis, Dave Fracchia, Steve May, John Chadwick
Produced at: The Advanced Computing Center for the Arts and Design, The Ohio State University, and Computer Graphics Research Lab, Centre for Systems Science, Simon Fraser University

Hardware
SPARC IPX, Crimson, Indigo, Personal Iris, Abekas, Macintosh, Amiga

Software
Modeling, animation, rendering, image processing and special purpose: The Advanced Computing Center for the Arts and Design, The Ohio State University
Softvisions; Photoshop; Deluxe Paint III

Copyright
Leslie Bishko

Ginza Walk Through

This is the reappearance of the old restaurant called Shiseido Parlour in Ginza in a fashionable area of Tokyo. Shiseido Parlour was built in 1927 and designed by Kenjiro Maeda, taking the style of art deco, and expressing the atomosphere of the 1920s.

Contact
Michio Iwaki
Shiseido Co., Ltd.
7-5-5 Ginza
Chuo-ku, Tokyo 104-10
Japan
03.3289.0106
03.3289.4308 fax

Producer
Michio Iwaki

Contributors
H. Hayashida, Y. Hamajima (freelance), N. Motoyoshi (freelance), M. Fukui, S. Igarashi, K. BaBa, T. Hashizume

Hardware
Silicon Graphics, HP 700

Software
Personal LINKS, TAV, in-house

Copyright
Shiseido Co., Ltd.

Grateful Dead: Infrared Roses Revisited

This is an entirely computer-animated music video set to a compilation of music from the "Infrared Roses" album. Animators melded 2D and 3D techniques to create amazing imagery that allows the viewer to become immersed in the scene.

Contact
Linda Jones
Xaos
600 Townsend
Suite 271E
San Francisco, CA 94103
415.558.9267
415.558.9160 fax

Producers
Gillian Grisman, Helene Plotkin

Contributors
Director: Justin Kreutzmann
Sound Designer: Bob Bralove
Art Director: Mark Malmberg
Animators: Tony Lupidi, Roberta Brandao, John Chadwick, Henry Preston, Hayden Landis, Ken Pearce, Eric Texier
Graphic Artist: Ric Tringali

Hardware
Silicon Graphics workstations (Personal Iris 4D35)

Software
Xaos proprietary

Copyright
Ice Nine Publicing Company, Inc.

IGI (Intergaractic Interface)

Our IGI is an image for the ride simulator of an eight-seater named "Conceptor," which is open to the public at the Fujita head office in Tokyo. You can experience the process of design production using a computer, through the medium of a designer's consciousness.

Contact
Katsuyuki Sugimura
LINKS Corporation
2-14-1 Higashi-Gotanda
Shinagawa-Ku, Tokyo 141
Japan
813.5420.5310
813.5420.5330 fax

Producer
Katsuyuki Sugimura (LINKS Corporation)

Contributors
Executive Producer: Kimihiro Abe (Fujita Corporation)
Co-Producer: Kuniyasu Baba (Kunix Corporation)
In association with: Masaya Fukuyama (Imagica Corporation)
Production: LINKS Corporation
Director: Takahiko Akiyama
Planning: Takahiko Akiyama, Yla Okudaira (Yla-Tech Co., Ltd.), Shin Saito (TAF Co., Ltd.), Hiroyasu Sakaguchi (Imagica Corporation)
CG Designers: Ryuichi Snow, Shoko Kitamura, Kouichi Hirata, Sanae Nakanishi, Mitsunori Kataama, Michiko Kanno, Hiroyuki Seshita, Takahiro Takenaka
CG Software Designers: Kouichi Noguchi, Ken Ohtani, Michiru Tanaka
Production Assistant: Keiichi Abe, Hiroshi Kamohara
CG in association with: Taizi Okuzawa (Buildup Co., Ltd.), Turu Ikeuchi (Buildup Co., Ltd.)
Digital Transfer Operators: Isao Ikawa (Imagica Corporation), Mansanori Nishi (Imagica Corporation)
Photographic Department: Multibox Production, Inc.
Set Coordination: Buildup Co., Ltd
Sound Producer/Music Director: James Shimoji (Mr. Music Inc.)
Sound Mixer: Yoshito Nagashima (Cricket Studio Inc.)
Sound Effects: Rackyo Group, Inc.
Music Composer: James Shimoji, Toshio Nakagawa

Special Thanks
Junya Okabe (Buildup Co., Ltd.) ,Fumihiro Nonomura, Yoshikazu Inui

Sponsor
Fujita Corporation

Hardware
Silicon Graphics Iris 4D, Sony R-NEWS, LINKS-2 (original, custom made)

Software
proprietary

Copyright
1993 Fujita Corporation, Kunix Corporation, LINKS Corporation

The Incredible Crash Dummies

First entirely computer animated show for network television.

Contact
Larry Lamb
Lamb and Company
650 3rd Avenue South, 17th Floor
Minneapolis, MN 55402
612.333.8666
612.333.9173 fax

Producer
Lamb and Company Inc.

Contributors
Director: Mark Mariutto
Producer: Pam Lehn
Executive Producer: Larry Lamb
Director of Color/Light: Doug Kingsbury
Lighting: Keith Cormier, Gayle Ayers
Modeling: Heidi Spaeth, Jim Russell, Milton Rodriguez
Animators: Ron Pitts, Kirk Kelley, John Donkin
Software/Special Effects: Scott Dyer, Eric Flaherty
Lighting/Tech: Dave Novak
Software: Marcia Deitrich, Jeffrey A. Thingvold
Special Effects: Jake Parker
Tech: Bob Born, Scott Gaff
Additional work: Doug Pfeifer, Paul Churchill, Beth Beyer, Kelly McManus, Kirt Moses

Hardware
CGI Computers, Abacus A60, Sony DVR2000

Software
Wavefront, Discreet Logic, and Lamb and Company proprietary

Copyright
1993 Tyco Industries, Inc.

JASON IV Real-Time Visualization

Jason is a remotely operated submersible used by the Woods Hole Oceanographic Institute. A visualization tool was developed to enhance remote research during a recent expedition. Jason's telemetry data was broadcast through the Internet in real time, allowing scientists across the country to observe the exploration in progress.

Contact
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Producer
Dave Pape, NASA/GSFC

Contributors
Chuck Molyneaux (SGI), Ken Stewart, WHOI

Hardware
Silicon Graphics 4D/240 VGX

Software
In-house GL code, Wavefront Modeller

Copyright
Public domain

Journey to Technopia

It's 500 years into the future. A mythical Dorean Overlord and his angry Firedogs come to the utopian star, Technopia to destroy the peaceful way of life there, which is managed by a central Computer Control Center. We, the audience, are taken on a hair-raising tour over Technopia and, through a futuristic process, shrink to molecular size in order to fly through the workings of the Computer Control Center. In the brain of the Computer, we discover and destroy the Overlord's Invaders. Technopia is saved!

Contact
Charlotte Huggins
Boss Film Studios
13335 Maxella Avenue
Marina del Rey, CA 90292
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310.305.8576 fax

knot^4

Computer graphics techniques are applied to the visualization of knotted and unknotted spheres in four dimensions.

Contact
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hanson@cs.indiana.edu

Producer
Andrew J. Hanson

Contributors
Animation/Modeling: Brian Kaplan, Robert Cross, Hui Ma, Lie-Hwang Hwang
Video Production: Eric Ost
Audio Production: Dave Rust

Sponsor
National Science Foundation, Indiana University

Hardware
Silicon Graphics Crimson

Software
Wavefront, proprietary

Copyright
Indiana University

La Goutte

Thirty-second TV commercial for Labatt Breweries' moderation campaign.

Contact
Angus MacKay
DHD PostImage
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Canada
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514.489.0242 fax

Producer
DHD PostImage

Hardware
Silicon Graphics

Software
SOFTIMAGE Inc.

Copyright
Labatt Breweries, DHD Postimage

Merck Corporate ID

Fifteen-second corporate identification for Merck.

Contact
Angus MacKay
DHD PostImage
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Montreal, Quebec H4B 1T8
Canada
514.489.8989
514.489.0242 fax

Producer
DHD PostImage, Lambert Multimedia

Hardware
Silicon Graphics

Software
SOFTIMAGE Inc.

Copyright
Merck, DHD Postimage

Minute Georgienne/ Georgian Minute

This work is inspired by the atmosphere found in Sergei Paradjanov's films. It is meant to be an homage to the Soviet filmmaker who was prevented from directing for more than 15 years. In 1982, he resumed his career and finished three films before dying in 1990. By the end of his life, while still creating colorful movies, he was a sad man, deploring all the lost time.

Contact
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Producer
Visions Infogothiques / Centre J.A. de Deve

Contributors
Alain Mongeau

Hardware
Quadra 700, Raster OPSU Colorboard 364

Software
Macromind Director

Moonwalk

Three-dimensional character animation of the Moonwalk.

Contact
Joe Huggins
Imagic, Inc.
1570 Northside Drive, Suite 240
Atlanta, GA 30318
404.355.0755
404.350.0302 fax

Producer/Art Director
Joe Huggins

Contributors
Animator and Computer Artist: Darlene Hadrika
Music: Geary Newman

Sponsor
Imagic, Inc.

Hardware
Silicon Graphics -25G

Software
SOFTIMAGE Inc.

Copyright
Copyright, Imagic, Inc., Atlanta, GA 1993

Mr. Hops

This upbeat interpretation of the brewing process shows Mr. Hops about to take the plunge. Proprietary facial animation and water effects courtesy of MetroLight's crack artist-technicians.

Contact
Dobbie G. Schiff
MetroLight Studios
5724 West 3rd Street, Suite 400
Los Angeles, CA 90036
213.932.0400
213.932.8440 fax

Producer
MetroLight Studios

Contributors
Executive Producer: Dobbie Schiff
Producer: George Merkert
Creative Director/Director: Jon Townley
Animation Director: Steve Martino
Producer: George Merkert
Character Design: Cliff Iwai
Storyboard Artist: Keith Tucker
Production Designer: Michael Scheffe
Lead Technical Director: Jim Hillin
Senior Technical Director for Color and Lighting: Steve Skinner
Senior Technical Director for Color and Lighting and Special Visual Effects: Jerry Weil
Technical Directors for Color and Lighting: Todd Gantzler and Brian Bowman
Technical Director for Character Animation: George Karl
Lip Sync: Greg Ercolano
Environmental Modeling: Mike Merrell
Character Modeling: Eduardo Batres
Software Design: Rob Rosenblum, Cliff Bret:

NBC Sports '92 Barcelona Olympics

The animation for the 1992 Barcelona Olympics incorporates the textrue of ancient times with Barcelona's famous architectural pieces, along with high-tech colors and particle eight beams of memorable Olympic moments. This piece was honored with an Emmy Award.

Contact
Dobbie G. Schiff
MetroLight Studios
5724 West 3rd Street, Suite 400
Los Angeles, CA 90036
213.932.0400
213.932.8440 faxProducer
Jim Wheelock

Contributors
Executive Producers: Terry O'Neill, Dick Ebersol, NBC Sports
Graphics and Music Producer: Bill Bonnell
Coordinating Director: Joe Cortina
Coordinating Producer: David Neal
Design Director: Patrick McDonough, Olympic Graphics
Executive Producer: Dobbie Schiff, MetroLight
Creative Director: Jon Townley
Producer: Jim Wheelock
Project Creative Director: Jeff Doud
Director/Designer: Jim Kealy
Supervising Animator: Mark Lasoff
Animators: Scott Bendis, Steve Blakey, Peter Meechan, John McLaughlin, Johnny Ornelas
Supervising Modeler: Con Pederson
Modelers: Eduardo Batres, Bill Kent
Senior Software Designer: Yun-Chen Sung
Software Designer: Rob Rosenblum
Assistant Producer: Jini Dayaneni
Post-Production Coordinator: Gayle Reznik

Hardware
Solbourne 5-604's, Silicon Graphics 4D Workstation, A60 and A66 Abekas, Celco Film Recorder

Software
MetroLight proprietary

Nestle: Milky Bar

A medieval chess fight between good and evil with 3D animated pieces. SOFTIMAGE was used as a modeling and animation tool, along with RenderMan.

Contact
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Animal Logic Pty Ltd.
123 Willoughby Road
Crows Nest, NSW 2065
Australia
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02.9067433 fax

Producer
Animal Logic—Sydney

Contributors
Art Director: Pedro Marin Guzman
Writer: Mick Sands
Production House: Film Graphics-Sydney
Director: Graeme Burfoot
3D Post-production: Animal Logic-Sydney, Felicity Coonan, Scott Wilcox, Chris Godfrey, Grant Fraser

Hardware
Silicon Graphics

Software
SOFTIMAGE, RenderMan, Quantel Harry

New Life Forms Sighted in Toronto

Given the physical design of a creature, it is possible to automatically discover many of the ways it can move. Some of the interesting gaits discovered for creatures are shown.

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Producer
Michiel van de Panne

Contributors
Eugene Fiume, Michael McCool

Sponsor
Natural Science and Engineering Council of Canada, Information
Technology Research Council of Ontario

Hardware
Silicon Graphics 4D/35

Software
Silicon Graphics GL with extra code for shadow-casting and compositing

Night Moves

Night Moves is a fairy tale about the mysterious events that happened one evening in suburbia. The three central characters are: the moon (a mischievous investigator), a set of plates (whose identity and purpose is unknown), and the dog (whose obsession gets him more than he bargained for).

Contact
Nancy Klimley
School of Visual Arts
205 Yardley Commons
Yardley, PA 19067
215.493.8775

Producer
Nancy Klimley

Hardware
Silicon Graphics, Polhemus

Software
Alias 3.1.1, HyperSpace

Oreo: Word Play

A clean, graphic, and playful pool of spots for a classic product. The challenge was to make the play-on-words humor read using only Oreo cookies and a white background.

Contact
Chris Wallace
TOPIX Computer Graphics and Animation, Inc.
217 Richmond Street West, 2nd floor
Toronto, Ontario M5V 1W2
Canada
416.364.6444
416.364.2539 fax

Producer
Stephen Price

Contributors
Directors: Harold Harris, Ken Nielsen; Animators: Ken Nielsen, Doug Masters

Hardware
Silicon Graphics: Crimson, Indigo, Personal Iris

Software
SOFTIMAGE Inc., Wavefront

Other Worlds

A visually stunning and scientifically accurate short film tour of our solar system produced for the new "Where Next, Columbus?" exhibition at the National Air and Space Museum in Washington, D.C.

Contact

John H. Grower
Santa Barbara Studios
201 N. Salispuedes Street
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Santa Barbara, CA 93103
805.568.1902
805.568.3733 fax

Producers

Patricia Woodside, John Grower, Smithsonian Institution National Air and Space Museum

Contributors

Director: John Grower
Narration: Ricardo Montalban
Science Advisors: Dr. Eric De Jong, Dr. Ted Maxwell
Animation Director: Eric Guaglione
Animators: John Grower, Eric Guaglione, James Hourihan, William Kovacs, Ron Moreland, Mark Wendell
Art Directors: Wayne Kimbell, Bruce Jones, Michael Gibson
Music: Wayne Sabbak, James Wood
Script: Andrew Maclear
Planetary images provided by: Jet Propulsion Laboratory, NASA's Solar System Visualization Team, NASA's Center for Earth and Planetary Studies, USGS Astrogeology Branch
Wayne Lytle, Cornell Theory Center

Sponsor

IBM Corporation, Wavefront Technologies, Inc., NASA/Solar System Visualization Project, Digital Magic Inc., Sound Advice, United Airlines, Inc.

Hardware

IBM RS6000, Silicon Graphics Indigo Elan, Apple Quadra 950

Software

Wavefront TAV 3.0, Video Composer, Dynamation, Photoshop

Copyright

Power of Dreams

The Power of Dreams tells a visual and musical story of conflict between good and evil, dreams vs. an existence of nothingness.

Contact

Dave Kaul
30 Simpaug Turnpike
Redding, CT 06895
203.938.2236

Producer

Dave Kaul

Contributors

Music: Jordan Rothstein

Hardware

Amiga 3000 14 Mbytes, Editing Equipment

Software

Imagine Rendering System

Reconstruction and Visualization of a Human Embryo Heart

Shows techniques for reconstructing and visualizing volumetric biomedical data obtained from serial sections. A heart of a five to six-week old embyro is reconstructed, using a digital blink comparator for section registration, and snakes, or interactive deformable contours, for segmentation. The resulting volume is rendred with a parallel volume ray-caster.

Contact

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Digital Equipment Corporation
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Producer

Kenneth Beckman

Contributors

William Hsu, Ingrid Carlbom, Demetri Terzopoulos, Michael Doyle
Data courtesy of Adrianne Noe, National Museum of Health and Science

Hardware

DECstation 5000, a DECmpp/12000/Sx Model 100

Software

In-house

Copyright

ROBERT MALLARY: Pioneer in Computer Art

ROBERT MALLARY: Pioneer in Computer Art traces the artist's career from his early interest in art and technology in the 1940's through his pioneering work with mainframe computers, vector graphics, and computer sculpture in the '60s and early '70s to his current collage work using a personal computer system. The tape explores Mallary's concept of a "systems" approach to art in which he integrates the physical process of assemblage with the electronic process of computer graphics.

Contact

Copper Giloth
University of Massachusetts
Department of Art
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Producers

Executive Producer: Copper Giloth
Producer and Director: Justin P. West

Contributors

Assistant Producer: Serge Vladimiroff
Narrator: Tom Cramer
Music: Serge Vladimiroff
Videography and Editing: Justin P. West
Post Production Facilities: The Electronic Visualization Lab University of Illinois at Chicago
Technical Assistance: Gary Lindahl, Dana Plepys
Computer Animation Design and Direction: Copper Giloth
Alias 3D Animation: Eric A. Furie, Laura Scholl, Ioannis Christos Yessios
Alias 3D Models: Laura Scholl
Digital Effects: Greg Huber and John Truckenbrod at Skyview Film and Video
Steadicam: Charles Papert
Technical Support: The University of Massachusetts at Amherst, ICGL at Princeton University, and Smith College
Credits: Andy Reich
We would like to thank the following people for allowing us to interview them about the work of Robert Mallary: Jeff Bangert, Colette Bangert, Hilton Abbott, Ruth Leavitt, Robert Russett, Vibeke Sorensen, Patric Prince, Lee Hall, and Roger Malina. A production of Fine Arts Video in Northampton Massachusetts. This project was funded through a SIGGRAPH Special Projects Grant.

Special Thanks

We would like to thank the following people for their help: Kirk Alexander, David Backer, Ken Bradt, Michael Cox, Stuart Cudlitz, Tom Defanti, Frances Giloth, Paul Giloth, Beryl Gilothwest, Sharon Harper, Jeff Heath, Marion Judd, Cynthia Neal, Mary OUNeil, Morris Partee, Lynn Pocock-Williams, Mirko Popadic, Joel Saxe, Jane Veeder, and Dan Zeller.

Copyright

Robo Jr.

This 3D animation tells the humorous story of a robot whose short pit-stop on Earth turns into an unexpected adventure when he leaves his son aboard their parked flying saucer.

Contact

Dale K. Myers
Microtech Graphics & Animation, Inc.
9602 Hartel
Livonia, MI 48150
313.525.3203

Producer

Dale K. Myers

Contributors

Original Music Score by Martin Liebman
Particle Effects by Jon Tindall.

Hardware

Amiga 2000, Video Toaster, 040/28 16MB RAM

Software

Lightwave 3D, Lightwave Modeler, VistaPro, DPIV

Copyright

Ruby's Dream

Ruby's Dream is a parody of Red's Dream. Ruby is a pizza cutter who dreams of someday happily slicing again . . . since most people order out for pre-cut pizza nowadays. Ruby livesin a residential kitchen.

Contact

Enrico Leoni
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SAS Campus Drive
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919.677.8000, ext. 7446
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enrico@unx.sas.com

Producer
Enrico Leoni

Hardware
Silicon Graphics Crimson Ellan

Software
SAS/NVISION

Sci-Fi Channel Open: "Big Bang"

Xaos created the I.D. and opening for the Sci-Fi Channel, which was launched by the USA Network in September. The 45-second piece involves complex integration and special effects. Xaos coordinated the talents of several additional facilities that contributed to this multimedia job.

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Linda Jones
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Suite 271E
San Francisco, CA 94103
415.558.9267
415.558.9160 fax

Producer
Sci-Fi Channel

Contributors
Art Director: Mark Malmberg
Production Manager: Eric Texier
Animators: Amelia Chenoweth, Laurent Huguemiot, Andrea Losch, Tony Lupidi, Henry Preston
Graphic Designer: Ric Tringali
Executive Producer: Helene Plotkin
Designer/Director: R. Scott Miller

Hardware
Silicon Graphics workstations (Personal Iris 4D35, Indigo)

Software
Xaos proprietary, SOFTIMAGE Inc.

Copyright
Sci-Fi Channel

Scottish Road Safety

An example of blending 3D animation with live action, with a good use of texture mapping.

Contact
Christian Hogue
Rushes
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United Kingdom
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071.734.2519 fax

Producer
Park Village Productions

Contributors
Verdi Sevenhuysen—Rushes 3D

Hardware
Silicon Graphics 4D25, 4D35, Indigo X524 4000

Software
SOFTIMAGE Inc.

Sendai Castle

The Sendai Castle was built by Masamune Date, a famous daimyo in the early 17th century, but nothing remains today. The recent computer graphics technology has made it possible, based on the historical record, to picture the castle buildings and interior paintings as they were.

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Yoshiyuki Hamano
CAD Center Corporation
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81.3.3470.8701
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Producer
Yoshiyuki Hamano, CAD Center Corporation

Contributors
Nigou-Sei Architect & Associate Office, Day Plus, Inc., Gizmo, Inc., Chishaku-in, Daigo-ji Shingen Mission, Daikaku-ji, Hayashibara Museum of Art, Imperial Household, Juko-in, Kennin-ji, Matsushima-cho, Nagoya Castle, Ohsaki Hachiman-jinja, Onjo-ji, Takumi Satoh, Zuigan-ji, Sendai City Museum, Tokyo National Museum, Tokyo National University of Fine Arts and Music

Sponsor
Miyagiken Gokoku-Shrine

Hardware
Silicon Graphics Crimson R.E. (Animation), VAX (Modeling)

Software
QuBISM (Animation), GDS/SVS (Modeling)

Copyright
CAD Center Corporation

The Silver Surfer

A mysterious "blip" headed toward Earth is discovered by NASA technicians. Simultaneously, a small boy is being chased by three bullies. As the "blip" disappears from the monitors at NASA, a strange space traveler appears and saves the young boy, leaving him with a special gift.

Contact
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Producers
Erik Fleming, Robert Letterman, Steven Robiner

Contributors
Director: Erik Fleming
Director of Computer Animation: Robert Letterman
Visual Effects Supervisor: Steven Robiner
Animation and Rendering Software donated by: SOFTIMAGE Inc.
Terry Edwards, Tim Horne, David Morin, Alex Urrutia, Gary Siela, Mark Schemm
Rendered on a Crimson / Reality Engine donated by Silicon Graphics Incorporated
Director of Photography: Jeff Eastin
Editor: Duane Tudahl
Music Composed by: Tom Hiel
Sound Mixer: Charlie Clouser
1st Camera Assistant: John Leonetti
Line Producer: Brandt Blanken
Associate Producer: Kevin Ackerman
Art Director: Denise Fedorchuk
Sound: Ken Olsen, David Kilmer
Special Software Including "Twisty Morph": Richard Addison
Advanced Graphics Software: Shahril Ibrahim
Chroma-Key Software: Matthew Plec
Additional Animation: J.J. Franzen
Special Imaging Software: Bill Spitzak
Particle System Effects: Susan L. Oslin, University of Illinois, Chicago
Title Design: Melinda Harrold
Titles, Opticals: Mar Elepaño, Sreescanda, Mike van der Veer
Model Makers: Steve Controneo, Ron Pardini
Story Boards: Larry Detwiler
Production Assistants: David de Vos, Dan Murray, Jason Fijal

Cast
Boy: Patch Kelly
Big Bully: David Wright
Bully with Shades: Lee Troutman
Plain Bully: Reed Troutman
Einstein: Merrill Ward
Norm: Steve Devorkin
NASA Staff: Gary Gelt, Kaye Kittrell, Richard Weinberg, John Gerken

Special Thanks
Marvel Entertainment Group, Inc.
USC School of Cinema
Panavision
Kodak
Sony
TRM Negative Cutting
Alias Research
CFI
Earth Imaging Santa Monica
Public Works
Silicon Graphics
Constantin Film Development Inc.
Chandler Group
VDI
Superior Film Service
Viewpoint
Management Graphics
Polhemus
Panavision New Filmmaker Program
Deluxe
Computer Animation Laboratory at the USC School of Cinema-Television
Richard Weinberg, USC Faculty Advisor

Hardware
Silicon Graphics 310VGX, Crimson/Reality Engine

Software
SOFTIMAGE Inc., USC proprietary software

Copyright
University of Southern California
Silver Surfer character: Marvel Entertainment Group, Inc.

Sintu

Sintu is about dance, movement, lust, and power. It is also about rhythm, color, form, and pleasure.

Contact
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Producer
Elena Popa

Contributors
Third Eye

Sponsor
Swinburne Institute of Technology

Hardware
Macintosh II FX, Video Spigot Card

Software
Quicktime, Adobe Photoshop 2.0, Macromind Director 3.1

Copyright
Swinburne Institute of Technology

Smart Drive

Animation produced for Fisher and Paykel, a New Zealand manufacturer of White Ware, to launch and promote their new washing machine technology called Smart Drive.

Contact
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Producer
Power and Vision

Contributors
Director/Animator: Chris Barrett
Production Company: Power & Vision, Ltd.
Client: Fisher & Paykel, Ltd.
Production: Nancy Kresse, Bill Veal
Modellers: Bill Rattenbury, Simon Ferneyhough
Animation Programmer: Chris Barrett
AutoLisp Programmer: Stewart Lee
Music: Gustav Mahler, Symphony #5, Adagietto, New Philharmonia, Sir John Barbirolli

Hardware
486 PC's, Silicon Graphics 4D/20

Software
AutoCad R10, Autoshade, RenderMan, In-house animation software

Copyright
Power and Vision Ltd. 1993

Sony "Bajo"

The cassette and the tape were created and animated using a photo-realism technique with SOFTIMAGE Inc. software. The tape was rendered twice: one with "Motion Blur," and the other one using standard rendering processes, so more vibrance can be seen. All of the shadows and effects were done in a DI post-production room.

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Producer
Cinemakit

Contributors
Teddy Thomas, Daniel Perez, Armando Aguirre, Daniel Crespo

Sponsor
Cinemakit, JMC Cretividad Orienta, Sony de Venezuela

Hardware
Silicon Graphics, Composium D F/X

Software
SOFTIMAGE Inc., Composium D F/X

Stabbur Makrell

Contact
Charlie Fremantle
CAL Ltd.
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Producers
Roger Guyett, Sam Richards, Kevin McGouan, Andy Breun

Contributors
Director: Trond Berg-Nilssen
Agency: Impact (Oslo)
Music: Trond Bjerknes, Vmp Oslo

Hardware
Silicon Graphics

Software
Wavefront, in house proprietary

StarQuest Adventure

StarQuest is a four-minute Omnimax motion-based ride film for the 1993 Korean World Expo, Taejon, Korea, to be shown in the Samsung Pavilion.

Contact
Dobbie G. Schiff
MetroLight Studios
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213.932.8440 fax

Producer
MetroLight Studios

Contributors
Produced by: MetroLight Studios for Landmark Entertainment
Executive VP in Charge of Production: Dobbie G. Schiff
CGI Director: Jon Townley
Executive Producer: Jim Wheelock
Producer: Mark Franco
Assistant Producer: Jane Stephan
Digital Effects Supervisor: Kelley Ray
Designer: Cliff Iwai
Modelers: Sean Cunningham (Aquatic), Mike Merrel (Pre-Historic)
Alan Ridenour (Saturn), Con Pederson
Technical Directors: Scott Bendis (Vampire Binary), Steve Blakey (Saturn), Brian Bowman (Saturn), Cliff Bret, Chiara Perin, Yau Chen (EPB TD), Daniele Colojacomo (Pre-Historic), Aliza Corson (Aquatic), Sean Cunningham, Rosa Farre, Todd Gantzler (Caveman-Starman Morph), Jim Hillin (Pre-Historic), Gary Jackermak, George Karl, John McLaughlin (Saturn/Aquatic/Black Hole), Peter Meechan (Black Hole/Aquatic), Mike Merell, John Ornelas (Vampire Binary), Con Pederson, Sean Schur, Jerry Weil (Aquatic)
Resource Manager: Steve Klevett
Production Manager: Jini Dayaneni
Systems Administrator: Andy Chua
Systems/Software Support: Greg Ercolano
Software Support: Rob Rosenblum, Yun-Chen Sung
Film Recorder: Bill Kent
Offline Editor: Ron Reynolds
Technical Support: John "Bear" Bryant, Daniel Loeb
Client: Dream Quest Images

Hardware
Solbourne 5-604, Silicon Graphics 4D workstations, Abekas A60 and A66, Solitaire 8XP Film Recorder
Oxberry 8 Port Camera

Software
MetroLight proprietary software, Wavefront Preview, RenderMan, Alias 4.0

Timbre Trees

Timbre Trees are functional compositions of sound, analogous to shade trees. Genetic algorithms were used to mutate these trees, to generate sounds, and to allow the user to guide their evolutions. Parameters from a motion control system were used to drive the synchronization as well as the timbre of sounds.

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Producer
James K. Hahn

Contributors
James K. Hahn, Larry Gritz, Joe Geigel, Jong Won Lee, Tapio Takala

Hardware
Silicon Graphics Indigo, Crimson

Software
James K. Hahn, Larry Gritz, Joe Geigel, Jong Won Lee, Tapio Takala

Copyright
George Washington University
Iris 4D/20G

TISEA Opening Animation

Commissioned for the Third International Symposium on Electronic Art, this work uses evolved surfaces and textures to extract algorithmically the notion of flow.

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Producer
Jon McCormack

Contributors
Animation, Programming, Music, and Production: Jon McCormack

Sponsor
Australian Film Commission, Wavefront Technologies

Hardware
Silicon Graphics Personal
Iris 4D/20G

Software
Custom by producer, Wavefront Technologies: Advanced Visualizer

Copyright
1992 Jon McCormack

Tokyo International Forum

The Tokyo International Forum is a multicultural arts center, designed by New York-based Rafael Vinoly Architects for the Tokyo metropolitan government. This video will be used as a visualization tool by Japan, on an international level, to promote the Tokyo International Forum prior to architectural completion.

Contact
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Rafael Vinoly Architects
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New York, NY 10013
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212.924.5858 fax

Producer
Wayne Herman

Contributors
W. Herman, D. Finn, F. Mendoza, G. Councilor, I. Kos

Sponsor
Tokyo Metropolitan Government

Hardware
Silicon Graphics Iris Indigo XS24, Personal Iris

Software
Alias 3.1.1.1

Copyright
Rafael Vinoly Architects

Transformers

Animation designed for theatrical film release. Preceded "Home Alone 2." Also being used as the opening for the televison show, "The Transformers."

Contact
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Producer
Lamb and Company Inc.

Contributors
Director, Animation Director: John Donkin
Producer: Pam Lehn
Creative Director: Larry Lamb
Technical Director: Paul Churchill
Modeler: Milton Rodriquez
Additional work: Doug Kingsbury, Keith Cormier, Gayle Ayers, Heidi Spaeth, Marcia Deitrich, Jeffrey A. Thingvold, Jake Parker, Jim Russell, Kirk L. Kelley, Mark Mariutto, Bob Born, Scott Gaff, Doug Pfeifer, Beth Beyer, Kelly McManus, Kirt Moses

Hardware
CGI Computers, Abacus A60, Sony DVR2000 DI

Software
Wavefront, Discreet Logic, Lamb and Company proprietary

Copyright
Hasbro, Inc.

Triangle Eat Triangle

Triangle Eat Triangle is based on the principles of geometric substitution. Triangles twist and divide like machinery to construct a constantly changing world of patterns.

Contact
Margaret Hallam
Electronic Visualization Lab at U.I.C
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712.996.3002

Producer
Margaret Hallam

Hardware
Silicon Graphics workstation

Software
Homegrown

Copyright
Margaret Hallam

Visualizing Seafloor Structures with Satellite Altimetry

This video shows an ocean-floor model generated from gravity measurement data that was obtained by a satellite from an ocean region between Antarctica and New Zealand. Points of interest are examined as the viewer "swims through" the environment.

Contact
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Producer
James McLeod

Contributors
Chris Small, David Sandwell, Paul Lackey, JJ Jenkins, Harry Ammons

Sponsor
NSF, SDSC, Scripps Institution of Oceanography

Hardware
Silicon Graphics 4D/320 VGX

Software
Wavefront TAV, SDSC internal code

Copyright
Contact SDSC for release, 1992

Wacky Races

Wacky Races is the multimedia entertainment software, composed of CD-ROM as Part I and Laser Disk as Part II, and established at Amlux OSAKA, Toyota's showroom. The laser disk software will be entered.

Contact
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DAIKO Advertising Inc.
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Minato-ku, Tokyo 105
Japan
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03.3437.8473 fax

Producer
DAIKO Advertising Inc. and Future Pirates Inc.

Sponsor
Toyota Motor Corporation

Hardware
SGI 4D-320VSX, 80GT, 35 elan, Crimson

Software
Alias Studio, Alias Power Animator

Copyright
Hanna-Barbera Productions, Inc.

Warts and All

Contact
Bruce Pukema
Ronin Animation
12036 Mississippi Drive
Champlin, MN 55316
612.421.7479

Producer
Bruce Pukema

Hardware
Silicon Graphics

Software
SOFTIMAGE Inc.

Copyright
Bruce Pukema

When I Was Six

When I Was Six explores a recurring childhood experience through the assemblage of memory.

Contact
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Producer
Michelle Robinson, Texas A&M University Visualization Lab

Hardware
Silicon Graphics

Software
SOFTIMAGE Inc., Wavefront Advanced Paint

Copyright
Michelle Robinson

The following computer graphics conferences have been invited to show a short video at SIGGRAPH 93. The purpose is to make SIGGRAPH attendees aware of the other excellent international computer graphics and art conferences. Each video will be seen at a special day and time in the small animation theater.

Ars Electronica

Ars Electronica is a festival for art, technology, and society. The Prix Ars Electronica is an international competition for computer arts graphics (images)/animation/music/interactive art, which includes monetary awards for winners in several categories.

Deadline for Prix Ars Electronica submissions: 28 February 1994.
Conference Dates: 21-25 June 1994
Conference Location: Linz, Austria

Contacts

Ars Electronica
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A-4010 Linz
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Prix Ars Electronica
Dr. Christine Schöpf
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IMAGINA

IMAGINA is an European event covering computer graphics, virtual worlds, and special effects. It includes a conference, an exhibition, and a competition: the "Pixel-INA Award." IMAGINA is organized by INA and the Festival de Television de Monte Carlo, with the collaboration of the CNC.
Conference Dates: 16-18 February 1994
Conference Location: Monte Carlo

Contact

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MEDIATECH and Premio Immagine (Image Award)

MEDIATECH, part of the IBTS-MeM (International Broadcasting Show), is dedicated to electronic communication. Presentation categories include: seminars, reviews, and contests. MEDIATECH brings together current issues in technological/professional works with a political and economical strategical analysis and a presentation of research projects and production with ample reflection on the open borders of experimentation with advanced technology. It is programmed and designed by a committee headed by Maria Grazia Mattei, with the collaboration of several international institutes. The Image Awards, now in their fourth year, are given to Italian artists for the best works in cinema, television, or research using any kind of computer technology.

Conference Dates: 14-18 October 1993
Conference Location: Milan, Italy
Image Award: 16 October 1993

Contact

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Machine Culture
The Virtual Frontier

Machine Culture: The Virtual Frontier

SIMON PENNY,

Machine Culture Chair,

Carnegie

Mellon University

The goal of this exhibition is to offer a survey of the current state of interactive and virtual art practice around the world. Many people are unaware that the full name of SIGGRAPH is "special interest group on graphics and interactive techniques." In this spirit, machine culture takes a wide view of interactive techniques. Not only will you find screen-based and interactive laserdisk artworks, but interactive environments, robotic artworks, and immersive systems. Artists in this exhibition are gathered from many countries, including Australia, Canada, Holland, Japan, Germany and the U.S.

1993 is perhaps the first time that an exhibition of such scale has been possible. This is due in part to the availability of sophisticated technology to artists, and simultaneously, the cultural interest in the these technologies as culture machines. SIGGRAPH is perhaps the only place that such an exhibition could occur, as it gathers both the technology and the goodwill of the makers of these technologies.

Artistic use of interactivity is a new field. For the artists included here, the nature of interaction and the interactive interface is a prime concern. The definition and use of that interface in this exhibition is diverse, and quite at odds with the increasingly narrow usage in interactive consumer electronics. The interface is the place where the machine meets culture; it is the place where the machine meets the body. These artists question which parts of the body the machine might converse with, and in what ways. Most of the artists represented in this exhibition are newcomers to SIGGRAPH, younger artists, many from outside the U.S., with novel approaches to interactive technologies. These artists have gone to considerable effort to bring and install their complex works for the consideration of the SIGGRAPH audience.

The catalog to this exhibition, the machine culture section of the 1993 Visual Proceedings, has offered these artists the opportunity to speak about their complex works and the ideas behind them. The catalog also includes a specially commissioned set of essays that is the first collection to address interactive and virtual art practice. Though some of the essayists are familiar to the SIGGRAPH membership, many are unfamiliar, and offer dynamic critiques. It is my hope that machine culture will bring the SIGGRAPH community together with active artists and thinkers in interactive technologies from the art world in an exchange of ideas and in the hope that a more sophisticated discussion of the cultural dimension of interactivity will result.

We are witnessing the construction of a new professional identity—the interactive media artist, an interdisciplinarian as comfortable with cultural coding as with computer code, and as familiar with the jargon of the art studio as the computer lab. There are those of us who have crossed over, in one direction or the other, but the generation at home in both places is just arriving. Some of them are in this exhibition. It is they who will invent interactive art.

I'd like to express my gratitude to the artists and essayists without whom this publication and exhibition would have been impossible, and likewise to the companies and individuals who have loaned hardware and software. The members of the advisory committee for machine culture are: Gary

Warner, Australian Film Commission; Erkki Huhtamo, independent theorist and curator (Finland); Jeffrey Shaw, director of the Institute for Image Media, Zentrum fur Kunst und Medientechnologie, Karlsruhe, Germany; Richard Wright, lecturer in computer graphics, London Guildhall University (Formerly City of London Polytechnic), UK; and Machiko Kusahara, independent curator and consultant, Japan. The committee has functioned in a different fashion from SIGGRAPH art show committees of the past. All the committee members live outside of the U.S. and have an active professional interest in interactive media. My charge to them was to suggest artists and artworks for the exhibition and assist those artists to take part in the exhibition—I am grateful for their advice and assistance. I'm particularly grateful to my assistant in the machine culture project, Harry Fozzard, who has taken an active, intelligent, and responsible role in planning the exhibition, in editing and designing this document, in corresponding with contributors and sponsors and all the other duties that fell to him. I'd also like to thank my colleagues on the SIGGRAPH 93 committee with whom it has been a pleasure and an honor to work, in particular, Alyce Kaprow, who has been a constant source of advice and good humor. And thanks especially to Molly Morgan-Kuhns, Mark Resch, and Bob Judd for their support and guidance.

This project is dedicated to the memory of Felix Guattari.

Contact

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- Chair and Curator, Machine Culture: The Virtual Frontier, SIGGRAPH 93
- Associate Professor in Art and Robotics, Carnegie Mellon University, Pittsburgh, PA
- Formerly: Area Coordinator, Electronic Intermedia, Department of Art, University of Florida

Machine Culture Committee

- Simon Penny, Chair, Carnegie Mellon University
- Erkki Huhtamo, Independent Critic and Curator, Video and Electronic Media, Finland
- Machiko Kusahara, Independent Curator and Consultant, Japan
- Jeffrey Shaw, Zentrum für Kunst und Medientechnologie, Karlsruhe, Germany
- Gary Warner, Australian Film Commission
- Richard Wright, London Guildhall University, U.K.
- Harry Fozzard, Machine Culture Amanuensis, University of Florida

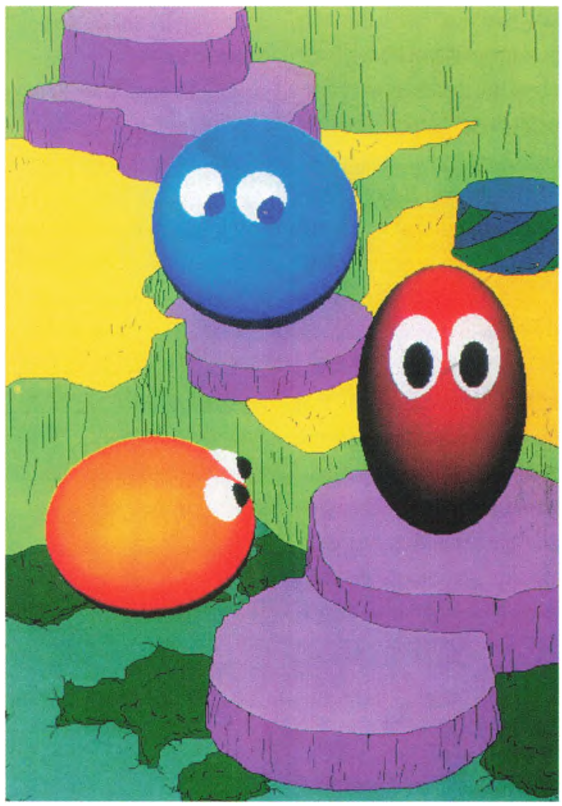
Edge of Intention

JOSEPH BATES, JAMES ALTUCHER, ALEXANDER HAUPTMAN, MARK KANTROWITZ, A. BRYAN LOYALL, KOICHI MURAKAMI, PAUL OLBRICH, ZORAN POPOVIC, W. SCOTT REILLY, PHOEBE SENGERS, WILLIAM WELCH, PAUL WEYHRAUCH, AND ANDREW WITKIN,

Carnegie Mellon University

Computing and art are becoming increasingly intertwined. Clear evidence of this appears regularly in the film industry, the music industry, and in exhibits such as this one. Artificial intelligence (AI) technologies and fundamental AI research have an essential role to play in this convergence, especially in the domain of interactive art.

A work of interactive art creates and responds to details of the interaction that the artist could not precisely anticipate when the work was constructed. The more sophisticated the interactivity, the more responsible the work is for carrying out the artist's intent. This means the artist must strive to create an active entity with a sense of aesthetics and of meaning with the ability to understand and respond to human reactions.



In constructing these subtle, behaving entities, traditional technical concerns of AI arise. These include how to transfer knowledge into the machine, how to represent that knowledge, and how to process it in ways usually attributed only to humans.

The work shown here is an attempt to create AI-based art. It is intended to be an emotionally compelling glimpse of how new kinds of machines ultimately may affect our ethics and our culture.

This work appears as a real-time, animated, simulated world displayed on a monitor. The 3D space, presented from a fixed point of view, contains three creatures that interact with each other and with a fourth user-controlled creature.

Each creature is an autonomous entity that seems to perceive its environment, act in response to those perceptions, tries to achieve its desires, react emotionally to events that occur, and form simple relationships with other creatures. Each creature has a distinct personality. The behavior of the creatures is not random, but it is not easily predictable either.

We call these creatures "woggles." The particular creatures are named "Bear" (blue), "Wolf" (red), and "Shrimp" (orange), to suggest their personalities. The woggles are autonomous. They "live" in their space and interact with each other whether a human is present or not. However, a human can enter the world, controlling a fourth woggle using a two-button mouse.

The primary physical repertoire of the woggles is to jump, slide, change body shape, move the eyes, and change eye shape. Two varieties of action have special social significance.

The first, called "hey," is to stretch the body upward for a moment while looking at a particular creature. This may be interpreted as a greeting, as simply acknowledging a creature, or as expressing sympathy. It may also be a request to play "follow the leader," an agreement to play that game, or a request to finish playing the game. Creatures try to determine the intended meaning in context.

The second action of special significance is called "in your face." The creature looks at another while pulling in its chest and expanding sideways. This makes the first creature look larger in the field of view of the second, and it is generally interpreted as a threatening behavior. Threats are quite effective in getting the attention of other creatures, but more subtle interaction and relationships are available using "hey."

The user woggle (purple), is treated by the others exactly as they treat each other. Using the mouse, the user can jump, slide, control the eyes, hey, and threaten. Aggressive users will generally provoke fear, anger, sadness, and dislike. Attentive, gentle users will generally comfort, please, play with, and make friends with the other woggles.

Emotion terms have technical analogs within the minds of the woggles, and thus we are simultaneously speaking technically and subjectively. Our artistic concern is whether the technical capabilities of the woggles clearly convey these subjective internal states, and whether this then creates appropriate emotional and intellectual responses in the human participants.

The woggle's world is modeled as a surface defined over a rectangle. The surface is painted, for human viewers, but the woggles see only its shape. In addition, they see the position, body configuration, and actions of other creatures. Each woggle body is controlled by a personality written in Tok, an architecture for the mind that integrates reactivity, goal-directed behavior, and emotion.

Each Tok mind maintains a tree of top-level goals and the subgoals they engender. The goals and subgoals are used to organize a collection of reactive mechanisms. There is no complete internal model of the world, but there are small, partial models built through selective sensing processes. Goal success, failure, prospective failure, and judgments that other creatures caused these situations give rise to happiness, sadness, fear, gratitude, and anger in varying degrees. Gratitude and anger affect the longer-term relationship of liking or disliking the creature causing the emotion. The emotional state indirectly modulates the creature's choice of goals and reactions.

The woggles are a result of collaboration between the Oz project and the Graphics and Animation research group at Carnegie Mellon University. Together, we are 13 faculty, graduate students, and staff, studying artificial intelligence, graphics, robotics, speech, drama, writing, and animation. One of our goals is to provide technology to let artists build dramatic interactive worlds.

A key feature of interactive story worlds, as in traditional stories, is the presence of rich characters. In interactive media these characters must be autonomous agents, not simply collections of narrative and dialogue. However, unlike traditional AI agents, which are intended to exhibit intelligence, these agents primarily must exhibit desires (goals), emotional reactions, and social relationships. Our approach is to build creatures that combine ideas from cognitive science with traditional hand animation techniques. We are concerned with controlling action, reaction, eyes, inter-character distance, and anticipation, from the creature's own internal mental state. This is an example of our notion of AI-based arts.

As this kind of work progresses, and the artistic and technical quality of simulated creatures improves, people interacting with these creatures may begin to feel the bite of philosophical questions that arise in AI research. If AI achieves its grand objectives, the issue of how one judges the presence of thought and feeling in unfamiliar (mechanical) creatures will become an important practical concern.

This work is intended to help raise these concerns before they arrive in our society in full force. We have attempted to apply known technology under artistic direction to build suitably confusing creatures, and thus perhaps raise these issues in personal, emotionally powerful ways. A sign of success for us is when our visitors sometime ask, "What happens when you turn them off?"

Production Systems Technology of Pittsburgh very graciously provided use and support of their RAL rule-based programming system. Their assistance is gratefully acknowledged.

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The Fence

COACTIVE AESTHETICS

San Francisco, CA

The coactive aesthetic is one that focuses on the interaction between the observer and the observed. The aesthetic is in the interaction between these two entities and is not manifested entirely in either. Furthermore, for the interaction to be considered coactive there must be qualities of this interaction that go beyond simple deterministic responses by the object to the viewer.

We seek to achieve behavior in the object that permits the viewer to perceive his or her influence on the object and the object's inherent behavior without understanding the nature of that influence. This means the object must have a certain level of autonomy in its behavior and the behavior must not be totally or trivially determined by environmental (sensory) inputs. We achieve this coupling of viewer and object with computers, sensors, and various computer-controlled devices.

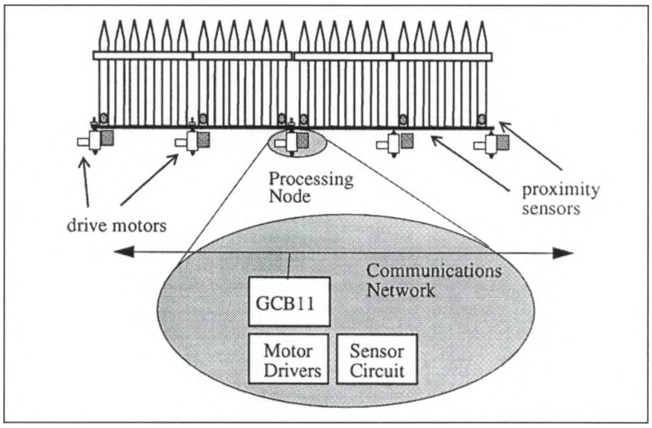
The real power of the computer as an artistic medium rests in its ability to respond in real-time to events in the world. Other uses of the computer may enhance different media but they do not constitute fundamentally new ways for aesthetic expression. Thus we are not proponents of electronic or computer art that highlights the technology for its own sake. We attempt to down-play the technology used to bring our pieces to life.

The coactive aesthetic exploits a secondary aspect of computers—their ability to perform complex control tasks. This ability creates interactive environments or entities that exhibit intentions or desires in the viewer's eyes. Humans are able to perceive intentionality of other entities only through interacting with them under a variety of conditions. Is an interactive art piece exhibiting the intentionality of the artist or of itself?

"A boundary . . . is a product of the interaction of an observer with the world and cannot be held to unconditionally exist."

—S. Salthe, in "Evolving Hierarchical Systems"

The Fence is an actual picket fence approximately three feet high and 12 feet long. It is divided into hinged sections that enable it to move and undulate in response to people in the room. On one side the fence is pristine white while on the other it is covered with graffiti.



Other questions such as "what makes a particular behavior intelligent or interesting (or beautiful)?" are also a guiding focus for the systems we create. By considering aesthetic in addition to scientific issues we are allowed a certain freedom in exploring all viewpoints and gaining unique insights. Our personal intuition is that the question of what makes a behavior intelligent will turn out to be largely a question of perception, and is thus closely related to aesthetics.

As interactive art matures, a language of interaction will emerge. This language of interaction will reflect a deeper understanding of the dynamics of interaction between systems (e.g., art object and viewer). Furthermore, this language will necessarily tie together aspects of intelligent, intentional systems and issues of perception.

At face value The Fence represents a boundary between two very different worlds. When the interactive aspects of The Fence are added it enables the viewer to experience concepts in a way that can only be alluded to (if at all) in other non-interactive mediums.

A fence is a stationary entity. It represents an immutable boundary. Indeed the concept of boundary, that is, where does the "thing" end and the "other stuff" begin, is itself changing (e.g., entification is a central issue in theories of complex systems), making our age one of mutable boundaries. Boundaries in all aspects of our world are changing at an ever-increasing rate. The Fence is a representation of that reality.

The Fence exhibits different behavior repertoires depending on with which side the viewer is interacting. This depicts in a dynamic way the dichotomy that exists on the two sides of a boundary.

The Fence also can express complex relational and intentional notions such as "aggression" and "playfulness" simply through the physical behaviors exhibited in response to viewers' actions. For example, The Fence singling out a viewer and moving to encircle him/her can be seen to express the notion of aggression or control (or safekeeping?). The Shy Fence moves away when the viewer approaches.

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The Vorkapitchulator

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The Vorkapitchulator is a computer-controlled video installation that is concerned with the construction of cultural conceptions of time and space that have resulted from a century's immersion into cinematic forms.

The primary element of the piece is a multi-axes, robotic sensing machine (panopticon) that consists of five black and white video cameras permanently mounted onto a large lead screw. The cameras travel along the various axes that this vortex provides, creating a constructed view of spatial events that corresponds to techniques in cinematic narrative montage. This imaging vortex is placed within a space that contains a variety of source material elements to be constructed into the montage, i.e., diorama, multiple objects in various scale sizes, and sampled television imagery.

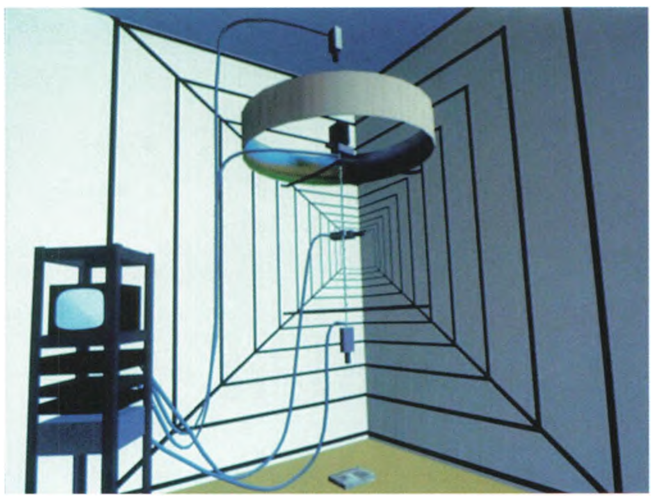
The displayed television image is then formed by mounting the monitors in an arrangement with half-silvered mirrors, so that several monitors contribute to making one final, virtual image that is projected onto a piece of glass. To view the image the viewer must locate themselves in the environment in such a manor that their presence and position become the significant element in completing the formation of the environment.

The pacing of the piece is under the master narrative control of computer-sampled broadcast television imagery, whose cut pacing will provide the edits between the various camera views within the piece. In specific television forms, such as soap operas and advertisements, there is a predictable range and distribution of pixel values that when comparatively analyzed over time can be decoded into its specific sequence of shots. It is from this analysis that the sequencing of the camera views will be determined. Through the codification and exteriorization of narrative form, along with the real-time experience of its constructive process, the gain, and loss, of control over time and space relationships is moved into the forefront of consideration. This information is derived by custom-built micro-controllers and software that control the other elements of the piece.

The montage is one of the primary signifiers of cinematic form, expressing both the faceting of space and the plasticity of time. The transitional message of the montage is also of importance, as a larger reading of the piece is about cultural transitions, to an increasing exteriorization of knowledge databases, brought about by the continuing transition into a culture where all conditions are represented in terms of codes.

Thus, the piece explores relationships between the elements of a viewer, their view (manifested as the panopticon), and their cultural domain. The piece identifies the act of viewing as being the significant act in the defining of self, completely embedded in one's cultural codes, such that the act of viewing and the act of being viewed are the same and the dichotomous relationship between viewer and subject no longer holds as a perceptual paradigm.

The title, The Vorkapitchulator, is derived from Slovko Vorkapitch, a Russian filmmaker who formalized the montage sequence in filmmaking, the vortex of contemporary image culture, and the capitulation to the narrative experience.



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The Garden of Earthly Delights

AGATA BOLSKA

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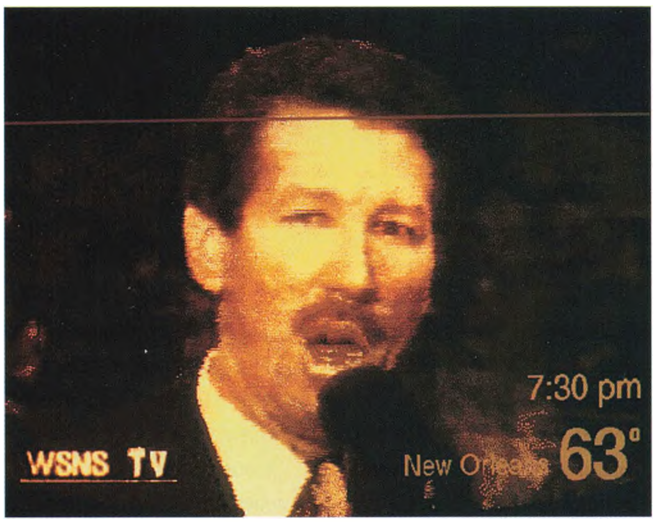
Inspired by the 15th century painting by Hieronymus Bosch, The Garden of Earthly (Delights) is a screen-based, interactive installation focused on ideas related to the television medium and the place it occupies in modern Western culture. Central to the piece is the "Garden" animation, whose symbolic characters represent various modern passions and delights, embodied in the television programs. The piece is conceived as a comment on and paraphrase of television. Like TV it is meant to inconspicuously control the users' choices, imposing on them specific decisions. By selecting respective symbols from one of various "Garden" animations, the users metaphorically fall prey to the flaws of human nature, as manifested in Bosch's work. Seduced by the "delights," the users become victims of the mediamatic illusion of reality.

The phantasmagoric creatures depicted in the Bosch's painting are entangled in surreal affairs with each other and with their own demons, conjured out of the fantasies and beliefs howling in the minds of the artist's contemporaries. Here, they are replaced by Western demons, whose faces flash through the television channels. In the modern world TV has filled the space vacated by religion, which in 15th century Europe served to link and unify many aspects of social life. Like Bosch's figures, we are now cringing under the burden of hellish visions brought forth by television daily news and horror movies, instead of ambos and preachers. Messages of violence smoothly intersected by omnipresent commercials and pandering advertisements saturate the viewers' minds. The sarcasm and surrealism of Bosch's painting reflect in the sleek surface of the TV screen. Deployed in front of a favorite chair or couch, TV embodies our beliefs and fears, and yet serves them with restrained dramatism—after all it is just the screen . . . Commodity advertisements, type-casting, food commercials—all of these strive to fill that void in viewers' consciousness that craves for indulgence. These are modern representations of greed and vanity.

Just as at home, sitting comfortably in front of the TV, the users of The Garden of Earthly Delights find themselves poised between the reality of an old armchair, flanked by the "Vanity Panel" and the computer screen. The panel, covered with familiar wallpaper patterns, conceals the equipment; all the users see is the screen, the keyboard, and the mouse—the three elements that make the interaction possible. The repetitive, teasing and numbing sound, present throughout the piece but changing with each new selection, parallels the character of television channels. While the stills and animations that appear in response to the users' selections are suggestive of TV, their palette subdued yet always slightly different with each entry, the messages and menus take the form of gothic-style notes characteristic of Bosch's time and, in some cases, quoting from the artist's writings.



The participants' past and current responses are analyzed and stored in the seven concurrent databases. The flow of the action is based on the users' choices and is different for each participant, depending upon the performance. The underlying database allows alteration of the available imagery and sound in the run time, while the participants are traversing through the "Garden's" paths, thus creating the possibility of numerous selections—of animations, stills and sounds—and adaptations to individual explorations.

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■ Dariusz Bolski

Family Portrait

LUC COURCHESNE

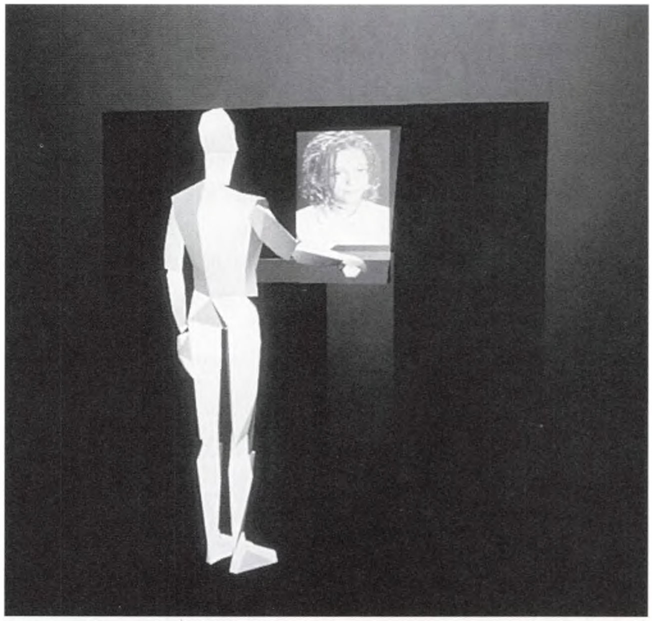
Universite de Montreal

"Who wouldn't distrust someone coming at him/her saying: 'Me and my friends are not real, we are a new kind of photograph?'"

— Adolfo Bioy-Casares

Imagine a portrait. You walk up to it and engage in conversation. You pick a question from a pre-established set on the screen. The portrait gives you a pre-recorded answer. A new set of questions, or comments appears. You get further reactions. As this process goes on, a conversation develops according to your curiosity and the subject's mood. The encounter may be cut short due to a lack of sympathy on either part, or it may develop into discussion of ideas, values or personal experience. The interaction is structured into levels of intimacy; you have to get to know and trust one another before getting on to highly personal matters. In the end, you may have made a new virtual acquaintance... or friend.

The technique that I have developed experiments with portraiture. Following the painted and photographic portrait, the hypermedia portrait demonstrates the same interests for human beings, this time capturing and rendering not only physical likeness but also fragments of behavior. These virtual beings do not appear in the flesh (I am working with video); and the questions are not verbal (chosen from a computer screen). Yet the interactive video installation, which uses widely available technology, works as a metaphor for an encounter. As with other virtual reality systems, my portraits are worlds onto themselves (that of the portrayed subject), in which visitors are invited to play a role (that of a conversational partner). There are some dangers (you may not like the reaction you get). But there are also rewards (getting to know the subject, and possibly discovering something about him/her—or yourself—in the process).



Imagine a series of hypermedia portraits that make a society of virtual beings. They all exist as individuals, lending themselves to personal encounters as previously described. But they are also "aware" of one another and may react to what is happening anywhere. They may want to speak their own truth about what is being said about them, or simply to add to an interesting conversation without being asked. Or they may discuss things among themselves, chat about the weather, or argue about a favorite controversy. Who these virtual beings are and what they have in common is to be discovered by visitors. Visitors, by their perspicacity or mishandling, may trigger a family drama that could turn a quiet portrait gallery into a video theater where a drama plays itself out.

A society of virtual beings is made of networked individual systems. As new virtual beings are added, each capable of hosting one active visitor, the installation grows from a single user to a multiple user system. A better balance is thus achieved between the society of virtual beings and the society of visitors. One possible outcome may be a forced interaction between the society of visitors, as a response to the interaction of the society of virtual beings.

Enter a portrait gallery. Norbert is a mathematician and dancer; he is also a friend of Sebastien, an ethnologist interested in majorettes and rugby teams. Alain is Simone's son and the former biology professor of Laurence, who specializes in archeobotany and is looking for work. Thierry and Laurence are close friends, having shared an apartment in the past. Thierry is a writer and works in a library; this is where he met Marianne, a graduate student in economics. It is through Thierry that Marianne and Laurence met Sebastien, and through Laurence that Marianne and Sebastien met Alain, who also owns a sheep farm in the Alps that is regularly visited by most of these people. Blanche, the author's daughter, first met Norbert in Montreal when he came to participate in a dance festival and stayed in their home. She later got to meet everyone else in Marseille when the author's family spent the summer there in 1992. This edition of the Family Portrait is about these people; it documents their life and tells about the process in which the work evolved. The group portrait was recorded in Marseille that summer.

Family Portrait is Luc Courchesne's new work dealing with portraiture in the age of hypermedia. The work is supported by the Institut Mediterraneen de Recherche et de Creation, the Ministere de la Culture (France) and the Canada Arts Council. The installation was premiered in Aix-en-Provence (France) in June of 1993 and it will be exhibited at the Canadian Museum of Fine Arts in Ottawa, November '93 to January '94.

I was born in 1952, the year broadcast television began in Canada. When I came of age, television was already part of the living room furniture. Computers appeared later but made a quick inroad into my life as they proved essential to my design work. The birth of the author in me happened when I realized you could plug a computer into a television set.

Hypermedia means a network of nodes and links. The nodes are the content, the material of the world and the links are the freedom to move within it. A hypermedia author creates a world of possibilities; then he/she invites people in and give them freedom; finally he/she characterizes the experience by developing a metaphor for the experience.

The builders of new worlds should not forget that what remains hidden is sometimes more important than what is shown if one is to make use of the visitor's brain. Mystery might best pull visitors through hypermedia. They get what they are after, and in that sense, are partly responsible for their experience. More than in any other medium, hypermedia entail shared authorship.

Media should not be used to create yet more images or to replace the real world with a better virtual one. The state in which we leave our first world, is essential to our survival. We are old biological apparatuses that still depend on the natural world.

We'll get used to cyberspace and virtual reality, the same way we got used to sun block and indoor swimming pools. Once we get accustomed to new media, the problem of the artist remains the same: to have a vision and to express it in some form, to stretch the boundaries of reality, to decipher order in chaos or chaos in order. New media should be used as media have been used since the beginning of art-making: to answer in our own words the old questions about imagination and representation, and what it is to be human.

I use it to make portraits. A portrait of someone is an account of an encounter between the author and the subject. Painted portraits happened over long periods of time and therefore are more conceptual than photographic portraits. They encapsulate in one single image hours of interaction between the model and the painter. Photography, on the other hand, makes realist portraits. The talent of the portrait photographer is to wait and pick the right moment when the person expresses the density of her being; the subject and the photographer wait for that magic moment in complicity. In my portraits, the entire encounter is recorded, and material is extracted to construct a mechanics of interaction that will allow visitors to conduct their own interviews. As this happens over time, the conversation evolves toward more intimate considerations. The visitor will have to invest time and great care to get to the subject's more secret personality, just as it took time and care for the author to get there.

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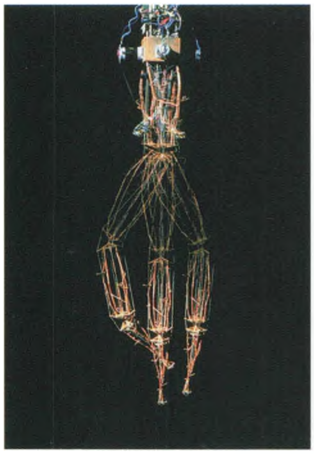
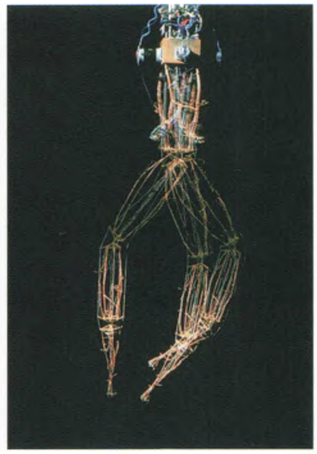
The Flock

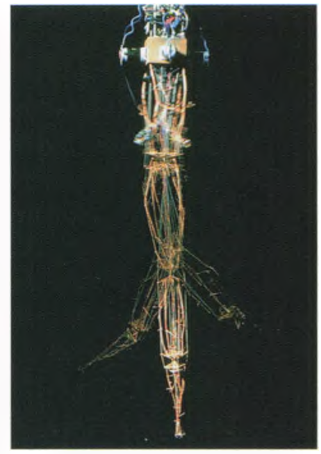
KENNETH E. RINALDO

AND MARK S. GROSSMAN

Interactive Emergent Systems







The Flock is a group of cybernetic sound sculptures that exhibit behaviors analogous to flocking found in natural groups such as birds, fish, or bats. As a class of social interactions, flocking behaviors are particularly interesting because they demonstrate characteristics of supra-organization, of a series of animals or artificial life forms that act as one. Flocking behaviors are complex, interdependent interactions that require individual members to be aware of their position in relation to others.

We are approaching the task of creating a sculptural and musical flock by designing and building three or more independent rule-driven systems that will interact to create one global behavior. The key concept is emergence, the coming together of systems with no central controller guiding their behavior. The global behavior is allowed to evolve naturally out of the local interactions among the systems. The results will be an illusive aesthetic that is complex, chaotic, nonlinear and often lifelike.

When participants encounter The Flock, they are drawn into an acoustic, kinetic, and infrared network. By producing their own sounds and movements, the participants will act in concert with the arms. Thus the environment affects the form and the form modifies the environment, which then affects the form again, ad infinitum.

Craig Reynolds has had much success with creating on-screen flocking behaviors with artificial organisms he calls "Boids." These simulated birdlike entities have been able to display complex group motion while avoiding obstacles and generally displaying bona-fide flocking.

After setting out to create our own computer sculptures we discovered Ilhan Ihnatowicz had taken a step in this direction in 1972. He built a creature called Senster (a computerized sculpture), which was able to dynamically sense its environment and, under software control, modify its behavior based on past experience and current environmental inputs.

As Christopher Langton and other artificial life researchers have pointed out, a properly organized structure need not be living (or even physically embodied) to display life processes. By this token The Flock will exhibit life processes; and since it is a physical embodiment, it will be subject to a far richer set of environmental stimuli and constraints than would a pure "in silico" organism. This helps bring the system dynamics into the realm where they can be better apprehended.

In The Flock, ceiling-mounted arms will detect sound with their microphone arrays and movements of the participants with their infrared eyes. The responses will depend on the personalities of the individual arms as they interact with the group (the other arms and the human participants). The software is designed to allow a wide range of learned and unpredictable responses, with an emphasis on cooperation to produce a group aesthetic.

The artificial creatures of The Flock communicate among themselves with audible telephone tones. For instance, an arm can sing its position to all the other arms, allowing them to follow its lead. This tonal language will also permit the programming of various dominance-submission behaviors. In addition, the arms sample sound fragments from the environment and can play them back through a speaker, providing a medium to communicate to the human participants additional cues as to the state of the "organism." The infrared proximity sensing allows a vocabulary of attraction and repulsion motions in response to the triangulated positions and movements of participants.

By seamlessly integrating electronic and organic elements, we are asserting the confluence and co-evolution of organic and technological cultures. The branching and joining of the physical forms echoes the temporal flow of interactions within The Flock. It is imperative that technological systems be modeled on the principles of general living systems, so that they will inherently fuse to permit an emergent, interdependent earth.

We want to thank Joe Kennedy, Silicon Graphics engineer, for his invaluable contributions to this project.

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Typhoid Mary

LINDA DEMENT

University of

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The interactive piece, Typhoid Mary, was made using a Macintosh Quadra 700 with the software Macromind Director, Colour Studio, SoundEdit Pro, HyperCard and Canvas at the Computer Centre, College of Fine Art, University of New South Wales, Australia. The project was assisted by the Art Research and Development Fund of the Australian Network for Art and Technology.

The work includes manipulated photographic images, poems, academic references, animations, sounds, stories that print out, and information from statistical reports and medical text books. There is no menu system or apparent user interface. By clicking somewhere on the images on screen, the viewer moves along the paths I have determined. There is no beginning and no end.

The links between the various bodies of information follow an internal logic: the logic of dream and hallucination, of the subconscious and subcutaneous: an illogic and, specifically, my illogic.

I use very personal and corporeal subject matter and my own blood and clutter aesthetic, with computers—a technology that is often associated with the impersonal, with slickness, cleanliness and the commercial world—a technology that I establish as a tightly controlled framework and within which I can create with the out of control in myself.

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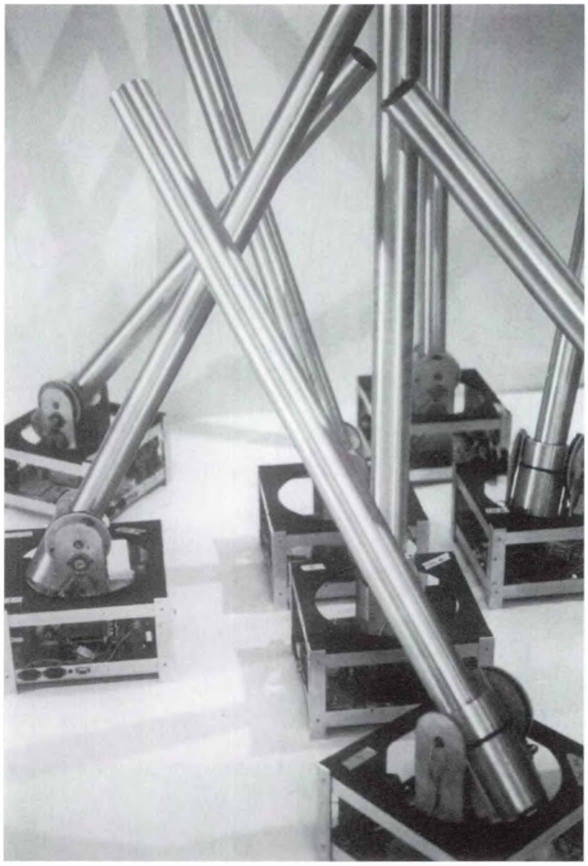
Espace Vectoriel

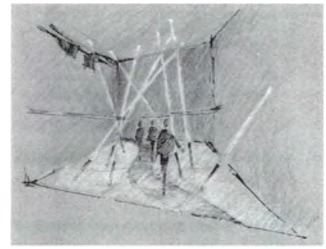
LOUIS-PHILIPPE DEMERS

AND BILL VORN

Independent Artists

Montreal, Quebec





Movement, sound, and light from objects are inevitable. Interaction with machines is centuries old. We implant life in machines so they can return life to our own environments. This installation is about the displacement of existing artifacts. It imposes our own perception of behavior upon a society of mechanical, audio and visual elements.

Espace Vectoriel paraphrases the mathematical term, "vector space" in which information or behavior is expressed in terms of vectors: entities represented graphically by lines or arrows. We often see computer graphics images made of vertices and vectors: a raw representation of a more complex object.

Espace Vectoriel is an interactive sculpture consisting of motorized tubes with a speaker and a light source within. By building a society of these elements, a group of eight, a simple scheme becomes complex and intriguing.

The motorized tube is approximately 1.25 meters long and has two degrees of freedom: full 360 degrees rotation and 170 degrees tilt. The sampled sound, light level and position of each tube are controlled independently and, equipped with custom-built synchronized control of all these media, interesting patterns and variations are created. For example, complementing tube movement can be complemented by light fading in while the tube and sound are rising. Variations of counterpoints in audio as well as movements.

Through this society of tubes, relationships between physical movements and their sound or light counterparts are explored. The concept of "replication" is fundamental to this work. Rituals, hierarchy, artificial life, chaos, the collective versus the individual, are among the relationships explored by using multiple modules. Organic compositions are also envisioned; for example, simulating the effect of wind on a field by a coordinated panning of movement, sound, and light, among all the tubes.

A series of eight sonar sensors makes the "society" react to the viewers. For example, on specific "windows," a tube can withdraw from its common path and bend over, spilling sound on the viewer standing in a particular spot; a direct statement about individuality. The interactive behavior of this work evokes the sensory organ of a natural organism. Combined with the interaction, a dark and hazy space recreates a hypothetical natural environment.

The society uses Bill Vorn's extensive sampling system (each tube has an independent audio output) controlled by MAX and Louis-Philippe Demers' lighting control system and customized robotics interface. Fabrication of the mechanisms and electronics is credited to Andrew Galbreath, Kevin Hutchings, and Alex Solomon of Form Dynamics (Toronto).

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The Data Mitt

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"In all the arts there is a physical component."
— Paul Valery, Aesthetics, 1934

"Reach out and touch someone."
— American Telegraph and Telephone, 1985

The physical component has been almost totally neglected in "computer art," which uses lasers, pen-plotters, and photo-offset techniques to produce purely 2D images lacking tactile quality. Cut off from the body, there is no trace of the "hand of the artist." Hence, it is especially difficult to assess the value of an art object produced in this manner.

There is a parallel void in digital communications: we can transmit and receive voice and coarse images, but we cannot reach out and touch anything. The current interest in virtual reality suggests that we can overcome this limitation through new technology. As these technical barriers begin to fall, more subtle barriers will emerge. The Data Mitt suggests one such barrier.

The Data Mitt offers an elementary means of telecommunication. The user is invited to place their hand into an electromechanical device containing a binary sensor (a squeeze ball that allows the user to transmit one bit of information), and a binary actuator (a primitive direct-drive motor that allows the user to receive one bit of information). This information is transmitted via digital modem to a symmetric arrangement at the other end of an ordinary telephone line. In this way we introduce a physical component into digital telecommunication: two users can hold hands at a distance.

The Data Mitt is a low-bandwidth version of the Data Glove. The Data Glove has become a virtual reality icon, which strives to incorporate the user's body into the computer interface. With precursors like the Hawaiian Shirt and the Exoskeleton from the early days of tele-operation, to the Air Force's Heads Up display from the 1980s, this effort has a long history. Getting the computer to provide realistic feedback in the form of pressure or tactile stimuli has proven elusive, partly due to the technical problem of time delays. Yet as technology closes the gap, we must ask, "What is at stake when a person wears such a device?"

Historically, devices that require the insertion of the body have not, for the most part, been used to provide pleasure. Fictional examples include the apparatus in Kafka's The Penal Colony and the Gom Jabbar in Frank Herbert's Dune. In Rome's Piazza Bocca della Verita, there is a church built by Pope Hadrian in 772 A.D. In an alcove, the stone mask of a local, pagan river god is affixed to the mouth of a water conduit. According to legend, if a person lies and inserts his hand into the Bocca della Verita, the Bocca will bite off the offender's hand.

This legend suggests Freud's Vagina Dentata. Rather than unpack nuances of this reference, we borrowed the Latin term for mask, persona, for our subtitle. In the contemporary world of computer-based art and telecommunications, this may be the last refuge for the hand of the artist.

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Rigid Waves—Liquid Views

MONIKA FLEISCHMANN,

CHRISTIAN A. BOHN,

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Narcissus—the young Greek man—recognized himself in the water, fell in love with his reflected image in the water, and was ruined for that. Today's Narcissus should reflect about the future and the perspective of media technology by viewing and interacting with his virtual image.

The interactive installations—Rigid Waves and Liquid Views—are based on the Narcissus myth. Both are reflection themes playing with the observer's image. The image seems to talk with the onlooker. A virtual mirror image of the observer is overlaid by a virtual scene.

Man is confronted with the machine, and they interact with the computer. Images come alive, driven by the action of the performer. The interface is the visitor's image. From his/her traditional passivity the viewer gets to interactivity with the image. S/he leaves an impression on the image.

A painting showing a mirror—the spectator moves closer to the image, and when s/he gets a certain distance, the painting changes more and more to a 'realistic'-style picture, gets sharper, and finally looks like a photo.

After giving the observer a pause to manage his/her surprise, the reality of the photo increases further. Then the mirrors in front of the picture begin to work. Their functionality is the final step into reality. The observer can see his/her likeness distorted, and can deform it by changing his/her position in front of the mirror.

After a short time of 'playing,' the performer will 'leave the scene'—the scene will leave its reality—getting in a new static painting, which will be kept until the next observer wants to dive into it.

The flat painting opens into a vitural space sutured into reality by photo-realistic and acoustic elements as the observer gets closer to the picture's surface. The observer becomes part of the world that happens in the painting, merging into the virtual life. When s/he leaves, the world slowly looses its activity, leaving his/her distorted image in it.

For Liquid Views, a watery surface of smooth waves is surrounded by an artificial landscape. Coming closer, the visitor sees his/her image reflected in the water. The observer is confronted with him/herself, before the surface of the water changes and the observer's image on it. Soft waves are released, influenced by the natural environment. By touching the surface the observer generates waves. After recognizing the liquid's behavior, s/he will try to test it in an extreme state, overstating it.

Nature manipulates vision. Vision can be controlled in a specific way but cannot be ruled over. The water may only be influenced or left alone, but the real master of it is not the observer. Easily the nature can be lead to an overdone state—out of control—needing a long time to pacify.

The realization is based on a horizontally positioned touch screen, on which a SGI Reality Engine simulates the water, implemented by special algorithms. The user's image is caught by a video-camera, installed beneath the touch screen. The image is created by texture-mapping with a video-picture in real time.

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Catholic Turing Test

GREGORY P. GARVEY

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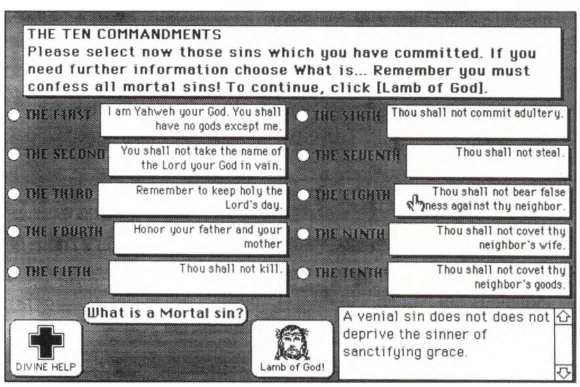
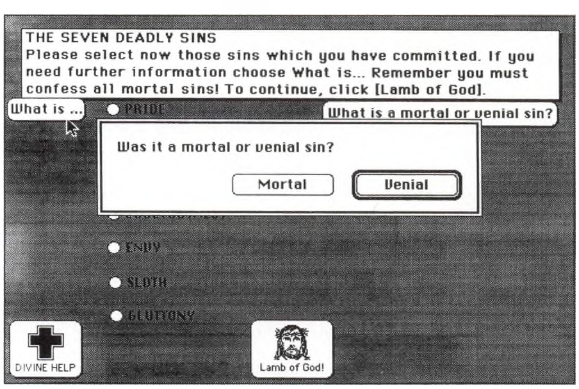
As the title of the piece suggests, the Catholic Turing Test takes its inspiration directly from the artist's experiences as a youth with the Catholic sacrament of confession combined with the now-famous test for judging whether or not a computer can be said to think. This test was first described in the famous article by Alan Turing, entitled "Computer Machinery and Intelligence," which appeared in the philosophical journal, Mind, in 1950.

This work challenges the sinner in the confessional to decide whether or not a priest or a computer programmed to act like priest is hearing the confession. In doing so the user/sinner can experience the ecstasy of forgiveness in a Manichean system governed by the binary logic of good and evil where guilt, shame, sin, and salvation, are all input variables that determine the catechism of output: namely how many "Hail Marys" and "Our Fathers" must be said for redemption.





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Feedback to Immersion

MACHINE CULTURE TO NEUROMACHINES/ MODERNITY TO POSTMODERNITY

TIMOTHY DRUCKREY

International Center for Photography

"The capacity of our sensory apparatus has been exceeded."

— Elie Theofilakis

"We used to live in the imaginary world of the mirror, of the divided self and of the stage, of otherness and alienation. Today we live in the imaginary world of the screen, of the interface and the reduplication of contiguity and networks. All our machines are screens. We too have become screens, and the interactivity of men has become the interactivity of screens. Nothing that appears on the screen is meant to be deciphered in depth, but actually to be explored instantaneously, in an abreaction immediate to meaning—or an immediate convolution of the poles of representation."

—Jean Baudrillard

"It's not a problem of the configuration or the semiotics of the image, but a problem of the temporality of the image."

—Paul Virilio

"Humbling the image is no antidote to humiliating the word."

—Martin Jay

Cybernetics speculates about the coupling of machine and person. Since Norbert Wiener's seminal Cybernetics or Control and Communication in the Animal and Machine (1948), the trajectory of technology development has been one of an increasing possibility of achieving that interface. In the past decade, the possibility of defining a relationship not simply between but within technology has become plausible. Yet the commercialization of cybernetics comes neither as a technical panacea nor without deep ethical concerns. As machines mutate into biology, the philosophical and political values of technology are challenged to confront more than conceptualized situations but rather to theorize the materiality of programmed or enhanced being. At the same time, the development of "realities" that are characterized as immersive or virtual are beginning to surround experience. The penetration of technology within the body and the socialization of simulated realities is more than a signifier of technological progress—it marks a transformation of knowledge, of biology, and of the cultural order in which knowledge is linked with ideology, biology with identity in terms of a technological imperative not necessarily connected with necessity. The issues raised by this potential for the narrowing of the boundary between technology and experience are vast. In many ways the development of several parallel technologies has reached a crucial point.

The convergence of the principles of artificial intelligence, the rich potential of cognitive science, the functional ability to simulate perception, the revolutionary development of computing power, the stunning maturation of computed graphics, and the lapsing efficacy of passive media is implicated in a cultural shift of daunting proportions. Digital technology has outdistanced hard science and now encompasses virtually every industry. The hype about virtual reality, now retreating into the academies and backtracking from unreachable presumptions, makes it plain that the fashionability of the links between technology and imagination, technology and desire, technology and the body, and technology and the liberation from actuality are resident in the imagination in a newly mediated form. Instead of a simplistic connection between style and illusion, the VR draws on the euphoria of simulation. Immersive and interactive environments appear at present as novelty. Dimensional interfaces and "tactile" feedback together represent a powerful possibility. In robotics, medicine, design, and simulation, the idea of spatial integration is a tremendous benefit. For the arts, access to technologies that wholly engage the participant could be a final blow to worn traditions of images.

The dispersal of the ideas about the potential of virtual reality (VR) is striking. Indeed a new book touts the immaterial nature of the corporation itself. Publication of The Virtual Corporation suggests how quickly the ideas of VR and cyberthink have affected business: the virtual future. "The challenge of the new business era, with its virtual products, is to adapt the product to the consumer, not the consumer to the product," write William Davidow and Michael Malone in their assessment of the transformation of industry rooted in microelectronics. Juxtapose this with the promises of CEO cum guru Jaron Lanier: "what people want ultimately is experience, because power is not real. Power only exists within a social abstraction. So what I think we're really seeing is a shift toward a more sensual and aesthetic definition of what technology is for. VR places human experience at the center of what technology is for, rather than human power." (Through the Looking Glass, pp. 39, 41). If we have hoped that the computer would offer a democratizing of creativity and communication we must also be prepared to admit that these ideas are not the privilege of artists. Creativity and technology are merging.

The recognition of the dematerialization of things is no shock to the art world. For more than a decade cultural and art theory has been speculating about the social transformation of what is being called the "new world order." Its focus however is not primarily on technology. But it is clear that the framework for the shift from industrial to service to information economies has been fueled by the computer. Only slowly has cultural theory come to consider this. The art world has, in too many ways, been reluctant to acknowledge

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technology as integral to the creative process. Suddenly the impact of electronic media and digital media have become a spectre to be encountered. The fear of compromise with often elaborate corporate interests and with the presumed frailty and intimidation of the machines themselves set the art world outside its status as future oriented. The decade of the eighties turned its attention instead on no less significant issues of sexual politics, multiculturalism, gender studies, and to a serious and far-reaching philosophical critique of the cultural mechanisms of representation. The importance of the ideas emerging from this period have not been fully realized. But the usefulness of social theory in postmodern culture is essential for the understanding not just of the function of representation in art and media, but for the understanding of the constitution of a culture inebriated by technology.

'Computer art' evolved simultaneously with often radical theories of representation. A discourse between the two, however, did not occur. Often caught in the rationale of technovelty, digital images (including animation, graphic design, etc.) seemed self-justifying and immune from the concerns of cultural criticism. Any reading of the hype surrounding digital culture and art knows that the responses range from dizzying exaggeration to ethical solipsism, paranoia to euphoria. Nevertheless, the merging discourses of creativity, technology, scientific visualization, experience, and art have reached critical mass. Theories of interactivity must be joined with theories of discourse. Without this, the affiliations between representation, intention and technology will remain mired in outmoded presumptions about the 'two cultures.' Images can no longer be disassociated from the tools used to create them.

The development of technology is rooted in notions of social progress. So-called 'primitive technologies' were deployed in social systems where the transformations of matter were essential. Many of these technologies thrive in the industrial and postindustrial period. Yet the millennial change looming in this decade will be rooted in technologies that transform information and cognition. With all of the assumptions of progress that have haunted Western culture, VR has emerged from the military-entertainment complex, a fact that cannot be overlooked. While the development of technology, particularly through the 19th century, was increasingly concerned with vision, the transformative technologies of industry maintained a functional purpose that formed the unfortunate groundwork for the concept of progress hinged on efficient methods of consumption within a culture of industrial production. Technology was not conceptualized within any coherent discourse of social change or the human impact of ontological and epistemological change it generated. An historical account of the visual technologies, beginning with photography and extending through film, television, video, and digital media, would be a massive project. Yet its is obvious that the assimilation of technologies of the visual have set a persuasive epistemological model into place. The notion of "visual truth" (see William J. Mitchell's The Reconfigured Eye) has been exposed as a fallacy at the same time that it has assumed an ever-greater instantaneous power. "Images," said Paul Virilio, "have become munitions."

Information technologies demand a reconfigured model of social change. Technology has reached a stage in which its effects can be processed in a system of feedback. The technologies that emerge from this are those we think of as immersive. This transformative aspect of technology, in which there is a shift from media that 'enframe' to technologies that immerse, is the most disruptive and most challenging dimension of the shift from the triumph of machines to the biologizing of technology. "Can these technologies," asks Donna Haraway, "be prosthetic devices for building connections?. Can these technologies be part of producing social agencies in first-world cultures that are less imperializing?" "My hope," is "that the power, the visual and sensory power of the technology, can be a way of dramatizing the relativity of our place in the world, and not the illusions of total power."

Molecular machinery, direct cortical connections, neuroelectric implants, phased array laser inputs, gene therapy, atomic imaging, forced feedback, molecular electronics, etc., are signifiers of a language of industrial technology and of the transformation of the body and of epistemology. But the transformation will take place first in the modeling of a cybernetic, interactive order. The fascinating aspect of this is that innovation is emerging from the merging of the entertainment and scientific visualization industries. For all the scientific potential of the use of the computer, the radical innovation is coming from image industries ready to enact interactive television, interactive books, interactive news, and interactive images (I recently heard Bill Clinton described as the "interactive President"). If images are to become increasingly interactive, then a theory of representation must be evolved to account for the transaction provoked by discursive participation. Intention will become reciprocal. While this endangers the authorial position of the producer, it simultaneously must account for an audience willing to investigate the space of electronic expression. In a culture in which accelerated images constitute experience, the immediate becomes compressed and volatile. How this will reshape subjectivity without recapitulating essentialist characterizations will demand powerful resistance to the exaggerations of a post-gender or post-identity culture. After all, it is not data that substantiates, or constitutes the self, it is language and interpretation. The role of vision in interactivity has been rightly emphasized as central. Images have never contained the potential to sustain so much information, or, perhaps, meaning. At the same time, images have never contained so much fascinating disinformation. Weaving between the two, subjectivity must distinguish not between fact and fiction but between communication and discourse. Interactivity, as both a theory of production and experience, is emerging as the essential discourse of form and content.

"Sociomedia" signifies that when we design computer media we are hardwiring a mechanism for the social construction of knowledge," writes Edward Barrett in Sociomedia: Multimedia, Hypermedia and the Social Construction of Knowledge. The anthology presents the papers of the 1991 MIT symposium, "The Social Construction of Knowledge." The institutionalization of hypermedia as a pedagogical form will focus interest on education as a "virtual realm," a "hypercontext," a "virtual presence." Yet the models elaborated in the essays, though structured around the idea of the usefulness of hypermedia, replicate ideas of rote communication. Creative discursive interactions rely not on the networked ability to comment on others, but to situate oneself within a dialectic, not just a cause and effect model. A model of interactivity will have to include an assessment of the fragmentation of knowledge, a reformulated concept of identity within discourse as well as the creation of media to manage information dispersal, and a refigured model for access and distribution. Hypermedia cannot become a form of electronic democracy unless it is ubiquitous.

Images are increasingly perceived as "knowledge." Scientific visualization is achieving a revitalized status at the same time that the privatization of the image market drives visualization out of the research labs of NASA or the Air Force and into the entertainment industry. The convergence of cable, fiber optics, broadcast television, networked communication, the reinvention of the telephone system as an information circulatory system, the funding of the digital highway, the demilitarization of DARPA and Internet, and revitalized imaging models, to suggest a few, presents a scenario for the "textualization" of the smart machine (Shoshana Zuboff). But more than "smart," the machine will become assimilated in ways that need serious consideration.

Complicating this developing area are re-emerging relationships between text, image, and sound that cannot be articulated as linear or absolute. The relativistic potential for text/image/sound suggests a form of multivalent montage. Unhinged from the narratives of modernity, the combinations of these differing forms of expression are liberated from normative functions and are presented as potential. The consequence of this unsettled state of electronic visualization is the equivocal image. Legitimated by the perceptual models of photography and television and by the computed algorithms of perception, the electronic image vacillates between actuality and hypothesis. And while the issues of the photograph form a significant foundation for the understanding of images, the splintering of the ontological substance of the image is both welcomed and entangled in the intricate relationship between the legitimation of the subject of the image and the representation of the intention of the producer. So much of the status of the photograph was predicated on its necessary link with a concept of the "real" that it has been discredited. Instead of an ontological relationship, the image emerging in 'postphotography' is more reasonably positioned as epistemological and simultaneously 'distributed' or perhaps dispersed.

Technoculture's spectacle is that of distributed thinking, distributed identity, distributed text, and distributed processing. In the many metaphors that are emerging, the fragmentation of form and the prioritizing of content is one of the most interesting. Hypermedia and interactivity present a range of solutions that reside within the machine and do not confront the issue of technology as a material force. Its physical insubstantiality though cannot be mistaken for a lack of meaning. What emerges in installation, environmental, and immersion technologies is the constitution of experiential space. From education to robotics, the transformation of knowledge is occurring. Seymour Papert, director of the Epistemology and Learning Group at the MIT Media Lab, sees "no technical obstacle to creating a "knowledge machine" that allows navigation through a virtual knowledge space." (Obsolete Skill Set: The 3 Rs). Non-linear principles of form, in fact, are the measure of a culture accustomed to fragmentation and montage. Information in this environment comes as an array rather than as a sequence. Knowledge as sampling, experience as intentional, communication as transactional, hyper, and access on demand—these are some of the terms of technoculture, a culture of "nomadic madness" (as Jacques Attali calls it).

"If the social machine manufactures representations, it also manufactures itself from representations. Decentered, in panic, thrown into confusion by all this new magic of the visible, the human eye finds itself affected with a series of limits and doubts. The mechanical eye, the photographic lens, while it intrigues and fascinates, functions also as a guarantor of the identity of the visible with the normality of vision." (Jean-Louis Comolli, "Machines of the Visible") This remark about what Comolli identifies as "the frenzy of the visible," referred to the second half of the 19th century. But while the essentials are comparable, the culture of Modernity in which the mechanization of vision evolved has been surpassed. The mechanical has been usurped by the technological. Images can no longer guarantee the legitimacy of the "normality" of seeing. The "frenzy of the visible" might be adapted to read "the frenzy of the virtual." But even considering the efficacy of representational issues, a structural difference exists between the panoptic authority of modernity and the transoptic discourses of postmodernity. The privileging of vision in modernism as revelatory has been outdistanced by the practices of deconstruction as participatory.

Without the lingering metaphors of escapism and rationalization, an art can emerge that is no longer self-reflexive and autonomous, an art that is deeply transformative in its ability to alter the terms of interaction. Creativity and technology might emerge on equal footing, but what will drive this field forward is a commitment to content based ideas. Jim Pomeroy, an artist of enormous scope, wrote in one of his last essays before his death in 1992:

"Technological art is even less likely to fulfill the aesthetes' divine regard for "timeless" art, since a good deal of the art produced with advanced tools can become obsolete quite quickly. Intelligent and accessible applications take a back seat to ever fresher tributes to corporate mystification on the part of commercial illustrator/programmers. In contrast to the remote, exclusive aura of tasteful connisseurship, techno-art is usually directly engaging and context specific. While over performing the roles of Recognition, Simulation, Containment, Inversion, Projection, Estrangement, and Identification, techno-artists have long been busy building up their own store of technical knowledge necessary for survival."

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Hack

IAN HAIG

Independent Artist

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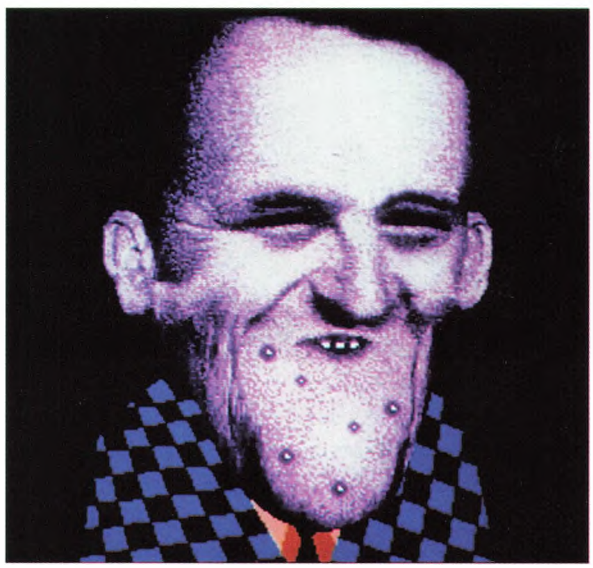
Hack is an interactive work informed by the electronic terrain of pop culture and the cultural history of comic books, cartoons, and computer games. The work is presented and designed in the guise of a simple computer game and carnival amusement display, a site that both culturally and historically has long been associated with notions of 'interactivity' in different ways. Therefore, one of the intentions of the work is to re-define our notions of the interactive in technological-based art, while looking over our shoulders to the video arcade and carnival sideshow.



The other cultural reference that the work draws upon is the Frankenstein monster, which serves as a central theme in the work: as a body made up of other body parts, a head made out of different heads, part robot, part human, part mutant, part machine . . . digitized, scanned, and robbed from the data banks of pop culture.

The computer game itself is often dismissed as the territory of pop culture—not worthy of serious consideration in the realms of art and interactive media. However the computer game and video arcade can reveal not only the fundamentals of many simple interactive concepts, but more important the video arcade has seen the standardization of certain concepts of interactivity emerge between user and computer in contemporary popular culture. Simultaneously simplistic/restrictive/limiting and addictive/involving/entertaining. . . whether its saving the planet from that alien invasion or searching for that elusive pot of gold.

For the generation that has grown up with Nintendo and Atari, the simple concepts of interactivity found in your average computer game appear almost second nature, like riding a bike. Their ideas and functions are instantly picked up on and related to, in a sense having become 'naturalized.' With this in mind, Hack (in a quite simple way) attempts to draw on and cast one's eye not to the simplicity of the computer game, but rather to look at concepts in computer-interactive art through the eyes of the video arcade: the cultural site, where a particular computer-interactive language is currently being written as we speak and encoded into the imagination of a generation.

Consists of multiple sections of a computer-generated head. The objective is to locate the central nervous system, or brain, by working through a maze of different sections of digitized heads. The user must deconstruct the display/game, through a process of elimination, by working through the different graphic variables. In very simple terms, this is just like a computer 'hacker' deconstructing the code of a particular program.

Hack is the first in a series of computer interactive artworks in the guise of simple computer-graphic games, which seek to close the gap between art, graphics, animation and computer/video games, using the interactive potential of the computer.

Hack proposes a design prototype for an interactive computer interface away from mouse-driven, text-based applications/presentations and a break with the standard tools associated with authoring/ interactive multimedia software.

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Handsight

AGNES HEGEDÜS

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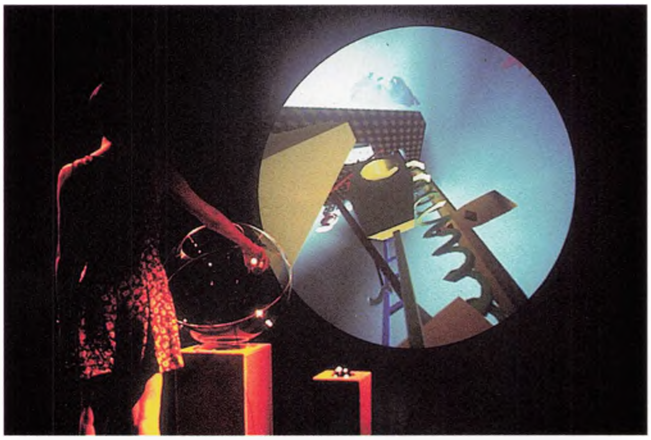
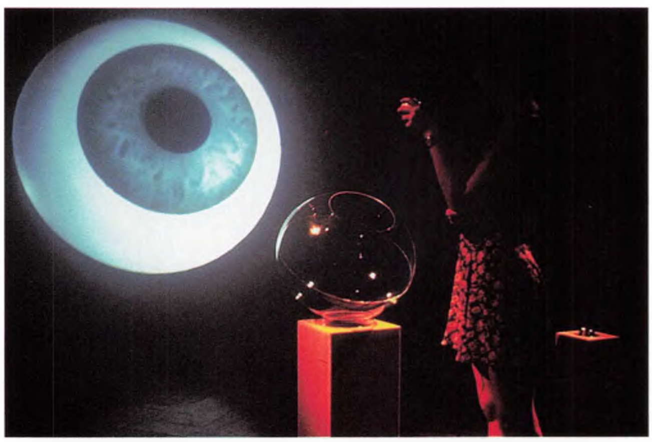
This work emphasizes aspects of virtuality, such as telepresence and disembodiment/re-embodiment of the senses. Handsight also affects a transverse relation between the virtual and the real by correlating a specific physical object with respect to its virtual representation. This is done within the circumference of a visual environment where the imagery becomes a spherical anamorphoses that embodies an augmented field of view—an 'endoscopic eye.' The thematic structure of this work is implied as an exteriorized phenomenological projection of psychological and symbolic spaces.

All elements coherently merge in one environment that is constituted by three main apparatuses, accompanied by a ready-made object: 1) a large circular projection screen onto which real-time computer graphic imagery is projected; 2) an interactive interface that the viewer holds in his/her hand. This looks like a large eye-ball, containing a sensing device that accurately measures its spatial position and orientation; and 3) a large transparent Plexiglas sphere with a hole in its center, into which the viewer can insert the eye-ball interface and then move it about inside. This sphere provides the viewer with an 'endo-spatial' enclosure that manual exploration maps directly into the representation of the virtual domain.





The eye-ball thus becomes a disembodied object—a virtual camera moving freely in space. The subject of observation in this real space is the transparent sphere, which when 'looked at' by the eye-ball, is itself seen to be represented as a virtual eye on the projection screen.

When actually entering the transparent sphere with his/her hand, the viewer also enters this virtual eye through its iris, and then confronts an image tableau that is located within this virtual space. Exploring the inner space of the transparent sphere, the viewer also explores the scenography of this virtual image tableau that is spatially located within the sphere. This conjunction of a virtual and physical space is achieved because the eye-ball interface communicates to the computer the exact coordinates of its point of view with reference to the physical sphere, and the computer then generates a representation of the virtual scenography onto the round projection screen in front of the viewer.

The physical sphere establishes a boundary in the virtual world between the exterior representation of an eye and an interior representation of an image tableau that is implicitly contained within this eye. Outside the actual sphere the hand held eye-ball 'perceives' the virtual eye as an object (macrocosmos) that is conventionally represented in a traditional perspective view.

This inside universe represents, as a computer-generated model, the iconography of a specific type of Hungarian folk art. That tradition created miniature religious scenes in glass bottles, and one example of such a bottle is also shown in the Handsight installation, illuminated in a box behind the viewer. The choice of this contextual reference was felt to be appropriate because such a bottle tableau also expresses a sign for mental (virtual) spaces enclosed in the world of physical forms.

Handsight is an interactive computer graphic environment by Agnes Hegedüs, first presented at the Ars Electronica in Linz, 1992. Application software by Gideon May and Richard Holloway. Produced with the cooperation of the Zentrum für Kunst und Medientechnologie Karlsruhe.

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Room of One's Own

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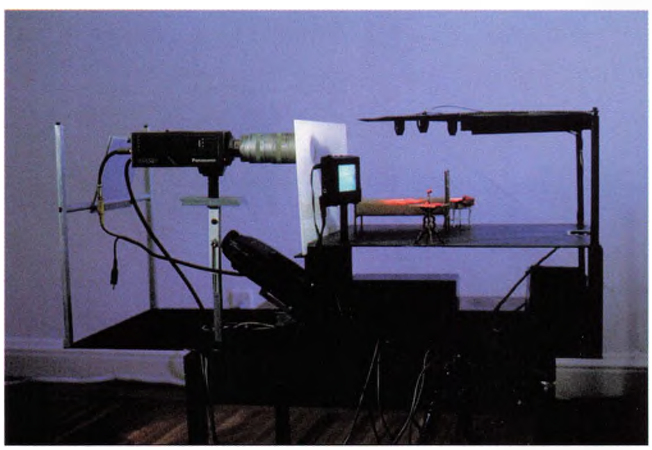
Room of One's Own is a computer-based installation in which the viewer initiates operation simply by "looking inside." The viewer voyeur's eye movements trigger the video and computer action. Constructed to reference early "peep shows" as well as feminist concerns about the construction of female identity, the viewer/voyeur is required to peer into a small specially constructed bedroom scene. A tiny video camera digitizes the eye movements and sends the signal to the computer, which causes the videodisk to access proper segments.

This pieces is not only about voyeurism but also about how one responds to being looked at. Several objects are situated in the tiny bedroom, including a bed, telephone, table, and television. Modular video segments are accessed as each is looked at. A Room of One's Own is also designed to respond to the viewer's physical presence via audio sensors placed beneath the mat upon which the viewer stands. Sound and words enter the environment and, like sirens, invite response. The image of the viewer's eyes are inserted into a small television set in the tiny room, making the viewer/voyeur a 'virtual' part of the scene being viewed.



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Faraday's Garden

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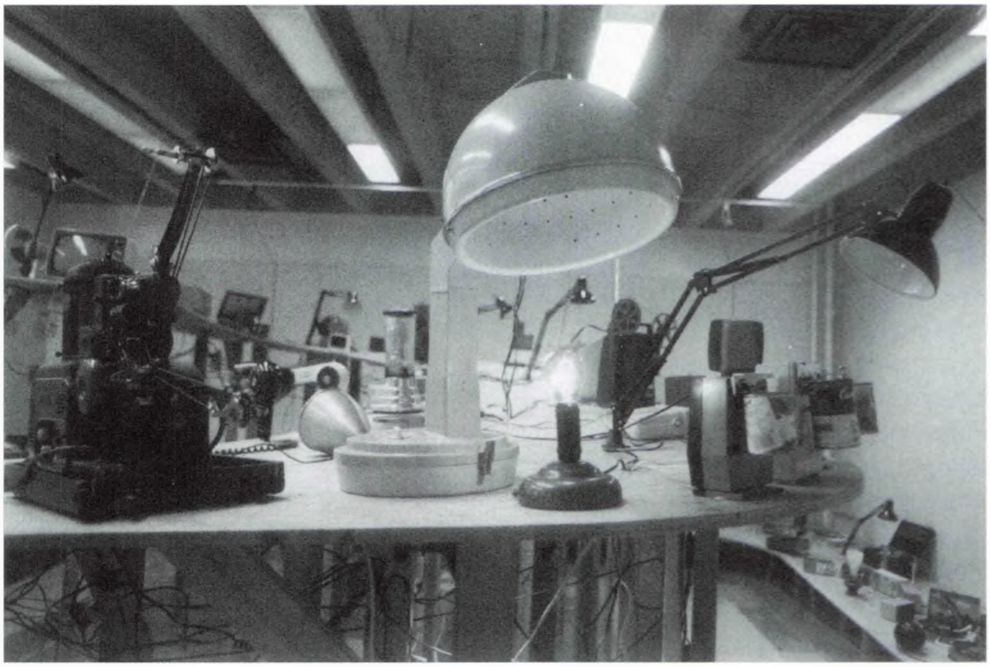
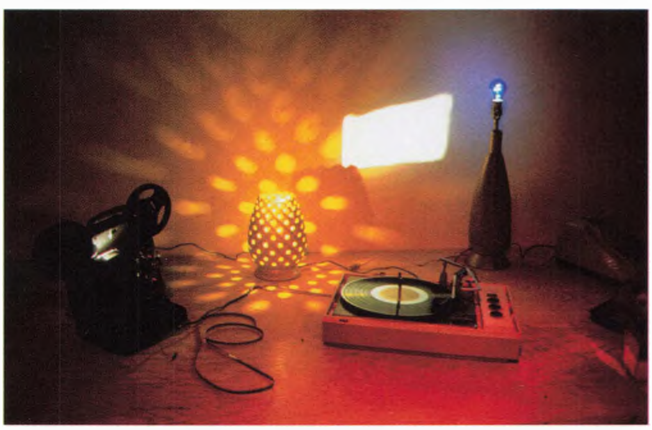


In Faraday's Garden, participants walk through a landscape of innumerable household and office appliances, power tools, projectors, radios, phonographs, and various other personal comfort devices. The floor of the room is carpeted with switch matting, a pressure-sensitive covering designed for home security systems.

The machines wait silently, ready to be activated at any moment by the footfalls of the public. When stepped upon, the switch matting triggers the various machines and appliances, creating a kind of force field of noise and activity around each viewer. Participants can control the machines' performance by their path through the room. As the number of participants increases, the general level of cacophony rises, creating a wildly complex symphony of machines of machines, sounds and projections.

The switch matting is broken up into a path of 96 separate input patches, with each being fed to a computer, which determines which of 96 relays (each controlling one or more appliances) are affected. Through software, the dynamics of the piece can be modified based on factors ranging from the number of participants to the time of day. The behavior of the machines can change to reflect the participants' presence, speed, or movement.

Faraday's Garden is conceived as a kind of technology garden. It is named after Michael Faraday, the great 19th century scientist, who was (among other things) the inventor of the first electric motor.



The machines and accessories (such as tapes, films, slides, and records) are collected primarily from thrift stores and flea markets. Since they span most of the 20th century (ranging from the Great Depression to the ultra-contemporary), movement around the room also functions as a kind of time travel.

Household appliances are coveted and exploited when new, then discarded and forgotten when obsolete. We maintain a kind of amnesia about these machines, as each is replaced by newer, more efficient models. So Faraday's Garden is an unruly, untended place, forgotten and overgrown. All wires and switches are left exposed, creating an intense environment of electrical current.

Interaction in Faraday's Garden fluctuates between a sense of complete and effortless control of technology (since you don't even have to lift a finger), to the lingering and disturbing feeling that these machines are somehow...alive, sensing and responding to your presence.

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"It is Interactive —but is it Art?"

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"The possibilities of egalitarian, more democratic, constructive forms offering new kinds of interaction, knowledge, and understanding may well be enhanced by the novel capabilities of the new technologies. They will, more than ever before, have to be struggled for."

— Andy Darley

The Myth of Interactivity

"Well, my next thing is going to be something interactive..." For some years now, this has been a stock answer in interviews with artists, and not only those who already work with electronic and digital technologies. Indeed, "interactive art" seems well on its way to becoming the art form of the 1990s. Yet one shouldn't let its present visibility delude oneself. Although contemporary interactive art may seem "groundbreaking," the ground had already been grubbed by such movements as Fluxus and E.A.T. (Experiments in Art and Technology) in the 1960s, as well as by a great variety of "postmodern" strategies, emphasizing recycling, deliberate confusion between "the original" and "the copy," and aiming at repositioning, sometimes to the point of reconstituting, the traditional art audience.

There seems to be more and more agreement that interactive art is the art form par excellence using the computer. Even though it was born before it, the introduction of the personal computer in the late 1970s certainly gave it a strong spark. But as interactive art is now proliferating, it must face new challenges. Doing "something interactive" with the computer may have been a sign of bold artistic innovation and on conformism ten years ago, but it certainly isn't it anymore. Since then, real-time visual computing has become commonplace and user interface design has undergone a dramatic development. An immense number of interactive systems from bank automats and game consoles to digital highways and sophisticated surveillance networks have been installed everywhere in the post-industrial society. Interfaces are, quite literally, inter more and more faces in daily life.

This pervasiveness of interactive system seems to have given rise to a process of mythicization of interactivity. There is a discrepancy between the ideological discourses surrounding and molding the concept, and the actual practices applying interactive technologies. The concept "interactivity" itself has become an empty signifier. It is used in vague and non-specified ways, lifted up from the actual historical processes of its becoming. It refers to a general cultural change, announcing the advent of a "society of interactivity." It is offered as a remedy against almost anything, from the relentless bombardment by the media industries to problems in education and personal psychology. The French critic Pierre Moeglin sees the discourses on interactivity as just another intellectual fashion. He ironizes the "trances of interactivity," the traces of which he perceives all around himself—in 'liberal' pedagogy, in sociology that emphasizes the role of informatics, and in the Lyotardian 'postmodern condition' of knowledge.

According to Moeglin, the idea of interaction, as manifested in our communication with different interactive systems, isn't equivalent to the idea of interactivity, which is a more abstract and general concept.[1] The fact that we engage in daily interactions with all kinds of mechanical and electronic devices isn't enough to prove that a change would have taken place in the basic quality of our lives. In other words, the existence of interactive systems doesn't automatically imply a democratic turn, a redistribution of power from "the producer" to "the consumer," or a reorganization of the information traffic. The concept of interactivity can be effectively used to disguise strategies for marketing, surveillance, and exercise of authority. This may be particularly effective, because it takes place in the name of the "individual initiative."

Interactive systems have, of course, "potential for change," but it has to be realized by the user. Unfortunately, most users easily submit themselves to the pre-defined modes of interaction imposed on them by system designers and marketing organizations. In most cases, these systems explicitly aim at automating the experience. This is reflected in the user interface design, which often has recourse to anthropomorphic and non-technological metaphors. The interaction has to take place as "naturally" as speaking, breathing, shaking hands, or making love. While this may offer possibilities for truly extending our sensory capabilities (a la McLuhan), it may also help to disguise the fact that the interactive system is never "innocent," free of ideological, political, and economical determinations.

Interactive Art in Two Worlds

Interactive art is in obvious danger of succumbing to these mythicizing tendencies. This becomes evident in pieces—I have see quite a few of them—that can, at most, be read as naive celebrations of technology. In such works the value of interactive technology is taken for granted, as creative and marvelous, and enough to justify the label of art. In other words, a system is displayed as art, and the technology itself becomes the attraction. Some critics have drawn parallels between the early history of cinema and the early history of digital systems.[2] In Lumiere brothers screenings their Cinematographe was the main attraction; the "art" of the cinema, its syntax and vocabulary, developed only gradually. Similarly, many interactive works might be explained as representing a very early stage in the development of interactivity as an artistic medium. There is, however, already enough evidence of critical artistic approaches to the technology to counter such excuses.

The problem here seems to be deeply intertwined with the definitions of art and the changes it has undergone during this century. As Martha Rosler and others have convincingly shown, "art" is not something eternal; it is conditioned by constantly changing discursive practices, particularly those originating in the "art world" (a loose system of museums, galleries, critics, dealers, art journals, collectors, and of course, artists).[3] Even though the old idea of art as a (collectable) object still has currency, there is now a wide agreement that art is really about contextualization, about creating conditions for perceiving something as art.

It is difficult to get a hold on interactive art, because it is split between different contexts, which, respectively, have different definitions for it. The two main camps are the art world and the "computer world," as exemplified by the SIGGRAPH conference. There is surprisingly little communication between them, either on a concrete or on a discursive level. A statement like the one by William Bricken, a leading virtual reality systems creator, "The 3D sound stuff at NASA is art. Myron's [Krueger] work is art. The code in the VEOS [Virtual Environment Authoring System] is art—that is, some coding style considerations are motivated by aesthetics," would hardly make sense in the art world—embracing everything is equal to nothing.[4] It does, however, make sense in the computer world, representing the flip side of corporate control, a "liberating" outlet in the midst of scientifically, functionally, and commercially oriented research.

The nature of art in the SIGGRAPH art show becomes really visible when contrasted with the trade show, the main commercial and technological focus on the conference. Art in the art show represents something which is not immediately functional. It is a kind of creative pastime, which is, however, close enough to the hard-core research to enjoy a certain respectability; it testifies to experimentation that could (and in some cases will) influence serious research and product development. Another characteristic is the treatment of technology as something value-free and neutral—only exceptionally have the pieces in the art show addressed questions about the ideological and political determinants of computer technology and of the institutions that support it. Whether this depends on the curatorial policy or on the works available, it is difficult to tell.

Against this background it is not surprising that Bricken mentions the work of Myron Krueger. While Krueger enjoys unquestionable authority as a great computer scientist, he himself has often stressed that his famous artwork-in-progress, VideoPlace, is without a practical purpose and meant to advance human creativity through the user's "playful" interactions with the system.[5] This means taking a stance, implying that the system could, but will not be, used for commercial and perhaps even for military purposes. Krueger's ethical stance is strengthened by his resistance to "totally immersive" systems, such as virtual reality. He is against "isolating people" and alienating them from "the other activities that take place in a work environment."[6] While all this is admirable, it also has contributed to making Krueger a somewhat marginal figure in the computer world.

Krueger's attitude contrasts with that of the Vivid Group, developer of the Mandala, another interactive "artificial reality" system, which bears remarkable similarities to VideoPlace (which precedes it by several years). Just as VideoPlace, Mandala has often been seen in the art context in the computer world. The basic differences in attitudes are reflected already on the hardware and software level: while Krueger painstakingly built his own hardware and software, the Mandala software was from the beginning meant to run on customary Amiga computers. While Krueger has stuck to constantly improving and demonstrating his system, Mandala has already been applied to several different purposes. Vivid Group's corporate videotape lists possible fields of application: video games, public installations, music video, education, corporate communications and training, teleconferencing, performance art.

Mandala is marketed as a master product that is able to accommodate all these different, sometimes ideologically conflicting, applications. In those art contexts where I have seen Mandala exhibited, the application hasn't, however, really been differentiated; the worlds interacted with have closest-resembled prototypes for video games.[7] The technology itself has clearly been the main attraction. The difference between "installation" and "demonstration" has been blurred. I have heard an explanation, according to which the "art" in the situation is not in the system itself, but in the activities it stimulates in the audience; this sounds like a vague echo from the happenings of the 1960s. Yet, it isn't very different from the pedagogical principles followed in the interactive displays in science museums. Of course, there is hope that some artists will adopt Mandala as their medium, and do something different with it. So far I have seen little that is convincing.

The Quest for Context

Timothy Druckrey provocatively writes in his review of SIGGRAPH '91 "it seems as if the field of computer imaging as a whole is constitutionally incapable of self-reflection," but his appeal comes straight to the point: "What is urgent but largely absent is an approach to the field that accounts for the contexts and consequences of image production."[8] While it would be too much to say that the interactive art originating from the art world would "as a whole" provide the answer, it unquestionably has some advantages. Even though it in most cases is dependent on public funding and technical expertise "from the outside," it is clearly less tempted to succumb to the views of the military-industrial complex.

While I don't want to lapse into a neo-totalitarian view of the latter—the "artist in residence" in a company- or a government-sponsored research center may enjoy a considerable amount of freedom to experiment—there seems to be a silent consensus about what is desirable and what is not. I am yet to see anything form that context that would match for example Jeffrey Shaw's interactive works in complexity and critical edge. Shaw, an Australian who has worked during most of his career in the Netherlands, has enjoyed funding from Dutch and French public resources, and is currently director of the Institute for Image Media at the ZKM (Zentrum für Kunst und Medientechnologie) at Karlsruhe, Germany.

Shaw's oeuvre is characterized by extreme coherence and density, and simultaneously by multilayered intertexturality. On one level, it can be interpreted as a continuing dialogue with the technologies of seeing, both from the present and from the past. In Shaw's work these technologies are always seen as inherently problematic, embedded in complex networks of political, economic, and social-psychological determinants. His series of "virtual voyaging" installations invites the participant on philosophical journeys, to explore and deconstruct these "machines of vision," and thus to question his/her own position as a viewing subject submitted to them.

A case in point is the unjustly neglected Inventer la terre (1986), a permanent installation commissioned by La Villette science center in Paris. The gilded steel column standing on a round black terrazzo pedestal invokes associations to ancient cosmological monuments (a la Stonehenge). Simultaneously, it is a kind of periscope with an eyepiece for the viewer. S/he can turn the column around, revealing gradually a panoramic view of the surrounding science center. However, there is another panorama superimposed on this one; a string of computer-generated views, depicting different cultures' ideas about the origin of the earth is seen "floating in the air." By pressing the handles on both sides of the eyepiece, the users can animate these views, as if launching a torpedo.

In a characteristic way, Shaw has amassed a great wealth of associations in an impressive, remarkably condensed form. Numerous polarities can be detected: ancient and modern, myth and history, rational and mystic, real and virtual worlds. Technologies used for surveillance and destruction are foregrounded. Through a kind of détournement they are transformed into philosophical instruments, stimulating reflection on the relativity of the foundations of our world views. But Inventer la Terre can also be read as a very early contribution to the current discussion about the implications of virtual reality technology. The view from the eyepiece actually evokes Ivan Sutherland's pioneering "see-through" helmet from the late 1960s.

Metacommentaries

Jeffrey Shaw's work is an example of what I have elsewhere called metacommentaries on interactivity.[9] This concept refers to an activity that aims at continuously de-mythicizing and de-automating prevailing discourses. The point of reference is the Russian Formalist thinking about the functions of the poetic language; its relatedness to the ideology of constructivism seems particularly fit here, considering the nature of production in technology-based art. Shaw's installations are his metacommentaries; they are spatialized sets of statements that often find their basic inspiration from ideas "in the air," such as a "virtual museum." These ideas are then probed, modified, and re-contextualized in the process of interaction with the participant.

Likewise, Lynn Hershman's interactive videodisk installations Lorna (1983), Deep Contact (1990-92), and A Room of One's Own (1992-93) are an impressive series of metacommentaries around gender, technology, and power. Hershman has been particularly concerned with the ways in which (male) desire has been built into the pseudo-interactive strategies used by commercial television, erotic peep-shows, etc. Toshio Iwai's works have been appropriately called "another evolution of moving images."[10] It could also be characterized as an on-going media archaeological excavation project. Iwai is particularly obsessed with pre-cinematic devices, such as zoetropes and flip-books, which he then recreates in new contexts, using surprising technological solutions. The interrelations between past and present, between "poor" and "rich" technology belong to the basic ingredients of his art.[11]

While Iwai belongs to a younger generation, it is important to note that both Shaw's and Hershman's art is deeply rooted in the artistic ideas and sensibilities of the 1960s. Their involvement with interactivity started long before they turned to digital technology. Also, it embraced many different media and approaches, from Shaw's work with inflatable structures and expanded cinema to Hershman's involvement in life art and performances in public spaces. In both cases the continuities between works using different media are much more important than discontinuities; something to think about for those who are all too keen to identify phenomena like interactivity with the appearance of certain technologies. What's more, Jeffrey Shaw's early work shows quite clearly that artists may anticipate technologies that are still in their infancy.

Even though it is extremely important that artists get personally involved in software and hardware development, it is equally important that their involvement doesn't stop there. There remains a need to make a distinction between a creative computer scientist and an artist, however difficult it may be. Interactivity is still primarily a mental and intellectual, and only secondarily a technological activity.

This applies also to the user/participant. However, it is important to counter arguments that state that interactivity is really only between the observer's ears; according to this view it doesn't matter if one is observing a painting or navigating the virtual world of Matt Mullican's "VR-painting" Five Into One, if one possesses an open mind and average mental capabilities.[12] It does matter, of course, but much depends on the challenges posed by the application in question. Interactive systems may quite well excel in promoting intellectual laziness. A simple stimulus-response model can advance business or provide entertaining pastime, but it is hardly enough for the higher goals of promoting "[t]he possibilities of egalitarian, more democratic, constructive forms offering new kinds of interaction, knowledge and understanding."[13]

Notes

1. Pierre Moeglin: "Les Transes de 1 'Interactivite," Les Transinteractifs, redigee par Derrick de Kerckhove et Christian Sevette, Paris 1990, 105-106.
2. For a critical treatment of this theme, see Andy Darley: "Big Screen, Little Screen: The Archaelogy of Technology," Ten.8: Digital Dialogues, Vol. 2, No. 2 (Autumn 1991), pp. 78-87.
3. See: Martha Rosler: "Lookers, Buyers, Dealers, and Makers: Thoughts on Audience," Art After Modernism: Rethinking Representation, New York: The New Museum of Contemporary Art and David R. Codine publishers, 1984.
4. cit., Brenda Laurel: "Artistic Frontiers in Virtual Reality," SIGGRAPH '92 Visual Proceedings, edited by John Grimes and Gray Lorig, New York: ACM, 1992, 60.
5. Most recently I heard him talk about this in his presentation at the TISEA conference, Sydney, November 1992.
6. Myron W. Krueger: "Videoplace and the Interface of the future," The Art of Human-Computer Interface Design, op.cit., p. 420; Myron W. Krueger: Artificial Reality II, Reading, Massachusetts: Addison-Wesley Publishing Company, 1991.
7. For example, Ars Electronica (1990), SIGGRAPH (Tomorrow's Realities, 1991, and G-Tech, 1992), MuuMediaFestival (1992), TISEA (1992).
8. Timothy Druckrey: "SIGGRAPH '91: Gambling on Empty," Afterimage, Vol. 19, No. 8 (March 1992), p. 2.
9. Erkki Huhtamo: "Commentaries on Metacommentaries on Interactivity," Cultural Diversity in the Global Village, The Third International Symposium on Electronic Art, Edited by Alessio Cavallaro et al., Sydney: The Australian Network for Art and Technology, 1992, pp. 93-98.
10. In a reportage about Iwai's work in the TV program, "What's Next," TV-Asahi, Japan, March 10, 1991. Toshio Iwai kindly provided me with this source.
11. Iwai partly finances his artistic production by creating technically innovative television programs for Japanese commercial television companies, such as Fuji TV. In Japan this is often, beside teaching, the only survival strategy for a media artist.
12. I am referring here to the debate raised in Finland by my publication, Virtuaalimatkailijan kasikirja [The Handbook of the Virtual Voyager], Turku: Lahikuva, 1991.
13. Darley, op. cit., p. 87.

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Hyper Scratch

HARUO ISHII

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Hyper Scratch presents an active creative space with an interactive system that is like a video game in which any person can easily take part.

Real-time synchronization of sound and images is achieved through the use of a personal computer. A touch panel is mounted on a monitor. This interface makes it possible for non-technical persons to interactively manipulate images and sampled sounds. These sounds and images are combined with a set audio rhythm through the use of a digital sampler and a personal computer. The images are then projected onto a 100-inch screen using a liquid crystal video projector, and are accompanied by stereo sound.

I want to examine contemporary society, international events, technology, and communications media. TV, radio, facsimile machines, and personal computers are said to have played a key role in providing instantaneous worldwide communication of events such as the collapse of the Soviet Union, the splintering of Eastern Europe, and the student uprisings in Tianamen Square. A lack of international communication may have been a contributing factor to the misunderstandings that lead to World War II.

In the Vietnam War and the Gulf War, called by some "television wars," real-time reports on television influenced the prosecution and outcome of the battles as they occurred. Today, political systems exist that attempt to control the information its people receive. If people are able to receive information directly, free from the control of their rulers, oppressive political systems embodied in those rulers will become untenable. As the Cold War has ended, the world has become more fragmented. It is becoming increasingly dangerous to depend on traditional political systems and values. Independent thinking is paramount in this new, uncertain environment.

Tools like ISDN allow fast, personal exchanges of large amounts of information. Soon, conventional text-based data will be replaced by visual images and sound. The value of face-to-face spoken communication may change. Electronically assisted communication will allow deep, direct communication between individuals with diverse linguistic and cultural backgrounds.

North Korea, a country that is very close to Japan, has limited communications with the rest of the world. In its isolation it has threatened to become a nuclear renegade. As a citizen of the only country that has been the recipient of a nuclear attack, I am very concerned about this issue.

Perhaps, through work such as Hyper Scratch, subjects such as nuclear proliferation may receive greater exposure to ordinary citizens. Through the use of an interactive system, I hope to symbolically express the closeness that all people share as citizens of this world.

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Blind Date

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As we approach the millennium, we find that we are unsure of what we are looking for and where we are. The information pollution that befuddles the mind leaves a wake of uncertain melange of people and machines blinded by information overload.

Our world generates a dizzying conflict of messages, desires, and revulsions within the amalgam of the post-postmodern world. It is about being overwhelmed and underwhelmed. Opposites are compressed into a new intentionally dysfunctional unity. It is about the birth of double and triple reverse psychology, double reverse satire and irony. I, myself, am suffering from plot twist overload.

Blind Date is an interactive installation that uses a touch-screen monitor to invite the viewer to touch an image of a hand. The monitor reclines in a mock seductive pose amid sexy fabric. When the viewer touches the hand on screen, the hand becomes aroused. The tension of machine arousal is heightened by a voice that pleads, "No, oh God, please no!"

This piece underscores the confusion over gender and body issues as we embrace technology. As technology has progressed, we have injected it into many aspects of our lives, including sexual and emotional intimacy. From pin-ups to blow-up dolls, phone sex, and bi-coastal relationships, machines have enabled the distancing of intimate behavior. A recent direction is interactive pornography on computer screen.

Machines provide a new intimacy. Are we simultaneously intrigued and alarmed by the horribly mixed messages presented by the media and by those that we encounter in our lives?

The Distancing of Intimacy: Toward Machine-mediated Closeness

I would like to share my views as an artist involved with questioning the changing modes of intimacy arising from the influence of technology.

It would be helpful to reflect for a moment on the traditional connotations of intimacy and intimate behavior. The term, "intimacy," as commonly defined, includes the innermost, most private or personal thoughts or activities of a person. Intimacy requires closeness and familiarity, and can be a deeply personal expression of thoughts or feelings through voice, touch, or gesture. It denotes a wide range of human behavior—from sexual intercourse to revealing oneself verbally, to the interaction of a painter with a brush and paint, to an auto mechanic rebuilding an engine. Something personal is revealed in each of these acts. For me, the cornerstone of intimacy is personal revelation.

Technology is becoming an intermediary for intimate expression. This creates a physical, emotional, or conceptual distance between the participants in an intimate act. Protected by distance and anonymity, a participant in a discussion group on an electronic network can reveal highly personal information to strangers or to invent alluring fictions. The physical protection afforded through networks acts like a barrier against assaults on the self, thus allowing great latitude for newly invented intimate behaviors.

The new, more distant intimacy is increasingly commonplace. Increasing use of long-distance transportation and communication allows remote contact. As distance is spanned more conveniently than ever before, we will intensify our contacts over distance, while diminishing involvement with contacts of proximity. In fact, for many people, long distance is more than "the next best thing to being there"— it is preferable. Years ago, some found it useful to keep relatives at a safe distance in a nearby town or city. As transportation improved, the perceived separation decreased, so that today many adult children prefer to avoid living in the same time zone as their parents. Some long-distance love relationships work in spite of their difficulties, only to crumble when the partners eliminate the miles between them.

Indeed, many find remote intimacy more comfortable. By keeping those close to us at a distance, potentially damaging confrontations are limited.

The physical presence requisite in traditional notions of intimacy is being redefined. Virtual presence through immersion in cyberspace will overtake physical presence. This shift brings profound implications for human interaction. The ultimate cyberspace might be one that cannot be distinguished from original reality. As cyberspace becomes increasingly sophisticated, intimate behavior will increasingly direct itself into virtual reality and away from material reality. As greater numbers of people spend greater percentages of time in the virtual domain, human-to-human communication—and skills of intimacy in general—will diminish from lack of use. In the near future, many of us may experience diminished interpersonal skills. This is already evident among children who become absorbed by video games and television. In a world of deteriorating social skills, the apparently less threatening world of cyberspace may serve as a haven for an increasingly dysfunctional society.

New products will arrive that plunge us deeper into an expanding definition of cyberspace. We can already envision a market for communication devices that mediate between people in conflict. Acting like a language translator for two people with a common tongue, the device listens to the words of each, decodes the essential meanings, strips them of inflammatory, racist, gendered, or other objectionable language, then presents the cleaned-up translation to the other person. Thus, the distancing of intimacy might be viewed in terms of the number of layers of mediation or its complexity.

As we become increasingly accustomed to machine mediation, our tolerance for human patterns of interaction will be tested. Today, most people recognize that humans are more fallible than machines. I can't help but wonder if we stand at the threshold of a massive human inferiority complex, in conjunction with increasingly mixed emotions toward both people and machines. At what point might someone abandon all attempts to deal directly with others and retreat into the embrace of a machine-mediated reality?

I don't want to imply that intimacy will necessarily fade away, but rather that new kinds of activities that feel intimate are already evolving. Human-to-machine intimacy is increasing within both mundane and grandiose arenas. An office worker may have more physical contact with a computer keyboard than with any person. In addition, on a non-physical level, the worker most likely has detailed knowledge of the inner workings of her favorite programs and understands how to avoid making them angry (crashing), and can negotiate their quirks and weaknesses. On a grand level, the virtual reality community is pushed by an incredibly powerful drive for immersion into an intimate interplay with machines. To what extent will human-VR intimacy provide a safe, convenient alternative to human-to-human intimacy?

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"Onyrisk" is a word play in French: «ony» comes from the term «onirisme», which refers to the dream state; «risk» was added to qualify the unknown involved in the interactive experience.

Onyrisk offers interactive surrogate travel through allegorical representations of dreamlike sequences. It is an experimental work that develops tools for a new interactive art form, which explores the limits of interactivity as applied to time-based material. The eerie texture of the visual, combined with an equivalent soundtrack, were chosen to enable greater connectibility among the different components; the global interactivity of our work is enriched by its combined potential.

In our normal state of consciousness, we are continually assailed by images surrounding us; we store those that are personally meaningful. By the time they settle in our memory, and eventually our unconscious, these images have been transformed by the filters of our personal perceptions. According to our differences and previous experiences, we create associations, arrange them in hierarchies of meaning, and give them emotional qualities.

During the sleeping state, the unconscious draws on this large repertoire of images and plays with them, juxtaposing, superimposing, and giving them an ambient and a symbolic quality. Onyrisk reproduces this process, but unlike dreams that remain essentially private, it exteriorizes the process and creates a communal and interactive experience.

Onyrisk is an attempt to implement true computer interactivity in the deep layers of the audiovisual, tracking and taking each of the viewers' decisions into account before moving on to the next sequence. Its interface is both fluid and full of the unexpected: it offers diverse images and sounds to the user in a fashion of ordered randomness.

Each user assists the computer in the creation of a unique path reflecting his/her own aesthetic and emotional patterns. In the process, s/he performs a sort of public dream. The experience is again analogous to the dream state in that only significant fragments are remembered. And these images will in turn perhaps become the source of new unconscious recombinations and transformations in future dreams.

Onyrisk is both a work in progress and a continually evolving project. It is the tangible expression of our theoretical work on interactivity, art, symbolism, and the conceptualization of hypermedia applications.

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Virtual Cage

CHRISTIAN MÖLLER

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The tactile becomes visible, the visible becomes audible, and the acoustic visible. Interactive architecture "conveys" impressions in another sense dimension: what is cast into question and becomes an object of playful development is the medium in which things appear to us.

The Virtual Cage is an installation intended to describe an architectonic space by means of a computer-controlled multi-channel audio system.

A glass platform that the viewer can walk across is located at the center of the installation. The platform is 2.5 by 2.5 meters in surface area. The glass components are mounted on a mobile, hydraulically cushioned steel structure. Two optical angle decoders, mechanically translated into the installation's two horizontal axes, transmit the platform's respective position to an IRIS Indigo workstation—it is continually tilted back and forth by the viewer's movements. The platform is surrounded by a five-channel audio-system, with four loudspeakers positioned in the installation's corners and one suspended directly over the middle of the platform. If one imagines there to be lines connecting the speakers and the floor of the installation then one is essentially imagining a wire model in the form of a cube: the "Virtual Cage."

This cage is filled with a swarm of individual dots that obey the laws of gravity and move around in space according to the tilted angle of the platform. The swarm-like being that gives rise to in turn generates the sound. The sound consists of the digitalized sounds of underwater insects, which could be diversified in it's complex structure in the moment of maximum closeness to the viewer. This effect is made up by fading a second sample sequence into the sound. Via a midi-mixer the computer steers the sound in space. The viewer thus experiences acoustically the dimensions and the limits of the space surrounding him or her and which is otherwise invisible and therefore not accessible to perception.

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Small Planet

MYRON W. KRUEGER

VideoPlace

The Videoplace was conceived in 1969, simulated in 1970, and first exhibited at SIGGRAPH '85 in San Francisco. Since then, its development has been updated in the SIGGRAPH '88 and '92 Art Shows. It is the origin of the concept of a shared telecommunication space and of unencumbered full-body participation with a graphic world through video projection of computer graphics—a format that so far is more attractive to artists than head-mounted displays. In this exhibit, several Videoplace installations will be networked together to allow participants to interact in a single graphic world. This installation is a departure from previous work in that the world portrayed is 3D.

We all know that the earth is round and that anyone who ever thought otherwise was an idiot. At least, that is what we are told. In fact, we have no first-hand experience that tells us that this is true. We simply take the scientists' word for it.

To make being on a sphere palpable, this environment will shrink the world to a scale that can be circumnavigated very quickly. Participants will stand in front of a large projection screen depicting a realistic 3D terrain. The projection screen will be a portal into that world. Participants will be able to move through that terrain by pretending to fly exactly as a child would—by holding their hands out from their sides and leaning in the direction they want to fly. In addition, they can control their altitude by raising or lowering their hands. When they descend to the ground, they do not crash through it as they would in most virtual reality systems. Instead, they move along the surface.

The navigation of this world is very satisfying by itself, because the means of navigation is so intuitive. Since this is a planet, if participants continue flying in one direction long enough, they will come back to the place they started from. We will construct the world to make it interesting to explore. In addition to exploration, there are other activities possible. For instance, participants' actions can change the planet as they move around it. They might defoliate the areas that they touch, or, alternatively, barren areas might bloom as a participant passes through. Mountains might rise and fall when a participant raises his/her arms. A variety of interactions will be implemented. These will be distributed around the small planet and will depend on the number of participants who happen to be together in a given part of the world at any moment.

At times, participants can interact in a game of tag or hide-and-seek. Since the representations of the participants will be Z-buffered into the 3D scene, they can hide behind a graphic tree, above a graphic cloud, or down in a graphic canyon. Alternately, they can cooperate in tasks such as herding animated creatures, shaping the planetary landscape, or spreading graphic vegetation.

While individuals participants do not always need to see themselves on the screen, a representation of them will be displayed at their location in the world so they can interact with other participants. Whether this representation is a polygonal representation, a silhouette, or a live video image is an aesthetic trade-off with terrain complexity.

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Fun House

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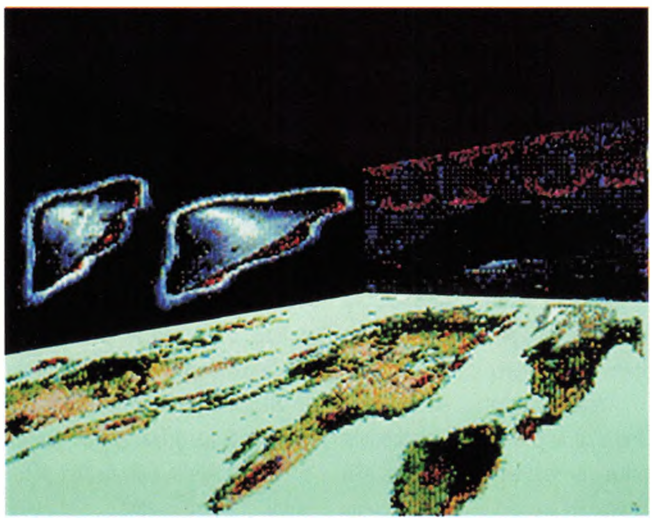
The promise of virtual reality has captured our imagination; networks will render it accessible. There can be little doubt that networked immersion environments or virtual reality will evolve into one of the greatest ventures ever imagined. It will draw from and affect the entire spectrum of science, commerce, and culture—including education, entertainment, and the creative arts. It will be multinational, and introduce new hybrids of experience for which adjectives do not exist.

For my SIGGRAPH 93 installation, I have built a Fun House. While making metaphorical reference to the "fun house" found throughout traditional amusement parks, the application is an investigation of interaction and perception employing networked, immersion-based virtual reality. It was the world that was utilized during the first long-range demonstration conducted between Carnegie Mellon University (CMU) and Munich, Germany, in September 1992. And a more recent demonstration, featuring yet another virtual world, was conducted between CMU and Tokyo, sponsored by the International Conference on Artificial Reality and Tele-existence, Japan.

The Fun House metaphor is particularly applicable to the container for virtual experience. Upon entering a fun house, one is acutely aware of being cast into a different world. One's senses are amusingly assaulted by a number of devices—trick mirrors, fantasy characters, gravity manipulation, spatial disorientation, mazes, and sound. In the virtual Fun House, various traditional devices are adapted and some new ones are offered.

Key attributes to be found in the Fun House include:



1) Objectification of "self" within an immersion environment. Users can select their image from a library including Frankenstein, Dracula, and a doctor, among others. The Cookie Man has proven to be a favorite. When entering the Fun House, users can see their image reflected in real time in a mirror. They can also see the images of other users. Users can extend their hands and wave at each other.

2) Interaction with a client (or agent) that has an "artificial intelligence." When entering the Fun House, you are greeted and spoken to by a client. It has a polite behavior and is programmed to face you, follow at a certain distance, and to stay out of your way. After a while, it stops following and says goodbye. Smart objects are also incorporated; touching them calls up events within the program.

3) Interaction with multiple users in real time. Networked telecommunications allow for the simultaneous support of multiple users within the Fun House. For the demonstration between CMU and Munich, the users selected the Dracula and Cookie Man personas from the library. Each user could see the other, had an independent point of view, and could move objects.

4) Users can attach themselves to a moving object. The Fun House features a Merry-go-round; users can grab hold and catch a ride while music plays.

5) Objects can attach themselves to users. The Fun House features a Flying Saucer ride, where users are transported up into the space craft, and they can pilot its flight.

6) Objects can be assigned attributes of physics. The Fun House features a Ball Game, where users pick up a ball and throw it at targets. The ball falls, bounces, and loses velocity. Thus gravity, velocity, and friction are articulated. The motion of the ball is sound intensive.

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The Mapping of Space:

PERSPECTIVE, RADAR, AND 3D COMPUTER GRAPHICS

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I991 saw two events, of different importance and seemingly unrelated. One was the long-awaited publication in English of what can probably be called the single most influential essay of modern art history—Erwin Panofsky's Die Perspektive als 'Symbolische Form.'[1] The interest generated around the re-emergence of this legendary essay, written in 1924-1925,[2] demonstrates that the problem of perspectival representation is still felt to be relevant to contemporary culture. The second event was the Gulf War, the outcome of which was largely predetermined by Western superiority in the techniques of perspectival representation.

The images, extensively televised during the Gulf War, perfectly confirmed Paul Virilio's thesis that modern warfare became a matter of the "logistics of perception."[3] True, broadcasts have included more traditional views of soldiers, planes, and tanks as seen from the outside by a video camera of a reporter. But what we also saw were not just images of the war, but endless images of the means by which the war was carried out: video images from an infrared camera mounted on a plane; video images from a camera installed on a weapon guided by a laser sensor; video in its role as "battle damage assessment" where a weapon equipped with an imaging device follows a weapon of destruction and records details of the damage. This was no longer a traditional report's view of a battle. We saw what the soldiers themselves saw: the images that were their only information about the enemy. More often, in a strange case of identification we witnessed what was "seen" by a machine, a bomb, or a missile.

The Gulf War was the combat of surveillance against camouflage, visibility against invisibility, human eye against computer eye. This warfare was indeed based on the "logistics of perception" but we can describe its visual techniques even more precisely. Visual perception was employed in a limited way as an instrument to capture and represent information about shapes and distances in 3D space. The effectiveness of such war technologies as radar, infrared imaging, laser sensors, and 3D computer graphics depends on the automation of this function of vision, the automation that began with the Renaissance perspective.

The use of these technologies today extends beyond warfare into all spheres of industry and science. Is there an appropriate term to describe the function of vision that they automate? For Plato, sensible particulars were but a pure reflection of ideas or forms. Aristotle criticized Plato, declaring that the primary substances were not the ideas but the individual things such as particular man or animals. These opposing views continued to be debated in scholastic philosophy, Plato's view giving rise to realism, and Aristotle's—to nominalism.

This essay will discuss 20th century automation of what can be called visual nominalism—the use of vision to capture the identity of individual objects and spaces by recording distances and shapes. The automation of this function of vision has started well before the century with the development of various perspectival techniques and technologies: perspective machines (such as the camera Lucida) descriptive and perspective geometry, and photography. But only digital computers made possible mass automation in general, including the automation of visual nominalism.

"The Most Important Event of the Renaissance"

According to a widely accepted narrative, perspective was already dead by the time art historians such as Panofsky began writing its history. Such narrative is announced, for instance, in the very title of Pierre Francastel's (Painting and Society; Birth and Destruction of Plastic Space from Renaissance to Cubism) (1952). The opening section of The Production of Space by Henri Lefebvre is equally authoritative:

The fact is that around 1910, a certain space was shattered. It was a space of common sense, of knowledge (savoir), of social practice, or political power...a space, too, of classical perspective and geometry, developed from the Renaissance onward on the basis of the Greek tradition (Euclid, logic) and bodied forth in Western art and philosophy, as in the form of the city and town.[4]

Yet, if perspective disappeared from modern art, it survived as one of the techniques of visual nominalism, a method for precisely representing a 3D world on a 2D surface. In this role, it extended into new domains (the whole of the electromagnetic spectrum) and became the foundation of new kinds of automated remote sensory technologies.

To consider perspective in this role we should turn to William Ivins' influential 1939 essay, "On the Rationalization of Sight." Ivins's approach stands in sharp contrast to the more traditional art historical analyses of perspective by Panofsky and Francastel. They are concerned with perspective as artistic form and do not look beyond its history in art. Ivins, on the contrary, is concerned with visual culture—the techniques and technologies of visual representation available to a society at a given moment and the fundamental role they play in shaping every aspect of society. Ivins argued that perspective allows the creation of precise maps of 3D reality, to record the shapes of concrete objects and the layout of concrete spaces.[5] It is the tool of a businessperson and a scientist rather than an artist. In Ivins's definition, perspective is "a practical means for securing a rigorous two-way, or reciprocal, metrical relationship between

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the shapes of objects as definitely located in space and their representations."[6]

Thus Ivins singles out the precise relationship established between objects and their representations as the most important principle of perspective. Bruno Latour recently extended this idea by pointing out that this relationship, made possible by perspective, allows us not only to represent reality but also to control it.[7] Latour sees perspectival representations as the "most powerful instrument of power," defined as the ability to mobilize resources across space and time and to manipulate these resources at a distance. For instance, we can't measure the sun in space directly, but we only need a small ruler to measure it on a photograph (perspectival image par excellence). And even if we could fly around the sun, we would still be better off studying the sun through its representations that we can bring back from the trip—because now we have unlimited time to measure, analyze, and catalog them. We can also move objects from one place to another by simply moving their representations: "You can see a church in Rome, and carry it with you in London in such a way as to reconstruct it in London, or you can go back to Rome and amend the picture." Finally, as Latour points out, "the two ways become a four-lane freeway! Impossible palaces can be drawn realistically, but it is also possible to draw possible objects as if they were utopian ones." Real and imagined objects can meet on a flat space of perspectival representation.

Ivins concludes his essay by stating that the beginning of the rationalization of sight through the discovery and the development of perspective "was the most important event of the Renaissance." The invention of perspective-propelled modern empirical science, for instance biology, which could now represent forms of nature with mathematical precision. It also stimulated the rise of modern engineering and manufacturing by making feasible the distribution of identical designs to far away places.

Modern designers, scientists, or engineers, of course, do not simply use perspective in the form in which it was formulated by Alberti in the 15th century; they have at their disposal much more sophisticated techniques. According to Ivins, the rationalization of perspectival sight proceeded in two directions. On the one hand, perspective became the foundation for the development of the techniques of descriptive and perspective geometry, which became a standard visual language of modern engineers and architects. On the other hand, the photographic technologies automated the creation of perspectival images. Both were the accomplishments of the 19th century; in fact, both were developed more or less simultaneously. Indeed, as Ivins points out, Niepce and Talbot, the founders of photography, were contemporaries of Monge and Poncelet, the decisive figures in the development of descriptive and perspective geometry.

Radar: Seeing without Eyes

Writing On Rationalization of Sight between 1936 and 1938, Ivins mentions such examples of the contemporary use of perspective as aerial photographic surveillance, classification in the field of archeology, and criminal detection.[8] However, all these applications of perspectival techniques already existed in the 19th century and, by the 1930s, did not represent the latest developments.

While photo reconnaissance was first employed systematically on a mass scale during World War I, the interest in using photography for aerial surveillance existed since its invention. Nadar succeeded in exposing a photographic plate at 262 feet over Bievre, France in 1858. He was soon approached by the French Army to attempt photo reconnaissance but rejected the offer. In 1882, unmanned photo balloons were already in the air; a little later, they were joined by photo rockets both in France and in Germany. The only innovation of World War I was to combine aerial cameras with a superior flying platform—the airplane.[9]

In 1858, Albrecht Meydenbauer, a director of the Government Building Office, published a proposal to use photographs for scale measurement. His proposal was based on the existence of a geometrical relationship between photographic image and the object being photographed. Why, for instance, climb a facade of a cathedral in order to measure it (as Meydenbauer had to do, nearly getting killed once) when it is much safer to measure a photograph? Additionally, wrote Meydenbauer, "some may find it hard to believe, but experience has proven that one can see, not everything, but many things, better in scale measurement than on the spot." In 1885 the Royal Prussian Institute for Scale Measurement was founded and the measurement of photographs of historic monuments became a frequent practice.[10]

It is possible that in the 20th century the "rationalization of sight" was not responsible for any new applications? In fact, while Ivins was writing his essay on perspective, across the Atlantic, in England, work was already underway to install twenty radar stations on the east and southeast coasts to provide surveillance of these air approaches.[11] These radar installations turned out to be absolutely essential in the coming war, allowing for the severely outnumbered Royal Air Force to defeat Luftwaffe in the Battle of Britain. Radar, the latest technology of visual nominalism, became Britain's most important weapon.[12]

Radar is an acronym for Radio Detection and Ranging. Like sound waves, radio waves create echoes when they are reflected by objects in their path. Radar transmits a radio wave in a desired direction. The signal reflected back from the objects is picked up by radar antenna. The time between the transmission and the reception of the echo indicates the distance to the object; the direction the antenna is pointing in when the echo is received reveals the object's position in relation to the radar. Detected objects appear as bright spots on the display watched by a radar operator.[13]

Radar is the best example of the rationalization of sight in the 20th century. All it sees and all it shows are the positions of objects, 3D coordinates of points in space, points that correspond to submarines, aircraft, birds, or missiles. Color, texture, even shape are disregarded. Instead of Alberti's window, opening onto the full richness of the visible world, a radar operator sees a screen, a dark field with a few bright spots. Here, the function of visual nominalism, which perspectival image performed along with many other functions, is isolated and abstracted.

Radar image serves a single function—but it performs it more efficiently than any previous perspectival technique or technology.

First, vision is no longer limited by the spectral capacity of the human or camera eye. Instead of relying, like photography, on the small region of the electromagnetic spectrum to which our eyes are sensitive, radar uses other regions, sending and receiving waves of different lengths. Vision is extended to include other sections of the electromagnetic spectrum. The visible becomes a small part of a larger field of sensory exploration of the environment. Consequently, the recording of objects' positions in space is no longer limited by conditions of visibility.

Second, this recording now takes place in real time. No longer do military commanders have to wait until pilots come back from surveillance missions and the film is developed. Now, the imaging is instantaneous. The image changes in real time, reflecting the change in the referent.

Along with radar, many other technologies of visual nominalism came into existence following the advances in electronics and computers during World

War II: ultrasonic imaging, multi-spectral photography, multi-spectral imaging, infrared, sonar, magnetic-resonance imaging, and so on. As radar, these technologies are effectively used to record distances, positions, layouts, shapes, and volumes. Sonar, for instance, detects objects in the water by using sound waves. Ultrasonic computer tomography uses sound waves and computer graphics to construct images of body tissues. Multi-spectral photography isolates energy reflected from surfaces in a number of given wavelength bands.

Engineering textbooks and encyclopedias group these technologies under the term "remote sensing," defined as the gathering and imaging of information without actual contact with the object or area being investigated.[14] This definition is helpful in separating the two operations involved in the technologies of remote sensing: the gathering of information and its presentation. The first operation may have nothing to do with what is visible to the human eye but in the second operation the eye eventually comes into play since the gathered information has to be presented to the human observer in visual form in order to be useful.

However, these technologies do not only perform the role previously played by perspectival representations but also rely on the same principle. Nobody is more clear on this point than Jacque Lacan. In "Of the Gaze as Object Petit a" from The Four Fundamental Concepts of Psycho-Analysis, Lacan emphasizes that perspective extends beyond the domain of the visible.[15]

Lacan starts by reminding us that an image is anything defined "by a point-by-point correspondence of two unities in space." To obtain an image of something we do not have to rely on light or to operate in the domain of the visible. Nor do we have to limit images to 2D representations of 3D reality. We can represent an object by another object or represent a 2D form by another form. All that is required is a rule to establish the correspondence between the points of the object being imaged and the points on the image.

Similarly, says Lacan, "what is an issue in geometric perspective is simply the mapping of space, not sight."[16] Perspective is one such rule, a particular method to establish a correspondence between the object and its image. Specifically, the method of perspective consists in connecting a single point in space (usually referred to as the point of view) with a number of points on the object by straight lines; the intersection of these lines with a plane creates an image. The fact that perspective, whether as a part of human sight apparatus or as a part of an apparatus of photography, works through light is coincidental. Light travels in straight lines; therefore it can be used to create perspectival images. But one can construct such images without light: "In Descartes, dioptrics, the action of the eyes, is represented as the conjugated action of two sticks."[17] As Lacan points out further on in the seminar, this idea that perspective is not limited to sight alone but functions in other senses as well defines the classical discourses on perception: "The whole trick, the key presto!, of the classic dialectic around perception derives from the fact that it deals with geometric vision, that is to say, with vision in so far as it situated in a space that is not in its essence the visual."[18]

Lacan's clarification that the principle of perspective is not limited to the visible helps us understand that the technologies of remote sensing function on the principle of perspective. Regardless of their lengths, all waves travel in straight lines, and therefore points in space are connected by straight lines to a point of reception (such as radar antenna) or recording (such as photographic camera). Radar, infrared imaging, sonar, or ultrasound are all part of what Lacan called "geometric vision," perspectival vision that extends beyond the visible.

3D Computer Graphics: Interactive Perspectivalism

From the moment of adaptation of perspective attempts have been made to aid the laborious manual process of creating perspectival images.[19] Between the 16th and the 19th centuries, various perspectival machines (more precisely, perspective aid devices) have been invented. They have been used to construct particularly challenging perspectival images, to illustrate the principles of perspective, to help students learn it, to impress artist's clients or to serve as intellectual toys. Already in the first decades of the 16th century, Durer described a number of such machines.[20] One device is a net in the form of a rectangular grid, stretched between the artist and the subject. Another uses a string representing a line of sight. The string is fixed on one end, while another end is moved successively to key points on the subject. The point where the string crosses the projection plane, defined by a wooden frame, are recorded by two crosses strings. For each position, a hinged board attached to the frame is moved and the point of intersection is marked on its surface. Other major types of perspectival machines that appeared subsequently included perspectograph, pantograph, physionotrace, and optigraph.

Why manually move the string imitating the ray of light from point to point? Along with perspectival machines a whole range of optical apparatuses was in use, particularly for depicting landscapes and in topographic surveys. They included the versions of camera obscura from large tents to smaller, easily transportable boxes. After 1800, artist's ammunition were strengthened by camera lucida, patented in 1806.[21] Camera lucida utilized a prism with two reflecting surfaces at 135 degrees. The draftsman carefully positioned his eye to see both the image and the drawing surface below and traced the outline of the image with a pencil.

The images produced by camera obscura or camera lucida were only ephemeral and considerable effort was still required to fix these images. A draftsman had to meticulously trace the image to transform it into the permanent form of a drawing.

With photography this time-consuming process was finally eliminated. The process of imaging reality, the creation of perspectival representations of real objects, was now mechanized. However, this mechanization did not affect other uses of perspectival representation. According to Latour, perspective establishes a "four-lane freeway" between reality and its representation. We can combine real and imagined objects in a single geometric model and to go back and forth between reality and the model. The process of the creation of a geometric model still remained a manual process, requiring techniques of perspectival and analytical geometry, pencil, rule, and eraser. Similarly, to construct a perspectival view of the model also required hours of drafting. The mechanization and automation of geometrical modeling and display was yet to come.

Nothing perhaps symbolizes mechanization as dramatically as the first assembly lines installed by Henry Ford in 1913. The assembly line relied on two crucial principles. The first principle was the standardization of parts, already employed in production of military uniforms in the 19th century. The second, newer principle, was the separation of production process into a set of repetitive, sequential and simple activities that could be executed by workers who did not have to master the entire process and could be easily replaced.

It seemed that mechanical modernity was at its peak. Yet, in the same year, the Spanish inventor Leonardo Torres y Quevedo already advocated the industrial use of programmed machines.[22] He pointed out that although automatons existed before, they were never used to perform useful work:

The ancient automatons . . . imitate the appearance and movement of living beings, but this has not much practical interest, and what is wanted is a class of apparatus that leaves out the mere visible gestures of man and attempts to accomplish the results that a living person obtains, thus replacing a man by a machine.[23]

With mechanization, the work is performed by a human but the physical labor is augmented by a machine. Automation takes mechanization one step further—a machine is programmed to replace the functions of human organs of observation, effort and decision.

The term "automation" was finally coined in 1947, and in 1949 Ford began the construction of its first automated factories. Automation was made possible by the development of digital computers during World War II and thus became synonymous with computerization. A decade later, the automation of the process of constructing perspectival images of both existent and non-existent objects and scenes was well underway.[24] By the early 1960s Boeing designers already relied on 3D computer graphics for simulation of landings on the runway and of pilot movement in the cockpit.[25]

By automating perspectival imaging digital computers completed the process begun in the renaissance. The automation became possible because perspectival drawing has always been a step-by-step procedure, an algorithm involving a series of steps required to project coordinates of points in 3-D space onto a plane. Before computers, the steps of the algorithm were executed by human draftspersons and artists. The use of a computer allowed to execute them automatically and, therefore, much more efficiently.[26]

The details of the actual perspective-generating algorithm that could be executed by a computer were published in the early 1960s by Larry G. Roberts, then a graduate student at MIT.[27] The perspective-generating algorithm constructs perspectival images in a manner quite similar to traditional perspectival techniques. In fact, Roberts had to refer to German textbooks on perspectival geometry from the early 1800s to get the mathematics of perspective.[28] The algorithm reduced reality to solid objects, and the objects are further reduced to planes defined by straight lines. The coordinates of the endpoint of each line are stored in a computer. Also stored are the parameters of a virtual camera—the coordinates of a point of view, the direction of sight and the position of a projection plane. Given this information, the algorithm generates a perspectival image of an object, point by point.

Computerization of perspectival construction made possible the automatic generation of a perspectival image of a model as seen from an arbitrary point of view—a picture of a virtual world recorded by a virtual camera. The picture, however, was crude and static. To produce a film of a simulated landing, Boeing had to supplement computer technology with manual labor. As in traditional animation, 24 plots were required for each second of film. These plots were computer-generated and consisted of simple lines. Each plot was then hand-colored by an artist. Finished plots were filmed, again manually, on an animation stand.

Gradually, throughout the 1970s and the 1980s, the coloring stage was automated as well. Many algorithms were developed to add the full set of depth cues to a synthetic image—hidden line and hidden surface removal, shading, texture, atmospheric perspective, shadows, reflections, and so on.[29]

In 1962, Ivan Sutherland designed his legendary Sketchpad program. With Sketchpad, a human operator could create graphics directly on a computer screen by touching the screen with a light pen. In the same year, ITEK began marketing Electronic Drafting Machine similar to Sketchpad.[30] Although both programs only dealt with 2D graphics, they introduced a new paradigm of interactive graphics: by changing something on the screen, the operator changed data in computer memory.[31]

When this paradigm of interactive editing was combined with the algorithms of 3D graphics, a fundamentally new way to use perspectival images emerged. This development was more revolutionary than automation of perspective construction per se. Indeed, a traditional draftsperson could have accomplished what the computer at Boeing was doing—generating plots in perspective given by a 3D database—only more slowly. But now it became possible to change the point of view of a virtual camera and see the corresponding changes in the perspectival image in real time. It also became possible to interactively build and modify 3D models and observe the changes on the screen.

The emergence of interactive 3D computer graphics started the race to eliminate the time delay between the action of an operator and the displayed results. In this race for speed, which accelerated in the 1970s as synthetic images began to be utilized in flight simulators, the algorithms of 3D graphics were gradually transported from software into hardware, each algorithm becoming a special computer chip. Silicon Graphics, one of the major manufactures of computer graphics hardware, labeled such a system a "geometry engine."

The term appropriately symbolizes the second stage of the automation of perspectival imaging. At the first stage, a photographic camera, with perspective physically built into its lens, mechanized the process of creating perspectival images of existing objects. Now, with perspectival algorithm and other necessary geometric operations embedded in silicon, it is possible to display and interactively manipulate models of non-existent objects as well.

Conclusion

In this century, automation of visual nominalism has entered a new stage. The signs of this automation are a multitude of new technologies used to capture and visualize 3D reality that merged since the middle of the 20th century such as radar, infrared imaging, laser sensors, CAT scan, magnetic resonance imaging, 3D computer graphics, and computer holography. Since the early 1960s, work has also been under way to automate vision completely, to create computer vision systems that would recognize objects and interpret scenes automatically.

The development of these technologies has been accompanied by massive research into the general problems of visual nominalism in computer science, experimental psychology, and neuroscience. New formal mathematical techniques were developed to analyze an image as a source of depth information and, vice versa, to transform this information into realistic images. The work on automation of visual nominalism has also lead to the new attention to particular aspects of human vision. In fact, a new paradigm for the study of human vision has emerged during 1970s at MIT. Within this paradigm, the goal of human vision is taken to be the recognition of shapes, leading researchers to study algorithms by which the brain "computes" shapes of objects from retinal input in the hope that these algorithms can be then used by computer vision systems.[32] The emergence of such a paradigm, which reduces human vision to a particular function, and the accompanying research investment suggest the economic importance of this function of vision for the contemporary society.

Notes

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10. Harun Farocki, "Reality Would Have to Begin," Documents 1/2 (1992): 136-146.
11. This section relies on two sources: Echoes of War, (Boston: WGBH Boston), videotape; McGraw-Hill Encyclopedia of Science and Technology: an International Reference Work in Twenty Volumes Including Index, (New York: McGraw-Hill, 1992).
12. Principles and technology of radar were worked out independently by scientists in the U.S., England, France, and Germany during the 1930s. After the beginning of the War, only the U.S. had the necessary resources to continue radar development. In 1940, at MIT, a team of scientists was gathered to work in the Radiation Laboratory or the "Rad Lab," as it came to be called. The purpose of the lab was radar research and production. The lab's first achievement was the successful competition of microwave radar that was small enough to fit on a plane.
13. Numerous variations of the basic radar technology exist. For instance, in addition to active radars that send a signal and detect energy reflected by the objects, there are also passive radars that do not send a signal themselves. However, all radars have in common the use of electromagnetic radiation (radio waves) to detect and measure objects in their vicinity.
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15. Jacques Lacan, "On the Gaze as Object Petit a," The Four Fundamental Concepts of Psycho-Analysis, Ed. Jacques-Alain Miller, Trans. Alan Sheridan, (New York: W.W. Norton & Company, 1981), 67-122.
16. Ibid., 86.
17. Ibid, 87.
18. Ibid., 94.
19. For a survey of perspectival instruments, see Martin Kemp, The Science of Art, (New Haven: Yale University Press, 1990), 167-220.
20. Ibid., 171-172
21. Ibid., 200.
22. Charles Eames and Ray Eames, A Computer Perspective: Background to the Computer Age, (Cambridge, MA: Harvard University Press, 1990), 65-67.
23. Qtd. in ibid., 67.
24. I am not aiming here by any means to provide a full account of the history of 3D computer graphics or its various uses. I am concerned with computer graphics as one development, among others, in the general move toward the rationalization of perspectival imaging. For a more comprehensive account of 3D computer graphics techniques, see J. William Mitchell, The Reconfigured Eye: Visual Truth in the Post-Photographic Era, (Cambridge, Massachusetts: The MIT Press, 1992), 117-162.
25. Jasa Reichardt, The Computer in Art, (London and New York: Studio Vista and Van Nostrand Reinhold Company, 1971), 15.
26. MIT became the major early research site for yet another new technology of visual nominalism—computer graphics. The Radiation Laboratory was dismantled after the end of the War, but soon the U.S. Air Force created another secret laboratory in its place—Lincoln Laboratory. The job of Lincoln Laboratory was to work on human factors and new display technologies for SAGE—the "Semi-Automatic Ground Environment," a command center to control the U.S. air defenses established in the mid-1950s. As part of this research, conducted through the 1950s and the 1960s, Lincoln Laboratory developed many key principles and technologies of computer graphics—CRT (cathode-ray tube) display, bit-mapped graphics, interactive control and algorithms for 3D wire frame graphics. See Paul Edwards, "The Closed World. Systems discourse, military policy and post-World War II U.S. historical consciousness," Cyborg Worlds: The Military Information Society, Ed. Les Levidow and Kevin Robins (London: Free Association Books, 1989); Howard Rheingold, Virtual Reality, (New York: 1991).
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28. "Retrospectives II: The Early Years in Computer Graphics at MIT, Lincoln Lab, and Harvard," SIGGRAPH '89 Panel Proceedings, (Boston, Massachusetts: ACM SIGGRAPH, 1989), 72.
29. For further discussion of the problem of realism in computer graphics, see Lev Manovich, "'Real' Wars: Aesthetics and Professionalism in Computer Animation." Design Issues 6, no. 1 (Fall 1991): 18-25; Lev Manovich, "Assembling Reality: myths of Computer Graphics," Afterimage 20, No. 2 (September 1992): 12-14.
30. "Retrospectives II: The Early Years in Computer Graphics at MIT, Lincoln Lab, and Harvard," SIGGRAPH '89 Panel Proceedings, (Boston, Massachusetts: ACM SIGGRAPH, 1989), 51.
31. In fact, interactive computer graphics technology appeared earlier, although it was not publicized. Already in the 1950s, the Air Force used interactive CRT displays and light pens in order to process more efficiently the information obtained by radar. Both CRT displays and light pens were designed at Lincoln Laboratory as part of the SAGE project. Using this technology, Lincoln researchers created a number of computer graphics programs. They include programs that allowed to display brain waves (1957), to simulate planet and gravitational activity (1960), and to create 2-D drawings (1958). "Retrospectives II: The Early Years in Computer Graphics at MIT, Lincoln Lab, and Harvard," SIGGRAPH '89 Panel Proceedings, (Boston, Massachusetts: ACM SIGGRAPH, 1989), 42-54.
32. The fundamental statement of this paradigm, David Marr's Vision defines human vision as "the process of discovering from images what is present in the world, and where it is." David Marr, Vision, (New York: W.H. Freeman and Company, 1982), 3.

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The Artistic Origins of Virtual Reality

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The history of virtual reality is often obscured. It is easy to get the impression that the Big Bang occurred at NASA in 1984 and that virtual reality is a triumph of the technical establishment alone. What has been overlooked is the important contributions that artists have made to the development of the field.

The dawn of virtual reality in the technical community is most often traced to a paper by Ivan Sutherland presented at the National Computer Conference in 1965 and another written by him in 1968.[1, 2] There were also two relevant dissertations at the University of North Carolina in 1970 and 1976.[3 4] Otherwise, during most of the 1970s and the first half of the 1980s, the idea of virtual reality was dormant in the technical community, except for the classified work of Tom Furness in the U.S. Air Force. Even these efforts were highly specialized and directed at single applications. There was little effort to communicate to the research community, let alone society at large, the fact that an explosive culture-defining concept had been discovered and implemented.

Given the length of the hiatus following the early work, one is left to ponder what precipitated the resurgence of virtual reality in the mid-1980s. The premise of this essay is that the ideas were actively pursued in the arts from the beginning, that virtual reality's rebirth as a technical field was triggered by the efforts of artists, and that increasing the involvement of artists now would foster more rapid development of the field in the future.

In the 1960s, many of the issues that we now associate with virtual reality were under active consideration in the arts community. By the beginning of the 1960s, Mort Heilig had already built his Sensorama, a full-immersion experience involving stereo film and stereo sound, along with separate tracks for mechanical vibration, wind, and olfactory stimuli.[5] In the 1960s, musicians in different locations were performing together in a virtual audio space. Among the most significant of these performing artists was Salvatori Martirano at the University of Illinois at Champagne-Urbana. His work also included attempts to create 3D sound experiences by using large numbers of speakers with separate synthesizers.[6] In the same period, Joseph Pinzarone attached 64 sensors to dancers and used their movements to control the generation of sounds.[7]

The efforts of Michael Noll, then at Bell Labs and now Dean of the Annenberg School for Communication in Los Angeles, were also important. While he was trained as a technologist, he made a series of contributions to computer art, a number of which should be included in any history of virtual reality. He created devices for stereo viewing, telepresence viewing, 3D drawing, and tactile communications that were motivated in part by a desire to use technology to redefine the arts. He also created a 3D graphics system for visualizing dance.[8 9 10, 11]

Computer-controlled responsive environments trace back to the work of Dan Sandin and myself at the University of Wisconsin starting in 1969.[12] There were also large-scale outdoor environments created by the PULSA group at Yale led by Patrick Clancy.[13] Aaron Marcus implemented an interactive, symbolic, computer-graphic environment titled "Cybernetic Landscape" in the early 1970s.[14] These experiments fully understood and explicitly stated the vision of what is now seen as virtual reality.

The sense that virtual reality was of fundamental importance came from artists who communicated it immediately to the public through their work. In addition, many aspects of virtual reality including full-body participation, the idea of a shared telecommunication space, multi-sensory feedback, third-person participation, unencumbered approaches, and the data glove all came from the arts, not from the technical community.

Beginning with my Metaplay exhibit in 1970 and the Videoplace installation at the Milwaukee Art Museum in 1975, the concept of a shared telecommunication environment was added to the virtual reality lexicon and implemented as well.[15] (The term Videoplace refers to the place created by the act of video telecommunication.) Videoplace was an official Bicentennial project, although it was not implemented on a world-wide scale using satellites as proposed. Several years later, Kit Galloway and Sherrie Rabinowitz did long-distance, two-way, video demonstrations creating what they called composite spaces.[16] Their efforts included performances in the virtual space as well as extended informal communication between people in two remote locations. In fact, during the 1960s, 1970s, and 1980s, artists performed more interesting experiments into the act of telecommunication than did the telecommunication industry.

In 1976, Dan Sandin, Tom Defanti, and Gary Sayers at the University of Illinois in Chicago invented the data glove under a grant from the National Endowment for the Arts.[17] (It is notable that Sandin and DeFanti also oversaw the implementation of the Cave at SIGGRAPH '92.[18] A number of years later, the glove that triggered the current wave of development at NASA was patented by Tom Zimmerman.[19] His glove was very similar to Sandin's. Zimmerman's goal was similarly artistic—he wanted a device for playing air guitar.[20]

The development of the original head-mounted display used for virtual reality at NASA was led by Mike McGreavy who had artistic training.[21] A year later, Scott Fisher, who had a degree from Rhode Island School of Design, joined NASA to work on virtual reality.[22] He had seen the Zimmerman glove demonstrated when he was at Atari, tracked it down, contracted VPL to make an improved version of the glove for NASA, and directed much of the early NASA research. By that time, the rights to the Zimmerman glove had been bought by Jaron Lanier, a musician.[23] Similarly, Durand R. Begault earned an MFA in music and "for about 15 years mostly composed music designed to manipulate and exploit the spatial element of sound much as other composers might manipulate timbre, pitch, or rhythm."[24] He wrote a doctoral dissertation on 3D sound before he joined NASA to spearhead the effort to add an audio component to virtual reality.[25]

Even in the present, there is a notable difference in the style of work occurring in the arts versus the sciences. Certain critical constraints of virtual reality are likely to be finessed in the scientific community. These include real-time performance, untethered freedom of movement, and minimal encumbrance. In contrast, almost all artistic efforts operate close to true real time. Whereas the technical community seems forever untroubled by the tether that connects the participant's head to the processor, Los Angeles choreographer Mark Caniglio places sensors on dancers and radios the information to the computer.[26] Artist Graham Smith's efforts to immerse viewers in images inspired VPL's Videosphere demonstration at SIGGRAPH 89.[27] However, he was disappointed with the results and now projects his images onto a dome at the bottom of a swimming pool and the viewers swim inside to watch. Similarly, artists were the first to embrace unencumbered approaches to virtual reality. It is notable that over two decades later, Bell Labs, Xerox Park, Sarnoff Labs, and Seimans are just now starting to do the same.

Given that artists have contributed to bringing virtual reality to its current state, it is arguable that artistic participation should be increased. This is especially true if the results achieved are divided by the dollars spent. Under the pressure of the Cold War and with tens of billions of dollars, technologists developed incredibly sophisticated simulation technology. However, without exception, their paradigm comprised a sedentary operator directing the movement of a vehicle through a virtual world by means of hand-operated controls. The concept as well as the implementation of full-body, multi-sensory participation in virtual worlds as a general-purpose medium was instigated by artists operating with very modest budgets. By the bang-for-buck measure, the artists have outperformed the research community, particularly in knowing what was a promising direction to pursue.

Finally, virtual reality is more than a technology—it is a culture-defining medium like film or television. Its use will be judged by aesthetic as well as technical criteria, whether it is used for artistic expression or practical application. Furthermore, it is likely that the new artistic medium will lead to new markets that dwarf the so-called practical applications.

Virtual reality has already changed how we think. Its implications are so broad that it cries out for the participation of all elements of society. I sought to celebrate this powerful new idea in my artistic work and to invite everyone to the intellectual feast in my books.[28,29] Brenda Laurel observed that the relationship between human and machine had ceased to be purely technical and had entered the ancient realm of theater.[30] Architect Michael Benedikt started the Cyberspace Conference to provide a forum for the intellectual issues to be discussed. Michael Heim has written a book that considers how virtual reality will change how we think and how we see ourselves.[31] It was the beautiful concept and the opportunity to reunite our culture through new super-medium for scientific analysis and aesthetic expression that led artists to push the ideas and the technologies required to create virtual reality.

Note: The author would welcome any information about other artistic contributions that he may have overlooked.

Notes

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17. Thomas A. DeFanti and Daniel J. Sandin, "Final Project Report to the National Endowment for the Arts," US NEA R60-34-163, June 30, 1977.
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The Machine in the Garden

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"Not only does god play dice...but he sometimes throws them where they can't be seen"

— Stephen Hawking

The Machine in the Garden is an interactive videodisk installation dealing with gambling and spirituality, twin distillates of our obsession with luck and fortune, weighing the apparently random outcome of phenomenon against a possible underlying order. Einstein's Theory of Relativity eliminated Newton's illusion of absolute space and time, and the combined research of quantum mechanics and chaos theory have shown the flaws in the belief that reality is predictable. As inevitably as we turn to organized religion for reassurance in the face of our mortality, and countless other systems of spiritual belief for their promises of miracles, we are drawn to games of risk and chance. Reconciling spirituality with our apparently reckless attitude toward technology becomes less problematic when we acknowledge that they are opposite sides of the same coin. Playing the odds and betting to win is a decidedly postmodern response to a failing faith in technological utopianism.

Modeled on the design of a casino slot machine, The Machine in the Garden incorporates the Buddhist motif of "See no evil, Hear no evil, Speak no evil," as the final image upon which each video display comes to rest. When the viewer approaches the installation they see, on three video displays, the same woman's face with hands covering her eyes, ears, or mouth. Pulling the slot machine lever to activate the installation, video from three thematic areas begins to scroll: imagery of war and destruction on one video display; talking heads of politicians, game show hosts, and religious figures on the second; and children's' programming and television commercials on the third. Simulating the action of a casino slot machine, the scrolling of the imagery gradually builds in speed, stopping suddenly in staggered sequence, on one of nine possible combinations of the woman's face.

The use of recycled broadcast imagery in this installation represents an interest in the reinterpretation and juxtaposition of images and themes that recur in mass media and popular culture. This technique has been employed in a series of installations incorporating technology from the 1950s, with the theme: women and technology, and the manipulation of the body through representation. This series of installations provides a framework of irony and empowerment for the presentation of complex issues and images, particularly as they relate to women. These installations counter the optimism and passive acceptance that women are expected to feel toward technology with the real impact it has had on their lives. The juxtaposition of old and new technology draws the viewer into an examination of popular culture in relation to the current 'revolution' in micro-electronics.

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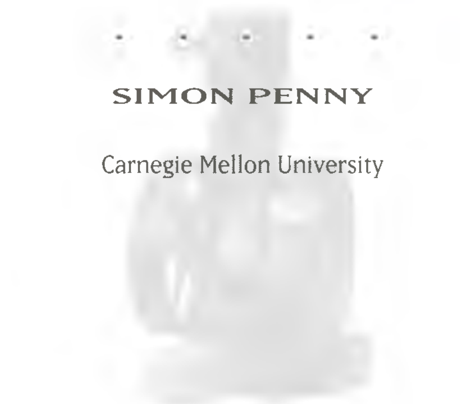
Old Ideas in New Boxes



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When we look at 'cutting edge' technologies, it is the radical newness that we are encouraged to see. This radical newness helps us forget that technologies arise out of past culture. The generation raised on Buck Rogers grew up to make the space race, and the generation raised on Star Treck are making the Holodeck. In order to understand the historical significance of 3D imaging, we must place it as part of the historical development of the automation of perspective. Lev Manovich has followed this line of study in his essay, as do Paul Virilio and Harun Farocki elsewhere.[1] According to this line of reasoning, we must look at computer graphics, interactivity, and virtual reality as moments in the larger cultural progression of the automation of visual systems.

This essay is framed by a question: where does computer graphics fit in the history of modern thought; what traditions is it heir to? It is almost a cliche that computer graphics is a quintessentially interdisciplinary pursuit. We hear that artists, cognitive scientists, designers, computer scientists, and a host of others are involved. But where are the central ideas coming from, where is the discipline of computer graphics in terms of philosophy, in terms of the philosophy of science, in terms of art theory, in terms of humanistic critique?

It has become commonplace for people in the art world to cite examples of computer scientists who regard the approximation of a color photograph as the goal of computer graphics. This esthetic goal is one which was thoroughly examined and in many cases, abandoned in the art world before the turn of the century. Two generations ago, Rene Magritte encapsulated the dilemma of representation with his (now famous) painting, "Ceci n'est pas une pipe." Dating from this time, theories of representation (semiotics and semiology being early examples) have been important issues of art theory, and over the last 25 years have been absolutely central. It is no coincidence that this analysis of repesentation comes at a time when image technologies (video, TV, computer graphics, offset printing, cinema) flood our culture in a kind of inflationary economy of images.

This association of computer graphics with a previous technology of pictorial representation is an example of the way a technology might 'carry' certain cultural attitudes. Such questions of 'embedded' value systems that shape a technology, in hardware or software, opens out onto a broad field, aspects of which I will discuss below.

Software reifies value systems. No selection process is value-free, by definition. Software projects are shaped by the world views of their makers, and their value systems are (often unknowingly) incorporated into the work. Computer engineering, software engineering, and knowledge engineering are all heirs to the tradition of engineering, the quintessentially industrial revolution science, concerned with production; efficient production, by means of standardization of parts and processes. A computer is a device for automating production. Automation of production is dependent upon standardization of objects and categories.[2]

It may be that this process of standardization is antithetical to certain creative goals. It is true that many art movements over the last century have attempted to come to terms with the phenomenon of industrial mass production: Constructivism, the Bauhaus, the Futurists, and 'multiples' by artists like Les Levine in the 70s. Art has yet to come to terms with this economic-industrial phenomenon. But in an historical moment when ideas of 'standardization' are being questioned, from social policies of multiculturalism to the instantly re-programmable robotic production line, it is also the applied sciences that must engage in such questioning.

There has been much discussion that virtual reality is a liberation from the so called 'mind-body duality' of Rene Descartes. This would be a marvelous thing if it were true, as neurological and physiological research over the last 50 years seems to indicate that such a distinction cannot be substantiated. That the mind-body split is, at best, a philosophical convenience, and at worst, completely wrong.

Contrary to popular rhetoric, one can argue that virtual reality technology, far from including the body in a virtual environment, actively excludes the body, re-affirms the Cartesian Duality, reifying it in code and hardware. One leaves one's meat body passive on the chair while the mind goes wandering, unhindered by a physical body, in pristine virtual space, itself a 'pure' platonic space, free of farts, dirt, and untidy bodily fluids.

Which brings one to a larger question: Why does each successive technology make the body more passive?[3] Why doesn't digital technology use the interface potential of the whole body? A bicycle does. Perhaps research into the virtual workplace will bring us an interface that uses the interactive potential of the whole body, the kinesthetic senses, memory for position in space. Certainly a virtual workplace in which one pushed keys on a virtual keyboard would seem silly. One can imagine a virtual workplace with physical tasks that utilized the body as a whole. One hopes that these physical capabilities would be utilized, not just 'occupied' with an interface as unproductive as a gym machine. Gyms are a very strange cultural phenomenon themselves. Can you imagine how strange it would appear to an agricultural worker of even 20 years ago, that armies of people pay huge amounts of money to do strenuous physical labor for no productive end? It is indeed curious that we design technologies that make the body passive and slovenly, then we are forced to design other machines that have no function except to counteract the symptoms induced by the previous machines.

But if virtual reality uncritically reifies the mind-body duality, is rationalism the totality of the computers' 'world view'? It is often asserted that the major ideas that have shaped this century are due to Marx, Freud, Einstein and Heisenberg. What effect have their ideas had on the development of the computer? And what of newer philosophical ideas that actively critique Cartesian rationalism: poststructralism and feminism and other varietiers of postmodern thought. We might ask ourselves 'What could a feminist computer be?' 'How might it differ from the computer we now have?'

What is a Feminist Computer?

Contemporary women artists who work in technological media are faced with a contradiction. The domain in which they are operating has been historically considered masculine, yet women's current access to electronic production tools seems to belie any gender barrier. Indeed, women have benefited in the last two decades to the extent that they have offered some freedom from the sexist art historical and critical practices attached to more established media. The philosophy of technology, however, has been articulated entirely from a masculinist perspective in terms that metaphorize and marginalize the feminine. In real social discourse, this claiming of technology has been reinforced by, and has probably encouraged, a male monopoly on technical expertise, diminishing or excluding the historical contributions of women to technological developments.[4]

So begins Nell Tenhaaf in her essay, "Of Monitors and Men & Other Unsolved Feminist Mysteries." She asserts that this invisibility of the feminine calls for 'a radical reconstitution of technology,' and we must ask ourselves whether the architecture of the machine and the premises of software engineering themselves are not so encumbered with old philosophical ideas that any 'reconstitution' would amount only to surface decoration.

A case example of the culturally 'male' perspective is the standard paradigm of navigation in virtual space. Simply stated, 'what the eye wants, the eye gets' in this world of unhindered voyeuristic desire. It is an implementation of what Jacques Lacan would refer to as the 'scopic desire.' 'He undressed her with his eyes'—the male gaze is equated with male sexual desire, a desire to conquer, to penetrate. Erkki Huhtamo has elsewhere traced an historical continuity from the 'penetration shot' in cinema to the 'powerful gaze' in virtual reality. So if navigation in virtual reality is the articulation of the phallic gaze, we might consider what a feminine alternative might be.

Agnes Hegedūs has presented us with such a 'radical reconstitution of technology' in her work Handsight. In this piece the hand guides a helpless eye, as one might help an elderly person. In conventional virtual reality, the eye can fly and grab, unhindered by the body; in Handsight, the body helps the helpless eye about the virtual space. In this provocative inversion of aspects of the conventional paradigm, an inversion which one is not told but discovers through interaction and consideration, Agnes Hegedus has given us something that one may truly call a work of art in this medium.

What is a feminist computer? We don't know, but people like Tenhaaf and Hegedus are suggesting some thought-provoking possibilities.[5]

Artistic Knowledge Bases

One of the things art seems to do is to function as a cultural 'early warning system.' Artists dealt with the idea of software, disembodied information, before the term existed in common language. Conceptual art can be thought of as "cultural software."[6] Conceptual artists worked on many of the problems that would arise within computer technology, outside of and before the technology evolved. Similarly, a vast untapped knowledge base for the development of interactive media exists in the corpus of happening-environment-installation-performance artwork of the last 30 years: formally radical experimental genres that took experiential space and the 'user interface' as their subject matter before anyone thought of the term. In a similar vein, Brenda Laurel has made a call for the relevance of the theatrical tradition to interactive design.[7] Not only is the cognitive science/computer science community generally unaware of these knowledge bases, but the general tendency for art research to pre-empt technological problems remains largely unremarked.

The artists in this exhibition have taken on the difficult task of exploring what kind of art might be made with these technologies. It is by no means a fait accompli; it may be that no art is possible with some technologies. It may be possible to dress technological tricks up in fancy clothes, but that is not art. Moreover, attempting to make art with these technologies may require re-definition of precisely what we imagine 'art' to be. But this is properly the territory of artists, who have been continually negotiating the re-definition of 'art' over the last century, in response to changes in culture and technology. Art in the modern period in our culture has propagated itself by continually disproving itself, continually re-inventing itself. Rembrant would not understand Monet, and Monet would not understand Pollock, and Pollock would not understand Koons. (In the same way that Newton would not understand Einstein, or Descartes, Deleuze.)

Many commentators, myself included, have suggested that computer-based interactivity and the phenomenon of virtual space represent a coming of age. This brings us to consider the possibility of an interactive art genre. Notwithstanding the many criticisms that may be levied against the deployment of computing in the everyday working world, there is no question that the realms of virtual space and electronic interactivity present profound and exciting opportunities for artists. But any artist who confronts this new territory can become immediately confounded by substantial esthetic dilemmas. Never before has there existed an art medium that possesses behavior. Myron Krueger has observed that most interactives tend to be 'one-liners.' Interactive media art will entail the development of new esthetic systems, esthetics of interaction.

Along with this burden, artists who choose to explore new media often also become developers of the hardware, as is the case with many artists in this exhibition. They find themselves in the R&D function of designing the technology, rather than simply esthetically manipulating a traditional art technology.[8]

There is also a burden of responsibility on the visitor to these interactive works, because the codes and conventions required to 'read' the work have not been culturally established. The unacknowledged burden on viewers of such work is that they must take care not to impose critical judgments germane to an older discipline (such as painting) upon a different technology.

Unrequited Consumption

Electronic technologies are consumer commodities. The relentless arrival of new models and updates is fueled, not necessarily by a cultural or societal need, but by corporate need for profit. Markets are constructed in order to sell the new model.

Artists who engage these technologies also simultaneously engage consumer commodity economics. Artists are induced to upgrade continually. This creates a financial load and a pressure to continually retrain, to learn the newest version of the software. The need to upgrade is not necessarily a product of their esthetic development. Thus artists are caught in a cycle of unrequited technological consumption; they cannot learn the new technology before it is replaced with another. If art practice requires a holistic consideration of the cultural context of the subject matter, then the pace of technological change prevents this.

Consider the condition of the garage developer of art technologies, of the artist who feels compelled to develop a technology to realize his/her ideas, on the usual limited funding. The esthetic ideas are intimately linked to the technology of realization. If s/he is lucky, s/he might get the project finished before the corporate R&D labs release a consumer version. But at most she'll have a year or two in the sun before there's a Nintendo or Panasonic version. At that point the esthetic value of that labor evaporates.

Technologies remain meaningless until they become enmeshed in, and play a meaningful part in, culture. In order to produce an artwork with any technology, the technology must be considered in its cultural context, in the way it functions in human culture, and the type of relationship that it can have with an artist and with a creative process. These things take time. So these artists adopt a medium that may ultimately be antagonistic to their goals. This is a dilemma of our time.

Notes

1. See Paul Virilio, War and Cinema, The Logistics of Perception, New York, Verso, 1989 and the film, "Pictures of the World" and "Inscriptions of the War" by Harun Farocki.
2. cf Manuel DeLanda, War in the Age of Intelligent Machines, Swerve editions Zone Books MIT 1991.
3. Maria Fernandez (personal notes), 1992.
4. Nell Tenhaaf in her essay, "Of Monitors and Men & Other Unsolved Feminist Mysteries" Parallelogram v. 18 #3 1992.
5. Although the works in machine culture: the virtual frontier were selected strictly on their merits, it is pleasing to note that 30% of the artists represented are women. I am disappointed to be unable to say similar of the collection of essays.
6. See "The Intelligent Machine as Anti-Christ" Simon Penny, SISEA 1990 Proceedings, Groningen, Netherlands.
7. Brenda Laurel, Computers as Theatre.
8. Woody and Steina Vasulka, themselves pioneers, organized an excellent exhibition of the (largely unacknowledged) history of artists (including many SIGGRAPH pioneers) who developed video and audio synthesis technologies in the 70s. Eigenwelt der Aparatwelt occurred at Ars Electronica 1992, Linz Austria. An excellent catalog to this exhibition is available from the Vasulkas. Interactive videodisks were also produced, and numerous pieces of the original hardware, repaired and in working order, were displayed.

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Public Domain Kiosk Project

PUBLIC DOMAIN, INC.

Atlanta, GA

The word "virtual" has been so overused that it is difficult to use the term without flinching, and yet, despite its rise to the status of premier buzzword of the nineties, it continues to suggest a certain relationship between consciousness and electronic space that is rich and descriptive. Just beneath the thin, slick, corporate gloss of the term's trendiness is a volatile zone of fractures containing a leaky matrix of nested meanings including, but not limited to: artificiality, simulation, representation, mimesis, prosthesis, multidimensionality, multiplicity, hyperness, velocity, otherness, the mechanical, the machinic, high technology, and, by extension, digitalization, fractal scaling, transpositionality, and networking.

A close reading of this complex system of semiotic leakages reveals a thoroughly mapped but unstable fault where the realms of the human and the machine are continually collapsing into each other. It is precisely along this fault line, on the "new edge" of the cultural domain, that a stepped-up conflation of separate consciousnesses is occurring that is becoming an ever more sexed, violent, hallucinogenic, media-dependent, shared mindscape. This evolving collective consciousness is characterized by a radical obsession with the reflected traces of the transformation of the human into the cyborg; the transformation's inscription as recycled mythologies animates a kaleidoscope of transient tattoos constantly re-writing shifting patterns (with neon intensity as the latest true color), hypermedia updates to the textual/cultural body. These are a new suit(e) of tribal scarrings worn in real-time and written in mutable signs on an electronic skin whose surface is an active projection screen for drifting, montaged morphs.

It could be argued that humans have always been cyborgs, and that it is only the naming of the awareness of this condition that is new. Humans have always co-developed with the tools of technology creating a feedback loop that, perhaps from the very beginning, was erasing the difference between humans and machines through increasingly sophisticated machine-body-metaphors, and later machine-mind-metaphors. The tool, as such, has a long history as an add-on, a bodily peripheral, a prosthesis—and, with the invention of writing, as an internalized machine/apparatus.

As this process continues, it is most easily evidenced in recent developments of devices constructed as attachments to the body, and redesigned to be incorporated via implantation or nerve/machine integration (e.g., artificial hearts, prosthetic limbs, hearing aids, etc.) The history of human dependence on mechanical devices for survival and maintenance of the individual body exemplifies the more general dependency of society on technology. Given the direction of technologies of the future such as nanotechnology, artificial intelligence, artificial life, biochips, and synthetic neurons, the body's rate of absorption of the machine will only quicken.

How will the cyborg organize relative to the "virtual"? Can the idea of virtual organization be read fractally as a scaled phenomenon representative of new cultural formations within e-space?

The interactive work presented by Public Domain, Inc. frames these questions by deconstructing its own principles of institutional formation, and attempting to design effective metaphors that simultaneously describe, illustrate, and demonstrate a model of interpretation of virtuality. The recognition of the centrality of the phenomenon of collapse to the never-ending reconstruction of meaning is taken as license for the use of a collaged fluxus of poetic images, texts, and sounds that askew conclusiveness in favor of dreams and dada. Implicit in this approach is a high valuation of noise, chaos, anarchy, nonhierarchalization, improvisation, conflict, discontinuity, experimentation, invention, and wild speculation uninhibited by any need to make sense. Ironically, it probably will anyway. If not now, then later.

Public Domain, Inc. (PD) is a 501(c)3 non-profit organization whose stated mission is to explore the interface between art, technology, and theory. To that end, Public Domain is presently engaged in five projects with complementary agendas that supplement each other to create a system of interdependent activities. They are: 1) Perforations, 2) Working Papers, 3) The Kiosk Project, 4) Video Production, and 5) Networking.

1) Perforations is a quarterly journal/media kit. Each issue develops different themes of contemporary life as they relate to technology. Topics are generally broadly defined in order to accommodate approaches to the material that are experimental, creative, and informed by multiple perspectives.

2) Working Papers is a series of presentations devoted to the various crises of legitimation, representation, and communication that constitute the contemporary scene of modernity and postmodernity. Participants come from a wide variety of disciplines, cross-disciplines and multi-discplines including art, philosophy, literature, poetry, literary criticism, computer science, architecture, video art, film, and music.

3) Upon completion, the Kiosk Project will be a series of interactive, hypermedia stations situated in public areas that will provide artists working in electronic media with an exhibition venue other than the traditional gallery or museum.

4) Video Production: Public Domain is actively planning to videotape and broadcast Working Papers on public access cable television.

5) With the recent donation of a Sun server to Public Domain, the group is able to provide Internet access to both its own members as well as designated representatives of other non-profit arts organizations. PD's existence as an Internet node has greatly facilitated interaction between members, provided a means of contact with participants in Working Papers, and allowed artists and theorists from around the world to contribute to Perforations, and to remain in communication with PD. The Internet has become the infrastructure necessary for Public Domain's on-going design as a virtual organization.

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Bentlow Stairs:

AN ELECTRONIC ARTIST'S BOOK

ED CUNNIUS,

ELNOR KINSELLA,

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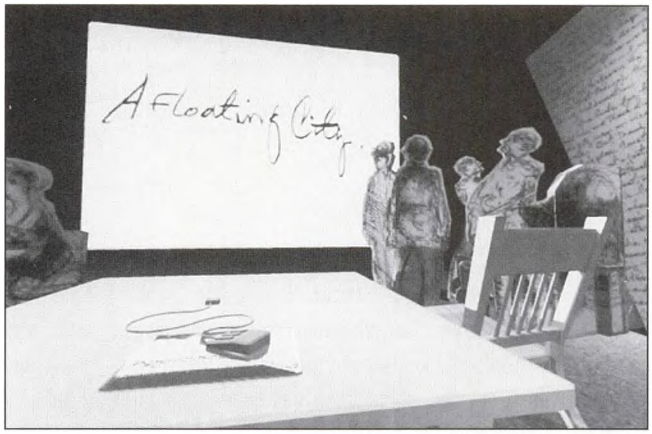
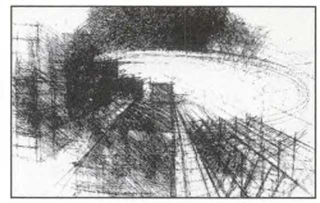
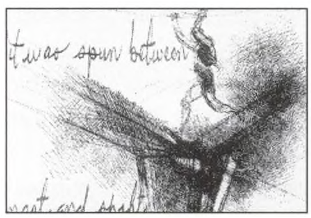
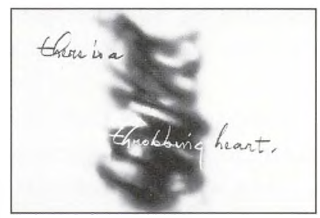
AND ALAN STACELL

Texas A&M University









Our work is an illustrated hypertext about a sea-going city called Bentlow Stairs. Bentlow Stairs is like all cities, a never finished, giant machine where people live, work, and dream. Unlike other cities, Bentlow Stairs is adrift—it is a massive floating steel lattice, free to roam the world's oceans. The book listens in on the inhabitants of the city as they consider themselves and the place they are building. Bentlow Stairs is about the culture and character of these people, and about the philosophy behind the making of all cities—even fantastic ones that float on the sea.

The story is told via electronically composited images and text that are presented as frames in the KMS hypertext system. The direction and flow of the book are controlled by the viewer using a mouse to select links. The illustrated fiction of the book consists of bit-mapped images overlayed with invisible link fields. These fields are made visible only when the cursor touches them; each frame contains from one to as many as six links. By scanning the screen with a mouse, the viewer can determine which elements are associated with a link and then choose whether or not to follow the link to pursue a particular story line. Some links are associated with words, others are associated with visual elements such as buildings or characters. Bentlow Stairs consists of more than 250 frames. Since the hypertext is a collaboration among several artists, a system was needed that supported multiple authorship; with KMS we could all work on the same set of frames simultaneously from multiple workstations.

Bentlow Stairs is presented within the context of an installation. The installation consists of large printouts of drawings, text, and characters from the book mounted on eight-foot panels. These panels are cut into different shapes and arranged around a small white wooden table and three chairs. On the table, there is a three-button optical mouse and mouse pad. Suspended in front of the table is a large screen where the frames are projected. The installation provides an environment within which viewers can interact with the book in a way that is more engaging than is possible with a desktop display. Everything seen and heard—including the other participants in the space—is a part of the mimesis. As such, the installation is an architectural connection between the viewer and the virtual city.

Bentlow Stairs' matrix of interconnected frames mirrors its structure and the relationships of its people. It invites the viewer to move through the metaphor of the city through a series of invisible doors. Each person who navigates through the hypertext assembles a different concept of the city, much like driving the streets of a strange town. Each person who reads the book can have a different experience. This "hyperspace" creates the sensation of moving through the piece, following trails that slowly build a large illustrated poem. It is this crafting and navigation of browsable trails through visual information that is central to the hypertext phenomenon. The structure of the hypertext is the heart of Bentlow Stairs; the individual images are the hinges in its web.

Our initial awareness of "working with a computer" has faded. As a tool, it is more familiar to us now than our old ways of making art. We take for granted that this device can do what it can do, and we are restless to make things with it. Bentlow Stairs is one result of that impulse, and it has been the one that has challenged us the most. By focusing on the phenomenology of hypertext, we work with only a small part of the art-making potential of computers. However, in using this rather simple information handling concept, we have had to think as painters, filmmakers, poets, and story tellers. We have attempted to build interactive narratives that can semantically flex and be retold by the viewer as he or she navigates the hypertext.

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Interaction and Play

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"I prefer the form of seduction for it stems from a mysterious duality/confrontational relationship, an enticing, intense, and covert attraction between the living and the non-living. It is not a form of response, but a challenge, a duel, imbued with an intriguing sense of distance and constant antagonism on which the rules of theme are also based."

— Jean Baudrillard

Reflecting upon the frantic commotion surrounding the new media, one can easily gain the impression of a world turned upside down. Naturally, there are technologies available today that in the course of evolution have attained a certain degree of complexity and perfection offering mind-boggling possibilities not only for the entertainment industry but for the artist as well. However, when we consider the perilously desolate state of computer art, it is difficult to understand why in our so-called post-modern era—inured as we are to the euphoria of technological advances—so much rhetorical and institutional endeavor is being invested in persuading artists to take up technologies that neither they nor their recipients really comprehend. Traditional modernists might, of course, take a more balanced view and contend that a different artistic concept is needed. They may also view that the arts simply have to yield to state-of-the-art technology and its inherent forms of perception in order to remain contemporary, or offer viable alternatives to the prevailing forms of application. But occasionally it is difficult to avoid the impression that instead of the artist creating the art, it is the art and the artists that now have to be manufactured for a technology, which has not arrived but has made deep inroads into our daily existence. If we exclude musicians and composers, artists have been very reticent in availing themselves of the computer, in the area of computer graphics, it was the technicians, programmers, and scientists who first submitted computer images as art. Quite the contrary was true in photography, cinema, or video, where artists soon seized upon this technology and began developing it in the initial phases without the generous support from the state and patrons of the arts.

Assuming the even partial validity of this analysis, this situation is at least worthy of further inquiry. The need to cloak a popular technology as an artistic guise certainly bears testimony to the fact that art per se generally enjoys a privileged position in our society. In this respect, our inquiry should not only focus on the media arts, since artists have been redefining the forms of traditional art since the beginning of the Modern era or even since the discovery of photography; demonstrating that there is really nothing under the sun that does not lend itself to artistic or aesthetic treatment. However, this process is both ambivalent and even paradoxical. If art is to embrace all things, then the contours delineating the artistic from the non-artistic or non-aesthetic will become blurred, eliminating the basis on which to appraise art. Furthermore, with the advent of electronics and the computer as the universal machine, a much closer link has been established between technology, commerce, and art than was previously the case with the analogous media of photography and film. Here, I will not expound on the possible commercial interests of industry, which are motivated by more pragmatic and pecuniary considerations than those champions of culture seeking to "interface" the new media to that strange species known as artists—who, for whatever reason, still enjoy blue-chip status. Perhaps we will only be able to observe the establishment of a new art form, traditionally defined in common with painting, sculpture, music, etc. This is realized by creating institutions, theories, exhibition facilities, audiences, and artists and by creating a demand and a market niche, while simultaneously reassuring that this new form is still in the experimental phase—i.e., "Don't expect too much." The "other" established arts are not exonerated from this criticism. They continue to operate along their traditional channels—which is why the vague term "art" is open to so many different interpretations and why no one is really quite sure of its true meaning or indeed has ever been. A different situation still prevails in the new computer-based media, where the need for legitimation is considerably higher, but the artistic threshold is set much lower. Just consider what is being marketed nowadays as art at international exhibitions.

Today's common strategies of sanctioning or trying to infuse kitsch with an aesthetic quality does not function as a form of self-reflection because computer art has not yet developed the aesthetic dogma found in modern art. This may not transpire until well in the future because computer technology is still in a phase of continual innovation. Modernism, on the other hand, assumes that the technique applied in a painting, for example, can in essence be developed no further; and secondly, that the aesthetic sensation is no longer paramount. Furthermore, artists no longer simply produce works of art but strive to infuse their work with multiple layers of self-reflection—posing questions like, "What is a work of art?" This can only function on the basis of an established set of criteria and expectations—which again is not the case in computer art. There, kitsch, banality, or certain other "effects" can only be taken at face value. Aesthetic fascination or the skilled mastery of a technique no longer constitute a work of art; much more, they are themselves the object of artistic inquiry.

At the same time it is both intransigent and illusionary of computer artists to adopt as a model the visual arts and their attendance institutions and forms of presentation and reception. Omitting for the time being the marginal and in fact regressive area of computer graphics, we can say that computer art distinguishes itself by virtue of the moving image and by permitting the construction of environments that are capable not only of eliciting reactions but also for manipulating interactively these events. Here lies the essence of computer art's distinctively playful dimension for the observer or user, which in the traditional arts has always been marginal and led to the still prevalent exclusion of entertainment as an artistic form. Even in the case of television, the most celebrated form of entertainment in terms of viewer time, the spectator is becoming increasingly involved in the playing of games, which, in turn, are observed by other viewers. Still, in keeping with our social customs, these games tend to be based on athletic skills or dexterity. On the other hand, toys or computer games, which posses at most some didactic but not aesthetic significance, have developed their own particular market.

If, for example, Paik's "Video-Buddha" had been revered as the icon of the electronic era in contrast to other closed-circuit installations, this certainly would not attributable to its manifestly symbolic character, but also to the exclusion of viewer-interaction. Indeed, the activity of the spectator, in so far as he or she playfully interacts with such an installation, is difficult for the artist to control. Does he use an interactive installation as a work of art? And what is the meaning of this? Similar questions arise concerning the work of Myron Krueger, a pioneer of interactive electronic art. Is he merely the inventor of toys for people to amuse themselves with? Do such works allow meaningful experiences in a space/time context, free of purpose or intention? But are not all works of art simply an invitation for each person to experience, grapple with, and interpret differently? If perception is action, why should there always be a dichotomy between perception and physical action? Must man's encounter with art be devoid of action, purpose, and intention for it to be of significance? Taken one step further: Is Odysseus, bound to the mast, a metaphor for man's reception of art?

Interaction is merely one more stage in the incorporation of the traditionally passive spectator into a creative process. This effectively means desegregating the work and the viewer, whose involvement hitherto was merely intellectual or emotional. This artistic endeavor did not arrive with the computer but emerged in the sixties in the movements known as kinetic art, action art, or the happening. To a certain degree, conceptual art and even pop art also belong to those movements that assert that the work of art is only realized when the spectator is present, or that attempt to undermine the divisions between serious and popular art. These artists employed rather simple installations, environments, and situations designed to incorporate the audience by challenging them to become active or by integrating their very presence into the work; for example, by entering a room, the spectator immediately transforms the environment or sees him/herself on a monitor. Typical for such works are those that encourage the spectator to alter his or her location to create different visual perspectives, while the picture requires that it can only be viewed correctly from one angle.

In the theater, efforts were made to correspondingly alter the principle of the proscenium, and in literature there was a transition from linear plot development to a more multi-layered, rhizomatic structure. In painting, the "all-over" art of Jackson Pollack bore witness to the fact that not only had the artist relinquished his focal point, but the painting itself was no longer subsumed within a centrally organized structure—thus permitting the viewer many different perspectives. This could also give birth to the idea that a painting could result from the collective efforts of a group of artists working on equal terms. This principle could only presuppose that the work or the space created within it is of a pluralistic nature. Even the tendency towards abstraction sought to realize this plurality on a semantic level. On the production level, the artist was transformed from the role of the manufacturer to someone devoid of a fixed pictorial objective, who uses a more or less random matrix of lines and colors as an imaginative surface on which the image starts to take on form as the artist intervenes.

Behind all these diverse endeavors was the conviction of avant-garde artists that by presenting an open and incomplete work, the spectator completes the work through his/her own participation. The intention of this interactive process is to transform the spectator into the artist, while simultaneously striving to make the "expert" superfluous.

Aside from art, the playing of games has come to be regarded as an area of voluntary human activity, not inspired by intention or motives. Play represents a surplus activity that negates the restraints imposed by reality and the urgency to satisfy primary needs. Moreover, play either inhabits or discovers other realities. Seen in this light, it is not surprising that the combination of play and art is a clear expression of a truly free and creative society, in which production and reception, creation and play co-exist in harmony. Today, interaction and "open" art works are easily reconciled with the insights revealed by the chaos theory and the resulting epistemological tenets of endophysics and constructivism. The model of the external observer, who seeks to objectively describe a system separate from him/herself, is gradually being superseded, not only in science but also in the arts. Instead we have come to accept the model of an internal observer situated in the world observed by him/her and affected or distorted by his/her activities—which, in turn, are influenced by this distorted world.

It is no secret that Duchamp had already begun to treat the system of art as a game or form of play, by manifestly devoting himself to chess. Similarly, the situationist had the declared program of overturning the traditionally accepted concept of art in order to create the conditions favorable for Homo ludens, the free, active, and creative human being. At the very same time, the Marxist sociologist and philosopher Henri Lefebvre, inspired by romantic projects of the situationists, developed his "Critique of Everyday Life," which in turn influenced Jean Baudrillard. He proposed the idea of the playful seduction or seduction as the basis of play in an illusionary world as the antithesis to a world obsessed with reality and power in which rational behavior is the driving force. During the sixties, the painter Constant, a member of the Cobra art movement and later a situationist, experimented with urbanistic designs; work that could be varied at will and was thus characterized by its intrinsic instability. He drew a strict distinction between a playful culture where each person develops his/her own creativity and a consumer culture that only permits choice between pre-ordained alternatives. According to Constant, the playful being, who purportedly emerged from the automatization of the production processes liberating him from utilitarian activities and bestowing upon him leisure time, is a nomad, whose behavior in every sense of the word can be conceived of as "drifting." Furthermore, this nomad has abandoned the conventional game that consists of sport and the attainment of an objective. Instead the nomad drifts along, encountering typical urban situations together with his fellow man, embarking on a quest for experience and adventure, constantly developing new environments, and, at the same time, modifying the rules of the game. Here, the situationists have excelled in developing ingenious scenarios. Homo Ludens, according to Constant, is no longer concerned with exploring the given, for example, nature, but instead pursues the creation of an environment "by artistically developing ambient structures" suitable for normadic life: "Life becomes a single, never-ending journey. Entire environments are in a state of incessant change, suspended for only the briefest of intervals, and thus continually providing new opportunities for exploration and experience." The model of the "wishing machines," the deterritorialization, and the rhizomatic structures of Deuleuze/Guattari represent the philosophical expansion of these objectives.

Does contemporary interactive art constitute the fulfillment of such utopian schemes—which may even appear less attractive today? At least from a technological point of view, architectonic space can soon find itself submerged beneath a continuous flow of changing virtual images. Using virtual reality technology it will soon be possible to enter virtual realities as one would a real environment. As far as interactive computer installations are concerned, the user is generally granted only a relative degree of freedom, determined by the artists or the creator of the system itself. The user has, at his/her disposal, a set of building blocks, from which various elements are selected and assembled. Here, the significance of the machines as an opponent can also be enhanced by integrating a "random generator" to exclude controlled manipulation. It may be possible to choose various strategies in combining elements in a montage or in exploring or to experiencing an artificial world or simply aesthetically structuring a given object or concept by adding new creative tools. Of course, when interactive works are exhibited in public, they are normally meant for use by one person, while the other participants assume the role of spectators of a performance. That means we are still dealing with a form of theater, but one that is lacking the seriousness traditionally associated with so-called "profound art." The users of interactive art not only play with the system, they simultaneously become performers portraying themselves. This is also true when the system permits the involvement of several players at the same time. On the other hand, this performance has absolutely nothing in common with drama, where the action is linearly pre-structured. In interactive art, the action develops spontaneously. To some extent, the artist resembles an animator by only providing a framework for action and thereby challenging the users to fill up this space with their own imagination. As theater, this can no doubt prove to be extremely boring for the viewers, but sufficiently intriguing for the participants.

Of course, interactive works of art like computer games tend to lose their novelty. Kees Aafjes, for example, created a bizarre sculpture with the title "Petting," which looked like an insect and also vaguely resembled a vagina. The interactive machine prompts the guest to touch it, to be intimate with it, to pet it. If the visitor complies with this request, the computer measures his "skin resistance" and the object begins making gurgling sounds, sighing and uttering a few phrases. There are ten variations available. Even if the petting with the machine could be symbolically amplified, the sensation would soon become redundant due to the lack of complexity, even if 100 different reactions were possible. Once the visitor sees through the mechanisms, the aura of the object presented disappears in spite of the sophisticated intentions of its maker. The game becomes boring when there is nothing to "win." But games incorporating the "win" aspect require skill or are subject to the laws of probability, which can hardly be reconciled to the concept of art and the way art is ordinarily received. That is the reason why these kinds of games rarely involve artists. Furthermore, the actual entering into a creative, playful process is contingent not only upon operating a pre-given system, but also upon the user's ability to devise his/her own games with new rules and material. Should this go beyond the elementary experimental stage, then this would be tantamount to the recognition gained from a public presentation—sought after by the artist and experienced by the user at most during his/her operation of the system. One gains the unerring impression here that the "cat is chasing its own tail." This also applies to the hypertext systems, no matter how well-structured, fascinating, and intelligent they are conceived as, for instance, in William Seamans, "The Exquisite Mechanism of Shivers." Here the user has a considerable amount of image-sound text sequences to choose from, which can be combined and merged in a generally straightforward manner. Using the materials at hand, anyone could create his/her film, and not only ephemerally; this system permits the product to be sorted for future viewing. However, it is precisely this predetermined material that is restricting the imagination. One is tempted to use one's own material to fill in the formal structures, so as to transcend the mere administration of a system capable only of accepting variations in syntax.

Consequently, reverting to the conventional role of the passive viewer is more satisfying. In probable awareness of the underlying imperfection and paradoxical nature of interactive work, William Seaman introduced a random generator that can combine the image-sound-text elements independent of the viewer's action.

Making the public aware of such questions with all their implications has been one of the achievements of interactive art. But, of course, we are a long way from the aesthetics of interaction. The systems purporting to be art are still at the exploration stage. Does this mean that we have no alternative but to wait until this experimental phase has been overcome, as some more modest observers of computer art would maintain? Or is it the case that the spectacular and primarily entertaining elements of the interactive system must first be indulged before aesthetically demanding forms of interaction or play can be developed at a more relaxed pace, in order to avoid making the mistake of trying to infuse this process with aesthetic elements? Or will the playful staging of "experience scenarios," where something happens, develop into a new essential dimension of art meriting greater exposure in the area of the traditional arts? Will the passive spectator, and with him/her, the artist become a thing of the past, banished from the stage of the art world? Do we as recipients of the arts want to become active participants? Are we not being seduced more by the perception of something, which we ourselves have not created, than by all the enticements offered by interaction? Have not illusion and art always existed side by side—with a common source and many overlapping features—without ever having managed to merge again following the arts' coming of age?

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Virtu-Real Space:

INFORMATION TECHNOLOGIES AND THE POLITICS OF CONSCIOUSNESS

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A significant shift is occurring in the make-up, physical nature, and composition of space as it is experienced in contemporary culture. This shift, which is a direct result of the ubiquitous presence of information technologies in the cultural landscape, signals that physical components alone no longer comprise the infrastructure of the contemporary social environment. The ads, which show American Express cards in locations where they function as architectural elements (i.e., a bridge support, a path on a golf course, a canopy over a restaurant dining area, and others), indicate that it is now a combination of physical components and virtual systems that support and sustain the "real" world. Virtual credit space, symbolized in the advertisements by the credit card, functions not only as structural support for the physical world, but also as solid footing and shelter for the people who live in that world. And since virtual credit space is operationalized by information technologies, it becomes clear in these commercials that the extent to which physical space has been infiltrated by information technologies is both extreme (the cards are pervasive) and covert (no one in the ads notices the cards). Furthermore, because the cards blend into their surroundings unnoticed, these corporate images also indicate that information technologies are our natural setting. It becomes clear, then, that the use of the credit card icon in these commercials represents the extent to which information technologies have become naturalized as an intrinsic part of contemporary social life.

When viewed in the context of VISA's advertising slogan, "It's everywhere you want to be," the American Express commercials also indicate that information technologies are ubiquitous: virtual space is under our feet, over our heads, and even part of our infrastructure. This ubiquity signifies not only that virtual space is everywhere we want to be, as VISA would have it. It also signifies that virtual space is everywhere we are. And because the credit cards connote debt, these advertisements serve as perfect representations of the concrete reality that contemporary culture is permeated by an overwhelming sense of unpaid credit balances. In fact, the placement of American Express credit cards in various spaces of the contemporary landscape suggests that our culture is founded on debt. This pervasiveness is not a novel notion—the presence of the enormous and growing National Debt is a well-known fact of life, and one needs only read tables from census bureau reports to realize that personal debt continues to rise.[1] But it is a novel notion for this situation to be a prominent, if unacknowledged, sales pitch for a corporation that attempts to sell more debt. Ultimately, this advertising campaign failed, and one of the reasons that was often cited for its failure was that the ads were exceedingly "cold."[2] Perhaps, however, the ads were too true-to-life: their suggestion of being trapped by debt created an all-too-real sense of debt fear in consumers. The foreboding debt subtext of these advertisements, which in many ways perfectly reflected the apocalyptic sense of vertigo experienced upon realizing that credit payments are not able to be met, apparently proved too painful for target audiences to confront.[3]

A second consequence of the ubiquity of virtual space, however, engenders repercussions that are more disturbing than the relatively harmless failure of an advertising campaign. Due to the ubiquity of virtual profiles—which are constantly updated with data about weight, library borrowings, driving record, income level, medical problems, video preferences, and numerous other bits of information—we exist everywhere. Our virtual bodies populate the contemporary virtual landscape. Consequently, our personal information is available to almost anyone who can access virtual space.[4] The scandal over Robert Bork's video rental record during his confirmation hearings demonstrated the relative ease with which this information can now be obtained. But we do not simply exist in virtual space. We are also constructed in that space. Mark Poster characterizes this situation in his book, The Mode of Information, as one in which ". . . individuals are constituted through their place in the circuit of information flows."[5] Although the concept of a place is antithetical to the placelessness of virtual space, Poster correctly indicates that one of the principal sites of identity construction in contemporary culture is cyberspace.

However, cyberspace is not the only site in which identity is currently constituted. There still must be a physical body that shapes itself in real space before there can be a virtual body. As such, identity remains, to a certain extent, grounded in physicality. But it is the way in which the physical body invents itself in real space that allows it to be virtually constructed. The use of a credit card provides an example. Each use of a card is first an inward construction of identity through a purchase—to paraphrase Barbara Kruger, "I purchase, therefore I am."[6] But the use of a credit card also enables virtual space to outwardly constitute the consumer's identity in terms of demographic information. One result of this situation is that individuals now exist as multiple entities. Consequently, the concept of a stable, Cartesian identity has been replaced by a highly unstable, dispersed identity. The fact that this identity is partially constituted by agents that exist in virtual space leads Poster to write that "Staying tuned in is the chief political act."[7]

The surveillance connotations of the phrase 'staying tuned in' are clear. There are crucial differences, however, between the virtual space method of surveillance and the real space method, which is most often represented by the panopticon. Surveillance via the panopticon in prisons is functional only when inmates can be visually located in 3D space by a controller. As Foucault writes, "[T]he major effect of the panopticon . . . [is] to induce in the inmate a state of conscious and permanent visibility that assures the automatic functioning of power."[8] Also, "The panopticon is a machine for dissociating the see/being seen dyad: in the peripheric ring, one is totally seen, without ever seeing; in the central tower, one sees everything without ever being seen."[9] It is clear that the strict boundaries of power that are created by this situation are established and enforced via vision. In virtual space, however, the distinction between surveillant and surveilled is unclear because both the subject and the object are invisible. When this is combined with the fact that every virtual entity is also multiple and dispersed, it is clear that virtual power sites are scattered rather than bi-polar. An additional difference between virtual- and real-space surveillance is that the omnipresence of information technologies insures that virtual behavior monitoring transcribes almost all social interactions by everyone—not only inmates—into data. Ultimately, it is this omnipresence that enables surveillance in virtual space to be a predictive device that operates before actions are performed, rather than a preventative device like the panopticon that functions after actions are performed.

The Identity Economy

And it is this predictive quality that has created what I call the identity economy. In this economy, almost every social transaction—every use of a credit card, every telephone call, every withdrawal of money from a bank account, every mail order, every magazine subscription, every visit to a doctor, etc.,—creates a potential surplus of demographic identity information. To again use the example of a credit card, a purchase on credit can yield the following information about the card holder: cost of item purchased, location of purchase, remaining credit balance, etc. Additionally, when cross-referenced with other files, the purchase can also delineate spending patterns. All of this information is in high demand by demographers. Consequently, in order to satisfy the demand for this information, each social transaction is immediately translated into a supply of data that corresponds to the demand. The result of this process is equilibrium, a term used in economics to describe situations in which the market is stable because supply equals demand. In this state of balance, the intersection point of the supply and demand curves indicates a point of "perfect" information.

The business economy places primary importance on this perfect point, and it is only at this point that the future of the business economy is secured.[10] Because it is only when there is perfect consumer information that the practice of predicting future spending habits is able to provide a correct economic forecast. This principle is perhaps most clearly illustrated by the credit card industry's practice of predicting the future spending patterns of cardholders based on previous card usage. It is clear that outdated, "imperfect" information would destabilize this practice and, by extension the business and identity economies. It is also clear that without the universal availability of consumer profiles, current information about consumer habits would be extremely difficult to obtain. Thus, it is now an economic necessity that virtual bodies exist in the information network.

It is important, however, to investigate the racial makeup of these virtual bodies. Due to the fact that large proportions of racial minorities are economically unable to obtain credit cards, and because of the low percentages of racial minorities in college and university programs where consumers often obtain their first credit cards, it is clear that virtual credit space is dominated by virtual white bodies.[11] This renders tactics used by the business and identity economies incapable of even acknowledging the presence of racial minorities in any way that approaches sufficiency, much less of attempting to predict their future spending patterns. But this situation also helps to explain, in part, the tremendous amount of effort that is expended on recruiting racial minorities for higher education; because without a pool of consumers on which to base its decisions, it is very difficult for the business economy to predict its own future. In this sense, education and consumerism go hand-in-hand, and to have a diploma is to be fully functional in the current form of consumer capitalism. Consequently, it becomes obvious that the virtual space of credit cannot be anything but a sphere of mostly white tastes. The inadequacy of the credit apparatus to register large groups of racial minorities, combined with the existence of racial prejudices, creates a situation in which racial minorities continue to be marginalized in contemporary North American culture.[12] One can only hope that Donna Haraway's "ironic dream of a common language for women in the integrated circuit,"[13] can also be a belief that in the future, the circuit will also integrate racial difference. At the moment, the common language is still symbolically and politically binary, resulting in a highly segregated circuit.

The ideas above indicate that it is no longer possible to speak only of real (physical) space; nor is it the case that virtual space has colonized real space (the contemporary landscape is not, and never will be, total virtual reality). Rather, the two categories of virtual and real space have collapsed into one another, creating a virtu-real space that on the surface seems like real space but is significantly different, especially in terms of the social relations that it produces.

Do

It is the idea of habits, and being caught in virtual space because of them, that is perhaps the most resonant theme in my work. Because habits—those unconscious, private patterns of repeated actions—comprise not only the times when we are most vulnerable; they also comprise those times that are most highly codified in virtual space. Some examples of the codification of habits include: yearly visits to a doctor for a physical examination, which create a comprehensive virtual portrait of health; daily attendance at an educational institution which, when cross-referenced with library borrowing records, constructs a virtual picture of intellectual and political interests;[14] and weekly uses of a credit card to purchase, for example, gasoline, producing not only a credit profile but also a virtual travel record. The fact that all of these actions are routine—yearly, daily, weekly—and banal—involving a routine physical, library books, and gas—renders them almost unperceived by the individual. But there is an inverse relationship between the extent to which these actions are registered by the individual, and the extent to which they are registered by the identity economy. Thus, the self-investigation of habits has become a political act.

In order to sufficiently deal with the issue of habits, and to address the ways in which those habits are monitored, I feel that it is important to confront virtual space on its own terms. Consequently, my work employs techniques and technologies associated with the postal and telephone systems, computer technologies, and the television/video apparatus, all of which are well-integrated into the circuits of the identity economy. By utilizing the same cultural technologies as the identity economy, I think it is possible to gain a clearer sense of the ways in which that economy functions, including how it affects a real body. The following examples are, then, my initial steps into the realm of political consciousness in virtual-real space.

Have Your (Post)Cards Read!

Have Your (Post)Cards Read!, which was first shown at The New Museum of Contemporary Art in New York, was modeled on credit card displays that are often seen in department store customer service centers. These displays are of particular importance to the identity economy because, after the customer obtains a credit card, the store is provided with a direct link, via mail, to that customer. Consequently, the postal system functions as a major, often overlooked, player in the functioning of both the business and the identity economy. The link via mail provides the store with a real-space address where consumer desires are most obviously and profitably materialized in the form of durable good purchases. But the link also allows the customer's habits to be codified by the store, thereby directing demographic target mailings. Each use of the credit card allows the store to obtain information about items that it believes are, and will continue to be, in demand by the customer. This information is then used by the store to target specific customers based on the data that is culled from their purchase records; a practice that subsequently determines which kinds of catalogs are sent to certain customers. The purchase of a power drill on store credit, for example, is an indication that the customer will again be interested in purchasing additional power tools. Accordingly, the customer will receive tool-oriented catalogs in the future. Of particular interest for my project, however, were the loopholes in this system that cause the system to malfunction. One hypothetical malfunction would be for a man to purchase a maternity dress for a female friend who is pregnant. Normally, this man would begin to receive maternity catalogs through the mail because the store would construct him as a pregnant mother. In addition to working with this obviously humorous situation, I was also very interested in opening up an oppositional space within the identity economy that would somehow interrupt the process of target marketing.

The piece consisted of two identical displays that were placed in the museum. Each display requested that visitors to the exhibition fill out a postcard-sized narrative survey, place a stamp on the card, and deposit it in a vitrine that was located in the entrance to the mall. Each display also indicated that the card would be returned to the customer showing the reader's approximation of that which the customer should not purchase—which is the exact opposite of a real department store's intention. The card requested the customer to:

"Please use this space to provide the reader with every piece of information about yourself that you want taken into consideration when your reading is done. Describe your allergies, favorite foods/places/activities, phobias, desires, sexual habits, life goals, inclinations, pet peeves, or any other characteristic(s) that you feel are important for the reader to know. Be as specific (or broad) as you want. This information will not be released to any other party—it's between you and the reader."

The reader, who was me, responded to the customers individually by reading the cards and marking them with a red rubber stamp that read, "DO NOT PURCHASE ____________________." and filling in the blank. The cards were then deposited in the mail, and the customers received their readings a month or so after the exhibition closed.

By requesting personal information in a narrative form (rather than a normal multiple-choice questionnaire that surveys income level, education level, appliances owned, etc.), the customer was encouraged to reveal a more detailed, comprehensive account of his/her personality. In this way, the readings were able to go beyond simple categorizations by responding directly to the complex individuality that exists behind most demographic information. The process of reading the cards also made it clear that statistical constructions of data, which are the result of marketing surveys, are often as misrepresentational as target marketing is faulty.[15]

Double Bind: Virtual Applause

In contrast to Have Your (Post)Cards Read!, Double Bind: Virtual Applause was about my own habits rather than those of anonymous customers. It was also an attempt to address the ways that the categories of consumer and criminal are collapsing into one another. One of the most prevalent methods of information processing that contributes to this collapse is the construction of a consumer record through the use of a credit card. As I continued to think about virtual space, it became clear to me that each use of a credit card generates a particular expression of personal enjoyment, which I call virtual applause. This applause is immediately codified by the credit card industry in terms of a profile that can include detailed information about the consumer and the purchase. Under these conditions, the consumer acquires a record that is based on personal enjoyment. And this record allows the consumer to be monitored. Hence, the double bind of virtual applause.

This double bind was evoked most strongly by the manila folders on the right wall, each of which was a self-constructed profile of one transaction that I have performed with my VISA card since I first became a member in 1986. I profiled every transaction in terms of the information that VISA provided on my statements, as well as my recollection of how I felt about the purchase. Additionally, I included information about how the transaction affected my body, since it is my virtual body that is marked by the transaction in virtual space. Each profile consisted of four broad sections: institutional information, statement information, transaction details, and effects. A sample effect for one transaction, the purchase of concert tickets, read as follows: "Subject subsequently experienced pleasure in and around the ear area, along with a certain amount of pleasure in seeing a 'famous' artist." On the left side of each folder was an acetate overlay of a diagram used by law enforcement agencies to locate scars and marks on the body of a criminal. Under this overlay was a full-length image of my body. The judgment of each transaction was listed as applause in every folder. As with the previous piece, Double Bind: Virtual Applause was meant in part to be humorous, but below the humorous facade I was also interested in presenting a sense of disquiet about the growing similarity that consumer monitoring shares with criminal monitoring.

Another type of double bind was generated in the piece by a cordless telephone receiver that was placed on the left wall. The voice that spoke from the speaker was my own. The telephone itself was not operative, but the telephone's speaker was connected to a looped cassette tape player that played continuously (the player was not visible). The tape consisted of a series of requests that I asked myself to respond to such as, "Please provide information about your weight," "Please provide information about your sex," "Please provide information about your habits," and so on, all of which were read from a law enforcement manual for constructing profiles of suspects. I answered each request as completely as possible, and each request-and-answer pairing was a message that I previously left for myself on my personal answering machine. The process of making this tape, and the incorporation of the telephone into Double Bind: Virtual Applause, represented an attempt to address not only the fact that virtual identity construction is prevalent throughout the telephone network. It was also an attempt to interrupt the process of objectification that is inherent in that construction process.

Both the manila folders and the telephone receiver/tape focused attention on the metaphor of a target. In the folders, a formal target was created by the lines that crossed over the full-length image of my body, as well as over my body part. Additionally, the folders were, in many ways, concerned with demographic target marketing. The telephone speaker also created a sense of targeting, primarily because of the fact that law enforcement models were used in an attempt to construct my own profile. These metaphorical appropriations made use of the fact that targets often serve the purpose of tracking and codifying the movements of a suspect through space. To a large degree, demographics is primarily concerned with determining the geographic area in which the consumer lives and the places the consumer has visited in order to pre-determine the consumer's future movements through space. Consequently, the prognostications of demographers contribute, in part, to the practice of actually moving bodies through space. This illustrates one of the ways in which a bureaucratic state keeps track of its citizens, as theorized by Deleuze and Guattari who write, "[The State] requires that movement, even the fastest, cease to be the absolute state of a moving body...to become the relative characteristic of a 'moved body' going from one point to another...In this sense, the State never ceases to decompose, recompose, and transform movement..."[16] Given this analysis, it becomes clear that bureaucratic consumer culture is a situation in which virtually every movement is targeted is one way or another.

Pelting

This idea was foregrounded in another piece, a performance/installation titled Pelting. In addition to again being concerned with habits, or habitual actions, this piece in many ways represented my attempt to negotiate with the existence of my targeted virtual body. For the performance, I was locked into a vault in an abandoned fur coat storage warehouse. For the two-hour duration of the piece, I performed various military-based actions, and periodically shot an unloaded gun directly at the camera that was taping me. The camera fed live video images of me to a monitor that was located outside the vault, and as I performed the actions, visitors could see the image of my body on the monitor, but I could not. In this way, the piece confirmed the inability of even attempting to make a mark on a virtual body, symbolically representing the relative lack of control that we have over the information that comprises our virtual profiles. The piece also confirmed, however, that in order to stay tuned in to oneself in a virtu-real landscape, one must become auto-surveillant.

RANT[17]

In summary, the three works that I have described above collapse private habits into public domains. Whether it is my reading of a customer's private ruminations on a postcard, or the publicization of my credit history and consumer desires, or the demarcation of virtual and real space, all of these examples confuse public and private habits, mirroring the way information technologies blur the line that separates private from public information. Historically, the public/private line has been drawn on the walls of the domestic space, a space where the Law of the Father has reigned supreme. The politics of this situation are manifest in the expression, "A man's home is his castle," a structure that is complete with mote and fortified concrete walls, suggesting the extent to which domestic space has long been protected by the Law. But a system like virtual space, which has no physical walls, fundamentally challenges—even dissolves—this boundary, along with the authority of the Father. Private information can now be obtained by using information technologies to penetrate even the walls of the bedroom to obtain data, for instance, about who rents sex videos and how often. The Law of the Father is highly challenged in this situation (recall the earlier statement pertaining to Robert Bork). Under these circumstances, questions about what constitutes privacy in virtu-real space become foregrounded. And as advancements in information technologies continue to facilitate and enhance personal information monitoring, questions of privacy have achieved a sense of urgency. The issue of privacy is doubly urgent because of the recently-inaugurated White House plan to construct an information superhighway. The economic potential of this plan has not escaped the agendas of corporate interests. But the issue of privacy has been conspicuously absent from such agendas, indicating that the financial economy continues to overlook the identity economy. As such, debates about virtu-real privacy must attempt to reveal the hidden agendas that exist behind the facade of "progress" via information technology development. Correspondingly, attention must also be paid to the extent to which individuals will be able to stay tuned in to their own bodies—virtual, real, or virtu-real. At the moment, even the boundary of the skin does not separate private from public, because almost every mark that is made on the physical body by a medical professional creates a corresponding data mark on the virtual body.

Faced as we are with the (purported) impending takeover of real space by virtual space (largely by pundits of virtual reality), it is of crucial importance to reveal their hidden agendas. It is also crucial to stay tuned in to the ways in which physical matter is manipulated. With this paper I hope to have revealed some of the agendas that I see being hidden in current debates about information technologies; and I also hope to have shown how I attempt to stay tuned in to my real body. Because, as Allucquere Rosanne Stone writes, "No refigured virtual body, no matter how beautiful, will slow the death of a cyberpunk with AIDS."[18]

Notes

1. Consumer credit outstanding in 1970 was $131.6 billion. In 1989, it was $778.0 billion. The ratios of this debt to disposable personal income were 18.3 and 20.6, respectively. Data taken from 1990 Census Bureau Reports, p. 510.
2. See, for example, the article, "'The Card' Ads Lose in Survey," in The New York Times, July 16, 1992, sec. D, p. 17, col. 3.
3. It is interesting to note that these advertisements were replaced by more user-friendly ads featuring, for example, comedian Jerry Seinfeld cavorting with a goldfish.
4. The recent emergence of Information American (an on-line database with an estimated 111 million profiles) and the growing use of computer networks is significantly contributing to this situation.
5. Poster, Mark. The Mode of Information: Poststructuralism and Social Context. Chicago: The University of Chicago Press, 1990, p. 136.
6. It is often maintained that no purchase in contemporary culture can be an inner-directed action because corporate adver-

tisements construct all consumer desire. But this method of analysis attributes no agency or cognitive ability to the individual and, in the end, is the product of a simplistic, insufficient, and exceedingly totalizing analysis of the world.

7. Poster, p. 136.
8. Foucault, Michel. Discipline and Punish: The Birth of the Prison. Translated by Sheridan, Alan. New York: Vintage Books, 1979, p. 201. Italics added.
9. Foucault, p. 201-202.
10. The business economy is not the only entity that uses the identity economy. But in this analysis, corporate culture relies on the identity economy to a larger extent than, for example, the library profession.
11. The relative presence of racial minorities in virtual crime space, however, is sure to be much higher than that of whites.
12. It should be noted that marketers do, in fact, notice the cultural productions of racial minorities, especially in musical cases like rap and hip-hop. But it must also be realized that one of the most profitable rap music ventures is still that of Vanilla Ice.
13. Haraway, Donna J. Simians, Cyborgs, and Women: The Reinvention of Nature. New York: Routledge, 1991, p. 149. Italics added.
14. The importance of monitoring intellectuals, especially "suspicious" intellectuals, because of their library-borrowing record was revealed in the FBI's Library Awareness Program. For an analysis of this surveillance program, see Foerstel, Herbert N. Surveillance in the Stacks: The FBI's Library Awareness Program. Contributions in Political Science, Number 266. New York: Greenwood Press, 1991.
15. This project will be continued in other venues in order to try to invent a way of conducting demographic analysis that does not replicate the corporate model. The piece will be shown again this spring at the Zimmerli Art Museum on the Rutgers University campus. Also, Capp Street Project in San Francisco and the Center on Contemporary Art in Seattle have expressed an interest in presenting it.
16. Deleuze, Felix and Guattari, Felix. A Thousand Plateaus: Capitalism and Schizophrenia. Translated by Massumi, Brian. Minneapolis: University of Minnesota Press, 1987, p. 386.
17. A form of expression often cited as appropriate to the information age. For examples of rants, see: Rucker, Rudy; Sirius, R.U.; and Mu, Queen. MONDO 2000: A User's Guide to the New Edge. New York: Harper Collins Publishers, Inc., 1992, pp. 210-220, 312.
18. Stone, Allucquere Rosanne. "Will the Real Body Please Stand Up?: Boundary Stories about Virtual Cultures," in Cyberspace: First Steps. Edited by Benedikt, Michael. Cambridge, Massachusetts: The MIT Press, 1991, p. 113.

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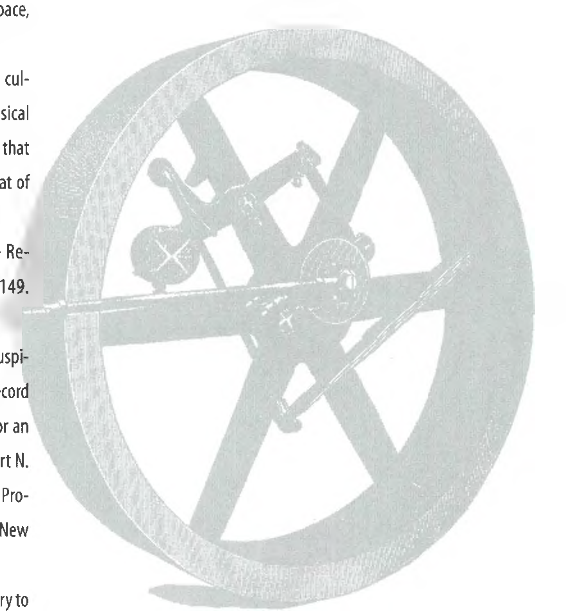

Interactive Plant Growing

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Institut fur Neu Medien,

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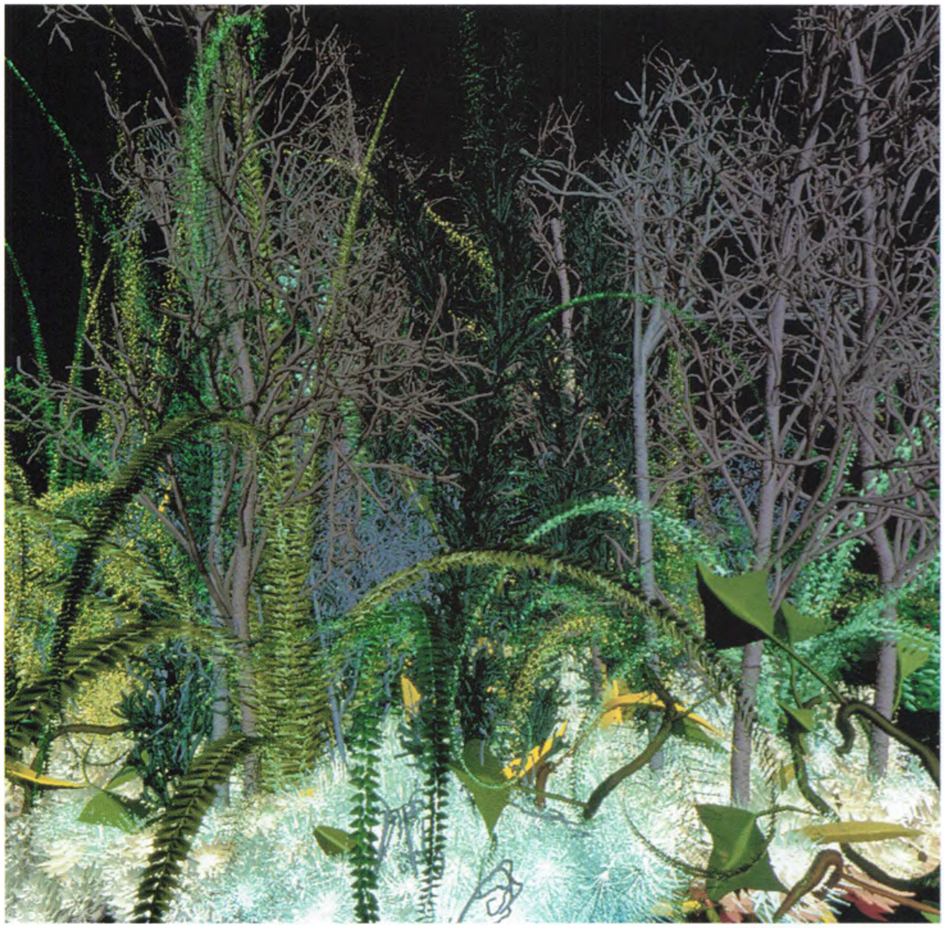


The rate of growth deserves to be studied as a necessary preliminary to the theoretical study of form, and organic form itself is found, mathematically speaking, to be a function of time. We might call the form of an organism an event in space-time, and not merely a configuration in space."

— D´Arcy Thompson, "On Growth and Form," Cambridge University Press, 1942

Interactive Plant Growing is an installation that deals with the principle of the growth of virtual plant organisms and their change and modification in real time in 3D virtual space. These modifications of pre-defined "artificially living plant organisms" are mainly based on the principle of development and evolution in time. The artificial growing of program-based plants expresses the desire to discover the principle of life as defined by the transformations and morphogenesis of certain organisms. Interactive Plant Growing connects the real-time growing of virtual plants in the 3D space of the computer to real living plants, which can be touched or approached by human viewers.

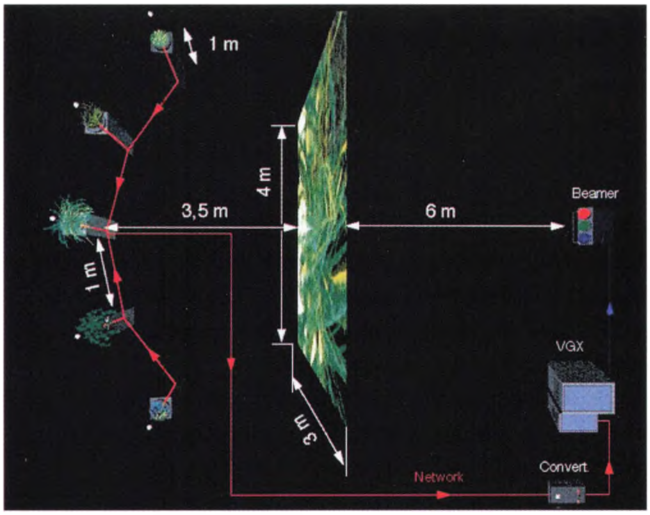
By touching real plants or moving their hands toward them human viewers can influence and control in real time the virtual growth of 25 and more program-based plants, which are simultaneously displayed on a video screen in front of the viewers. By producing a sensitive interaction with the real plants, the viewers too become part of the installation.

The various distance modulations of the viewer's hands directly effect the appearance of the virtual plants, as they are ferns, mosses, trees, vines, and a cleaning plant. By sending different data values to the interface (which connects the plants and the growing program), the appearance of the virtual plants can be modified and varied. The viewers can control the size of the virtual plants, direct the rotation, modify the appearance, change the colors and control new positions for the same type of plant.

Each virtual plant species has at least six different variations, but generally there are more possibilities than just 25 variations of five plants, since the size, color, and translation can be modified for each single plant as well. All variations ultimately depend on the viewers sensibility to find the different levels of approximation distances.

In Interactive Plant Growing, artificial plants grow in a virtual 3D space, programmed by Laurent Mignonneau and Christa Sommerer on a 4D -VGX 320 Silicon Graphics Computer. This virtual growing is based on specially developed algorithms, according to the different morphological characteristics of real plant differentiation. Virtual growing is not based on the same principles as real growing, rather the appearance of movement and differentiation and determination during this evolutionary process can be considered to be optically similar.

In the program a new method of differentiation was developed that can be compared to the L-Systems of Aristid Lindenmayer, but using special randomizing parameters, which are seen as "artificial growth and differentiation regulators." These randomizing parameters determine the morphology of the organisms by controlling their variations of forms. Each step in



the construction of the plant forms is randomized in the greatest possible extent within prefixed minimum and maximum limits; like this the potential variations are as great as possible.

This leads us to different botanical growth forms. Plants like ferns, vines, or mosses change their appearance depending on the randomizing defined variables for size, length, rotation, translation, angle, and color. This idea of advanced randomizing could be compared with the term "walking randomizing." The limits of randomizing could be considered as determination, whereas the randomizing itself can be representative for the differentiation.

The electrical potential of the real plants gets measured by special sensors, which are attached to the plant roots. This electrical potential is then compared with the electrical potential of the viewer. This voltage difference varies depending on the hand-plant distance. The sensitivity of the plant ranges from 0 to about 70 cm in space. These electrical signals are amplified, filtered, and sent to the converter.

Each plant is attached to an independent amplifier. A converter transforms the analog-amplified and filtered signals into digital data values. All five amplifiers send their signals to the converter; a multiplexer selects the signals to be converted. These values are then sent to the parallel port of the 4D VGX 320 Silicon Graphics computer. A special protocol (interface program) between computer and converter makes sure that each data value coming from each plant is interpreted in synchronization and in real time by means of the growing program during the drawing of the virtual plants.

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Adelbrecht

MARTIN SPANJAARD

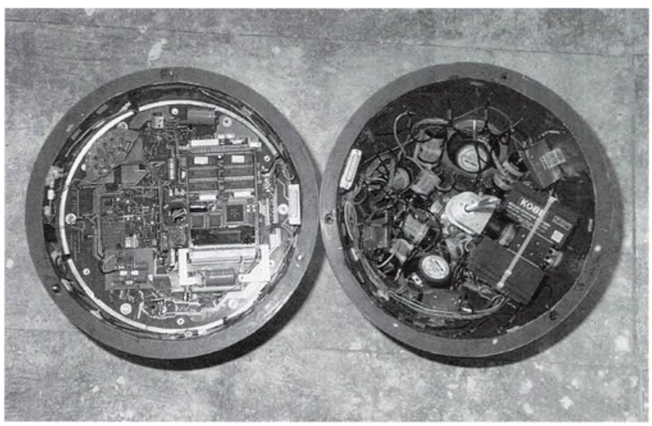
Montevideo Time-Based Arts

To briefly describe Adelbrecht: it's an anthropomorphized protozoa-robot in the form of a ball of 40 cm. diameter. It—or let's say: he talks about his life: rolling, bumping, and ball/human interaction: the things that happen to a ball. He confronts us with the boundary between Being and Machine, with the crossing of It to Him. I function the example and the source of inspiration, so he also is a self-portrait. Finally, he is an actor trying to interest us enough to follow him for some time.

Adelbrecht is a ball, rigged with an eccentric hanging electric motor, which makes him roll. The ball is fitted with some sensors, a computer and a Dutch voice, speaking English. This ensemble enables him to have a limited knowledge of the world and to chatter about it.

His sensors detect position, bumps, ambient sound level, touch, and low batteries. An interrupt-driven program scans his sensors 10 times per second. Each sense (sensor + software) detects among other things the occurrence of a 'state,' e.g., rolling, not rolling, bumping a lot, bumping normal. The combination of states leads to the perception of 'situations;' e.g., being stuck, being petted, bumping a lot. He discriminates some 17 different situations.

Furthermore he computes 'mood' and 'lust.' Lust degrading from the moment he is being awaken till he puts himself to 'sleep' (typically around several minutes) and rising again during his sleep. Petting heightens his lust. However if he gets stuck his lust lowers fast. If this lasts long enough he'll switch himself off. But not after having asked for help, getting angrier all the time. His mood, hovering around a mid-level, functions likewise. Mood and lust affect each other. An 'outer loop' program uses all this (plus a diversity of sensorial information) to generate speech and behavior: understandable, meaningful, but not predictable.



The first time I showed an earlier, far less powerful version of Adelbrecht to the public in 1984, something happened that could have been a hint not to go on with the project. A small crowd of relatives and friends was gathered in a small, shabby gallery in Amsterdam. Awaiting the moment when they would finally see Adelbrecht, about whom they had heard me say for more than two years: 'he is almost finished.'

At exactly three o'clock I released him from the back room, to let him roll to the middle of the crowd. He halted, introduced himself and began his first public role. I stood there, sweating and waiting for something to go wrong, as had happened 20 minutes before, probably due to 'stack overflow.' And indeed, five minutes later it happened: a long 'aaahh' nagged through the room. I walked over, picked him up, opened the lid, and reached for the reset switch. This tableau occurred several times, but my guests were convinced, consuming drinks, food, and conversation. Half an hour later, one of them asked me to come and listen to Adelbrecht. Fortunately he still rolled and made sounds, although not the intended ones.

He kept repeating: "I am god, I am Christ, I am god, I am god-damned, I am god," etcetera, etcetera. One way or the other, in the regular sentence 'I am Adelbrecht' he said one of the curses he could utter after a bump and then started that sentence anew, so he never reached 'Adelbrecht.' This went on, till he suddenly switched the direction of his motor backwards, which is possible but not allowed. This causes Adelbrecht to unscrew himself. The two halves of the ball started to part and after a little while the round god shut up. At that moment I couldn't think of a better ending of the afternoon.

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Neuro Baby

NAOKO TOSA

Musashina Art University

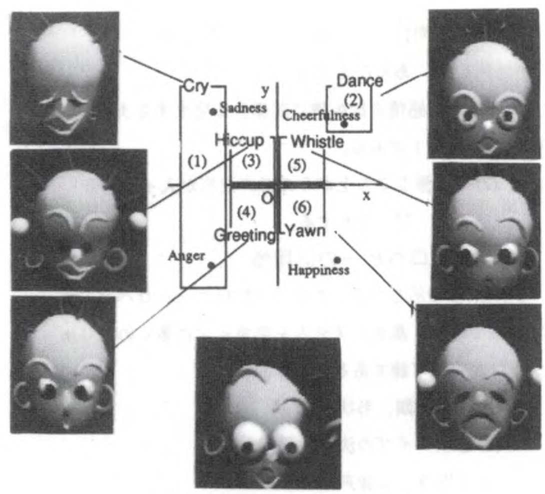
An automatic facial expression synthesizer that responds to expressions of feeling in the human voice.

I created a new creature or a piece of work that can live and meaningfully communicate with modern, urban people like ourselves, people who are overwhelmed, if not tortured, by the relentless flow of information, and whose peace of mind can only be found in momentary human pleasures. Neuro Baby was born to offer such pleasures.

The name "Neuro Baby" implies the "birth" of a virtual creature, made possible by the recent development of neurally based computer architectures. Neuro Baby "lives" within a computer and communicates with others through its responses to inflections in human voice patterns. Neuro Baby is reborn every time the computer is switched on, and it departs when the computer is turned off. Neuro Baby's logic patterns are modeled after those of human beings, which make it possible to simulate a wide range of personality traits and reactions to life experiences.

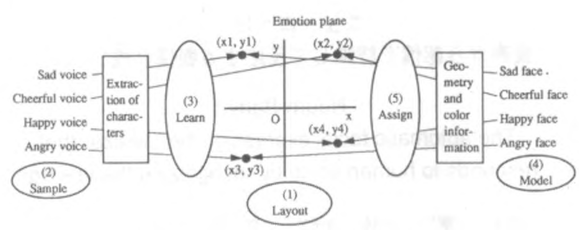
Neuro Baby can be a toy, or a lovely pet—or it may develop greater intelligence and stimulate one to challenge traditional meanings of the phrase "intelligent life." In ancient times, people expressed their dreams of the future in the media at hand, such as in novels, films, and drawings. Neuro Baby is a use of contemporary media to express today's dreams of a future being.

Basic Characteristic of Neuro Baby and its Interaction with the External World



(7) **Surprised: A special event which occurs** when a loud voice input comes in.

An example of event mapping



The five-step designing process of a Neuro-Baby

This work is the simulation of a baby, born into the "mind" of the computer. Neuro Baby is a totally new type of interactive performance system, which responds to human voice input with a computer-generated baby's face and sound effects. If the speaker's tone is gentle and soothing, the baby in the monitor smiles and responds with a pre-recorded laughing voice. If the speaker's voice is low or threatening, the baby responds with a sad or angry expression and voice. If you try to chastise it, with a loud cough or disapproving sound, it becomes needy and starts crying. The baby also sometimes responds to special events with a yawn, a hiccup, or a cry. If the baby is ignored, it passes time by whistling, and responds with a cheerful "Hi" once spoken to.

The baby's responses appear very realistic, and may become quite endearing once the speaker becomes skilled at evoking the baby's emotions. It is a truly lovable and playful imp and entertainer. In many ways, it is intended to remind speakers of the life-like manner of the famous video-computer character Max Headroom.

Two major technologies were combined to create this system: voice analysis and the synthesis of facial expressions.

Voice analysis was performed by a neural network emulator that converted the voice input wave patterns into "emotional patterns" represented by two floating point values. The neural network has been "taught" the relationship between inflections in human voices and emotional patterns contained within those inflections. During interaction with the baby the emotional patterns found in the observer's speech are continuously generated.

During the translation stage, the two values for emotional patterns are interpreted as an X-Y location on an emotional plane, onto which several types of emotional patterns are mapped. For example, "anger" may be located on the lower left of such a plane, while "pleasure" would be located on the upper right of the same plane. Each emotional pattern corresponds to a paired facial expression and a few seconds of voice output.

During the performance, the facial expression is determined by interpolating the shape, position, and angle of facial parts, such as eyes, eyebrows, and lips. These parts were pre-designed for each emotional reaction.

One FM TOWNS, Fujitsu's multimedia personal computer, is used for voice analysis, another FM TOWNS is used for voice generation, and a Silicon Graphics IRIS 4D is used for image synthesis.

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The Labyrinth

FRED TRUCK

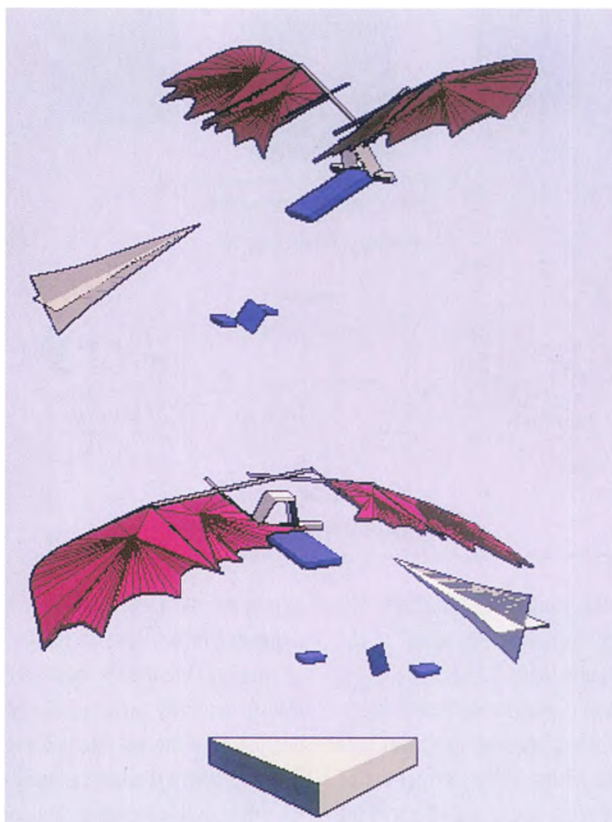
Electronic Bank

The Labyrinth is the setting for participation in the myth of Dædalus, builder of the maze for Minos, legendary ruler of Crete. When Daedalus ran afoul of the King and was imprisoned in the Labyrinth, he built wax wings on which he and his son Icarus attempted the flight to freedom. The Labyrinth floats above, its two-faced blocks a visual pun based on the double-headed axe that marked the original Labyrinth. The ornithopter (as improved upon and built by Leonardo da Vinci) is poised below, ready to fly to freedom, needing only a pilot.

For Leonardo da Vinci, swimming under water was the original flight simulator. In Codex Atlanticus, he notes: "Write of swimming under water and you will have the flight of the bird through the air." Nowadays, we can use computer technology in the form of virtual reality to create very credible flight simulations for jet fighter pilot training. What, I wondered, could I do with virtual reality techniques to construct an artist's flight simulator for one of Leonardo's flying machines?

The da Vinci Flying Machine is a heavier-than-air craft sustained in and driven through the air by flapping wings. My design, based on a combination of one Leonardo developed in the 1490s and his design for the bicycle, uses bicycle pedals to drive the wings. Rather than try to model in detail all the ropes and pulleys that provide Leonardo's machine with avionics, I eliminated them, emphasizing instead its spare, geometric lines, and of course, the bat-like wings he drew so many times.

The da Vinci Flying Machine differs from conventional aircraft in major ways beyond the use of flapping wings and human muscle for power. Leonardo's designs have no instrument panel. Flying is actually done by the seat of the pants—that is to say, visually. The pilot's head is the foremost object, rather than a windshield, cockpit canopy, or engine and nose.



These points raise a good question. How will the user's point of view operate once the user is piloting the machine? Since the pilot's head is the foremost object, does the ornithopter need to exist as a 3D model in memory while flying?

In typical virtual reality directional techniques, motion of the user follows in the direction the user points. This technique allows flying through the Labyrinth, and means that while flying, the flying machine need not exist in memory since the pilot's gaze would usually be linked to direction. It is more desirable for the pilot to be able to look in a direction that differs from the ornithopter's flight path. This lends a degree of visual realism to the virtual experience of piloting the craft, because there are no restrictions on the pilot's ordinary manner of surveying the environment.

When the user has a point of view independent of the direction of movement, it is sometimes referred to as the hummingbird metaphor. The hummingbird metaphor is particularly appropriate for the da Vinci Flying Machine because like the bird, its wings flap.

In the future, several directions are planned. These include, but are not limited to, 1) comparison of third-person virtual reality (in which the user sees himself or herself piloting the flying machine) and immersive virtual reality (in which the user experiences the virtual environment directly); and 2) construction of a hardware interface for the Leonardo computer model, which will give the user the physical experience of piloting da Vinci's flying machine.

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Another Day in Paradise

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Independent Artist

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"In palms ever appearing youthful; in palms I am revived"
— Carl Friedrich Philipp von Martius, 1816

Palms furnish food, shelter, clothing, oils, waxes, timber, fuel, building materials, fibers, starch, wines, soap, brooms, mats, hats, sugar, wine, vinegar, baskets...

The look, the color, texture and even the fragrances are maintained. The process replaces natural plant fluid with a preservative. The trunk of the preserved palm tree is hollow. The result is a realistic plant environment constructed to specified measurements.

Watering, pest control, auxiliary lighting, skylights, replacement due to plant mortality or due to outgrowing of space, special planters... are no longer necessary. Architects and designers can now plan the palm trees in the projected environment and design the height, shape, and type of tree that will be used. Three preserved palm trees with integrated monitors. The first palm plays a continuos loop of a video. We see the architectural surface of Orange County and hear the story of Vi Vuong, a Ph.D. student at UC Irvine.

"Another Day in Paradise" is the motto of the city of Irvine in Orange County, California. Incorporated in 1971, it is renowned as one of the largest, most successful planned communities in the nation. Here, we can glimpse into the future living environments—an ideal represented. Our Town, circa, 1993. An hour's drive south of Los Angeles, past Disneyland, the Nixon Library, and John Wayne airport, the American Dream personified. Inspired by Disneyland, this model city is carefully studied by developers and architects from around the world.

Only ten minutes away are the nation's preeminent shopping malls—Fashion Island and South Coast Plaza and it is a major magnet for international business, the prototype of the new multinational city. The chairman of the Irvine Company who practically owns the town, calls the Irvine property his "raw canvas" and plans to devote the rest of his life to its development. A spectacular 100-square-mile canvas just waiting to be filled with the familiar landmarks of the late 20th century commercial civilization—office parks, housing tracts, and shopping malls, crisscrossed by highways.

Vi Vuong fled with a group of other 14-year-olds on a boat at the urging of their mothers who didn't want them to grow up to die to finally land at John Wayne Airport. An estimated of 600,000 of "boat people" have drowned trying the similar route of escape. Oddly, the largest Vietnamese community settled in Orange County next door to the Nixon library.

1993 marks 20 years since the "end" of war with Vietnam. Since then it has been a subject of thousands of books, articles, and scores of motion pictures and documentaries. And yet, this country has still not come to grips with the idea that it has actually lost the first techno-war.

The second palm has hidden surveillance cameras in the fronds and the monitors mirror the viewer and the immediate surroundings. It is silent.

The third tree is interactive with an integrated computer that allows the viewer to "scratch" below the surface. This palm houses a collaborative effort with excerpts of "Monkeybone Take Me Home" and The Sacred and the Toxic" by Sean Kilcoyne and footage from the daily life in Vietnam by Kathy Brew. The media emblems of the Vietnam war are challenged by images of people who are trying to pick up the pieces and go on with their lives. The preservation process of palms is the bed on which these images and stories unfold.

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Animatrix:

INTERACTIVE COMPUTER INSTALLATION

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Animatrix is a computer dancer, reminding us of a Bodhisattva, a Buddhist creature in half-enlightened state.

The installation consists of three parts:

1) The graphics program that calculates the movements of the Animatrix, depending on user input.

2) he music program that interactively composes the music, depending on user input.

3) The user interface.

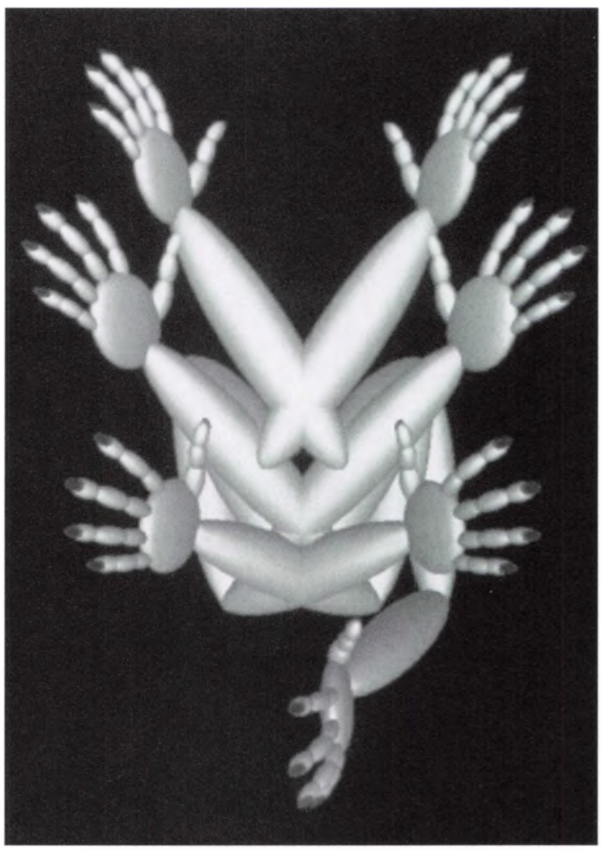
The user interface is a double joystick consisting of two positioning devices attached to each other. The Animatrix reacts to the movements of the interface and starts to dance; at the same time rhythmical music is triggered.

There is a relation between the movements of the interface, the movements of the Animatrix, and the music, but the relation is not straightforward: sometimes the Animatrix seems to be a willing dance partner, and at other times it seems to have its own life and to dance its own dance. By playing with the system the user will gradually discover that s/he is not only able to influence the dance of the Animatrix, but also the music and the rhythm that comes along with it.

There are two levels of interaction:

1) Positioning the interface gives direct control of some of the movements of the Animatrix, and of part of the musical composition.

2) Variations in moving, twisting, and rotating the interface are measured and analyzed over a longer period of time and cause more complex patterns of music and movement.



The graphics program receives the input data and reacts directly to it. It passes the data on to the music program that also reacts directly to it. Both programs analyze the input data over a longer period of time, and exchange the results of their analyses continuously. The music program analyzes and evaluates the timing and rhythm aspects of the user's movements and processes this information in its composition rules. It then sends the results of the analysis to the graphics program.

The graphics program analyzes and evaluates the positioning, twisting, and rotational aspects of the user input and passes it on to all body parts of the Animatrix, each of which has its own set of rules that tell it how to move and how to react to the results of both analyses. The movement information is then passed on the music program.

The work was supported by the following institutes and companies:

Fonds voor Beeldende Kunsten, Vormgeving & Bouwkunst, Amsterdam, the Netherlands

Institut fuer Neue Medien an der Staedelschule, Frankfurt am Main, Germany

Kunsthochschule fuer Medien, Koeln, Germany

Silicon Graphics Computer Systems, Koeln, Germany

Internationaler Wiener Kompositionswettbewerb, Wien, Austria

Writing Rules for Art's Sake

For several years I have concentrated on the investigation of the possibilities for automation in the art creation process. I have approached this research from an conceptual (and artist's) point of view.

Tools that supply automation during the making of an art work already exist, and are being used by artists in an wide area of applications. However, I have been looking for an automation tool that affects artistic thinking at a more abstract and basic level.

If there exists something like an artist's formal language (where every artist uses his or her own version of this language, but all languages belong to a certain class), one could think of a tool that supplies automation at a level where it will affect such a language. In fact such a tool might call for the development of a new class of formal art languages, and it is clear that if an artist is going to be using such a tool, this will influence his or her way of thinking from the moment of conception of the art work.

There is a lot of research going on in the scientific community. Many new programming paradigms are being developed, like dynamics motion control, inverse kinematics, behavioral systems, artificial life

systems, fractals and L-systems. These paradigms are all implementations of more or less complex, lifelike systems into the binary world of the computer. I have looked at these paradigms from the following points of view:

How could those paradigms be used as an artist's tool?

How will implementations of these paradigms affect the artist's thinking?

A virtual world can be represented in the computer: in the virtual world are its inhabitants (objects). The inhabitants behave according to laws and rules that are described in the program. Each individual object follows its own set of rules, which may be very simple, but as a group the inhabitants will show an emerging group behavior. Such a group behavior can be rather complex, even if the underlying rules are simple.

Artificial intelligence researchers are looking for life and searching for rules that cause life-like behavior. Being an artist, and not looking for life, I would like to reconsider the set of rules. Rules can describe many things, for instance physical behavior according to laws of gravity and collision, or individual behavior like "avoid the others and fly forwards." But rules could also describe what an object might look like, or how a viewer might interfere in the system and change the set of rules.

Once a system has been implied, in which a set of rules can be defined and applied to a set of objects, the thinking process of the artist can be directed into thinking about possible sets of rules. Possible rules might describe how objects behave individually, how they are born, how they live and die, how they mate, survive, and mutate, what they are and what they look like. Rules could describe how the system is visualized, and whether its output will be graphics, text, or sound. Last but not least they could describe how the objects react on a viewer's behavior and interference, how a viewer's behavior and interference might change the rules, and how the rules might change themselves.

By defining the set of rules the artist creates the elements of the formal language that is going to be used. The machine will take care of the application of the rules of this language, and here's where automation comes in. Once the program is running, events (elements of the composition) will occur in a non-predictable order. A story is being told, although it may be a very abstract story. If the program is interactive, the story will be non-linear: the viewer has become involved in the sequence of events.

An important aspect of the artistic creation process has been taken over by the machine, viz. the application of formal language rules. The focus of the artist's imagination has been shifted from application of rules to defining a set of rules.

I have started my work by describing movements for objects with simple mathematical functions. I built an application in which variations on a rule could be made by changing some parameters; the application would run fully automatically and the output would be an animation on videotape. ("Automated Animations," part I, 1991).

I have then started to program a virtual world in which the inhabitants must obey laws of Newtonian dynamics: gravity, collision and friction. Several animations were the result of running this system with various parameters. In some of these animations the virtual camera would be one of the inhabitants of the virtual world ("Automated Animations," part II, 1991 and "25 objects meet," 1991/92).

I have extended the system with behavioral rules for its inhabitants. I have changed it to a real-time interactive system and added sound to it. The computer installation "7 objects meet" that was the result of this work was exhibited at the Ars Electronica 1992 ("7 objects meet," real-time interactive computer installation, 1992).

My most recent work is the interactive computer installation "Animatrix," (in cooperation with the composer Masahiro Miwa). This installation has two rule systems running concurrently: one for the movements of a seven-armed dancer, and one for the composition of the music. Both systems communicate with each other continuously ("Animatrix," real-time interactive computer installation, 1993).

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Soft Future

CLOSE YOUR EYES. NOW, IMAGINE A WORLD, THE WORLD OF THE FUTURE. WHAT DO YOU SEE?

RICHARD WRIGHT

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Will you see a technological utopia, a city of gleaming metal spires orbiting spacecraft, a world spared from nuclear annihilation and united by a common belief in the benefits of rational progress? Nowadays, probably not. At most your vision is likely to be an end to recession, economic stability for at least a while, a new order of gray-suited bureaucracy. Perhaps you see nothing at all, just a hazy mist of half-forgotten ideals. But when I close my own eyes there is still something there lurking in the background, like a memory chopped up into disparate fragments. It coagulates, forming an surface—it is the surface of a computer screen.

Technology was the collective vision of the future in the West for quite some time. Now, technology in its most virulent form as electronic media still tries to keep our beliefs about the future alive, by recreating them as images. With my mind's eye, I can see pictures projected on the screen inside my head. They are special-effects movies, "Terminator 2," "Robocop," and "The Lawnmower Man," they are computer games, they are documentaries on virtual reality—and they are from the future. Media events seem to have become the repository of our ideas about what the future would be like, but their function is not just to represent those ideas, to symbolize a set of goals that are being actively pursued, but to actually become the future itself. For the construction of sensational scenes of fighting robots, space flight, and mind expansion, use of the most advanced digital imaging technologies is necessary. Each new movie feels compelled to outdo previous efforts in the seamless surety of its effects. Every transformation must be shot full-frame, without any cause for the viewer to claim sleight-of-hand, and it must be utterly convincing, making any suspension of disbelief quite unnecessary. Technologically mediated narratives of 'the future' are used to construct the contemporary perceptions of technology itself. This perpetual and constantly reinvented future is represented today by imagery generated by modern computer technology like mathematical visualizations, scientific graphics, digital effects, and animations of virtual environments full of "images beyond imagination." Technology has become a shadow cast by the future onto the present.

But behind this screen of media technology lies a sense of loss. It is the loss of what Jean-Francois Lyotard called the "grand narratives" of the West, in particular the enlightenment dream of rational progress. None of the utopian predictions of the past seem to have been fulfilled. There is no universal peace based on the impartiality of scientific thinking, no achievement of the leisure society, and the new generation has been described as the first to be economically worse off than their parents were. Science no longer delivers, and media presents just a memory of the future. Instead of trying to build a better tomorrow, we now use the latest media technology to simulate visions of the future in music videos and special effects films much more efficiently than having to change the world itself. This is not a hard future of imposing architectures and hurtling spaceships, but a soft future of media extravaganzas and digital effects, existing synthetically on the screen. The result is that we are living in a requiem for a future that never was, played by a virtual future that always is.

The ideal of continual progress has degenerated into that of constant novelty and distraction. Technology today has to struggle hard to keep up with the expectations that people have of it, always having to surprise them with something new. The imaging technologies needed to produce the effects in science fiction films are often more advanced than the state of the technology they seek to imitate. This is as though it is more important to see what an advance in technology would be like than for it to actually exist. It is not that science has ceased to grow and expand but that the areas in which we expected it to succeed and change our lives for the better seem to have been deflected onto other paths.

The more that new media offers us in terms of creative potential and technical agency, the more that they become their own subject. Consider virtual reality technologies as the ultimate means of giving complete form to the full extent of the human imagination. When we look around us to see the results of their applications, we see interactive games about more technological subject matter—giant battling robots, star fighters, mutant experiments—the creation of a world in image form that has otherwise proven too costly to achieve. Technology enters discourse not as fact, but to provide evidence of its own myth. Its hypothetical repercussions are as misplaced as discussions of the social impact of 'space travel' were in the 1960s as though it were already an everyday event. Now that the promise of human space flight to alien worlds has receded, NASA attempts to keep the magic alive by developing virtual exploration such as with the 'telepresence' system. This remote sensing and control apparatus allows a user based on earth to experience the sights and sounds received by a robot that may be operating millions of miles away in deep space or on other planets. An interactive 'movie' created out of data accumulated by the Viking One has also been used to simulate a flight over the landscape of the planet Mars. This surrogate astronautics can be enjoyed in a consumer version by anyone with a home computer and a laserdisk player as though it is a video game. As well as visible phenomena, synthetic imagery can also be

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used to represent other astrophysical events such as magnetic fields, and interstellar combustion as travel scenery. Thus we see the latest technology working hard to prevent the glamour of space science from fading.

Computers are advancing, in order to process more information, to generate more effects. Bereft of any humanitarian ideals, technological determinism is left to pursue increasing functionality and a spiraling extrapolation of its specifications. The goal for the electronic media artist is assumed to be that of increasing quantities of tools for more and more minutely controlled manipulations of the image. The range and diversity of functions for computer-aided art and design work has multiplied to the extent that it outstrips our outmoded notions of creativity as aesthetic inventiveness. The insistence of this goal of unlimited expressive power seems to be an opportunity for the computer to display its features and abilities and invite our admiration, regardless of whether they meet a pre-existing artistic demand. The correct vehicle for this panorama of technical conquests is the show reel, the superlative form of state-of-the-art posturing.

No matter what technical potential a new medium promises, it must connect with a current cultural practice in order to be taken up by a community and exploited. This inevitably results in many of its expressive abilities being constrained or completely ignored because they are not relevant to the needs of a certain group. But a Western industrial society operating under the pressure of continual technical progress introduces a conflict into this situation. As more is always assumed to be better, it is assumed that the more technical features and options that a device provides the more it constitutes an advance on what has gone before. In the field of art and design this becomes a strategy of marketing computer media as providing a range of expressive means far beyond what was possible with 'traditional' media, even though many functions may have no obvious application. It is considered up to the artists' boundless creativity to find interesting things for the new equipment to do. This highlights a fundamental contradiction at work in contemporary Western thinking. On the one hand there is a fiction based on the rational perfectibility of the material world through technical agency and an increasing of information exchange. This is manifested in the history of art as the modernist project of continual aesthetic innovation and increase in formal devices. But on the other hand are the operation of cultural practices as constructions restricting the use of knowledge and materials to within parameters considered relevant to its concerns, usually defined in historical and sociological terms.

When art is industrialized under the modernist rubric, the equation is biased toward greater expansion of the means of production for its own sake. Artistic creativity is judged to be an insatiable beast that cares only for the next stylistic advance or fashion through which it can excrete some ready-made 'content.' The future of art is required to settle into the form of an unbroken stream of new expressive tools. This tendency is supported by eager computer manufacturers who strain to develop the new media and to meet artistic problems that have not yet arisen. Thus the aesthetics of tomorrow are constantly preempted by the latest technological commodities and brought forward into today. The idea of the future of art as a place in time has been eradicated and replaced by the future as an attitude of mind embodied in a business strategy.

But the cultural reaction to this new futurology has been to undermine it by using it to reconstitute the past. Look at the explosion of references to science fiction periodicals and serials of the fifties and sixties that have occurred in contemporary media and advertising. If modernism has insisted on a logic of progress toward the ultimate explication of form, then postmodernism disrupts this by placing the project into a space outside the one-way march into the future and leaves it circling aimlessly but frantically fabricating new styles and effects. The past of Dan Dare, Robbie the Robot, and Astonishing Tales resurfaces as a memory of a future of arrogant optimism and coercive submission to technological imperialist ideals. The absurd machines of Heath Robinson from the 1920s and 1930s are recreated as computer animations that lament our belief in the value of scientific improvements to domestic life.

In the original film "Terminator," the murderous robot that comes from the future dresses as a leather-clad motorcycle hoodlum. In the sequel "Terminator II," the first robot returns to protect us from the new T-1000 robot that can take on any identity and seems impervious to force. Through T-1000, we experience a future that can take on a variety of threatening forms, as a trusted law enforcement agent or even our own mother. We find we are now encouraged to trust the constancy of the original terminator cyborg, still dressed as the romantic biker anti-hero of the past, coming on like the young Marlon Brando in "The Wild Ones." But we need not unduly fear the liquid steel cyborg of "Terminator II," remembering that James Cameron unfairly chose not to show us that it could just as easily have turned itself into the Swarzenegger cyborg if it had wanted. We must not reject the prospect of a future that is always altering its form by turning back to the predictability of the urban cowboy, an image as artificial as its liquid nemesis. For the appearance of a uncertain future also frees us from the obligation to follow failed solutions, images that we can now cast back into the melting pot.

Living without a future, the electronic image has become not a window into an external tomorrow, but a mental projection. Like Freud's dream image, it is a screen upon which we can interpret the signs of our desires and anxieties. But the computed image is not read like the convenient symbolisms of a single inscribed idea or belief. It is a soft image, impressionable, amorphous, and badly behaved, like the id of rationalism's ego. It contains the unconscious of technology, in which we find the roots of half-submerged yearnings for new beginnings. Just as digital imaging allows the image in the cinema film to be transformed and recreated into any future world that is currently desired, so the trajectory of modern progress is deflected from its original course into a number of alternative scenarios. The logic of technological determinism is now threatened with its imminent fall from grace as the future is replaced by the image, the soft image. The relentless historical surge of fundamentalisms toward their belief in their own inevitable triumph is met by the blank tolerance of digital media that now stands in the way of their single image of victory.

Digital technology has no form—look at your computers, they are all the same. They have no mechanical parts, they are just boxes of tiny silicon cubes. They are becoming smaller, they are becoming invisible. Soon they will disappear from the real world altogether and will exist only through the images they project. This technology does not act, it evokes. It can implant the images of hidden desires in our brains, there to grow and germinate.

When the human imagination tries to exercise its powers today it can find itself strangely limited by what is possible with current state-of-the-art technology. For our powers to conceive of new ideas and situations seem constricted to produce solutions in terms of technological developments rather than trying to think of a new social strategy or political force to replace the disappointments of the last decade. But this technological colonization of the imagination provides a collision point from which a new stimulus can direct scientific advancement. Deprived of a clear vision of the future to work toward, the researchers at the 'blue sky' Californian science parks wrack their brains to find new challenges for their intellectual might. They must be put to sleep and learn to dream their own dreams until they can live without the comfort of the future. Remember the science fiction writers hired by the U.S. military to brainstorm ideas for new weapons and who came up with the Star Wars system of space-borne laser guns.[1] Now that the dissolution of the evil empire has removed the logic of that 1D race for hardware supremacy, what can the science fiction writers offer us in the soft future? Our crystal ball is a video frame store and its pixels are already energizing in response to our thoughts.

Through the digital image society has started to dream again. The dream is a land beyond time—it can fit a whole lifetime of possibilities into the duration of a single night. Its future cannot be charted or planned, it is fuzzy, soft. A world without a future is a world of dreams. When we look into the computer screen we see the dreams of technology unfolding. But now they can be dreams that we can interpret to tell the stories of our own lives.

Close your eyes.

Notes

1. In 1980 one of the informal groups advising President Reagan on what became the Strategic Defense Initiative was the Citizens Advisory Council on National Space Policy, a group run by two science fiction writers. Chairman Jerry Pournelle later stated "...sci-fi writers...turned out to be very key in this process because they could write the documents that were understandable by the President."

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Light and Dark Visions:

THE RELATIONSHIP OF CULTURAL THEORY TO ART THAT USES EMERGING TECHNOLOGIES

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Abstract

Critical theory and cultural studies are increasingly being used to understand the function of the arts in contemporary technology-dominated, postmodern culture. This essay examines the relevance of these analyses to the work of artists who use emerging technologies. The first section reviews core concepts that are useful for understanding art/technology linkages from postmodernist, post-industrialist, and post-structuralist writers. Concepts discussed include the rejection of the modernist idea of a single dominant cultural stream, the demarginalization of diverse voices, the increasing importance of information and the impact of mediated image and representation on ideology and behavior, and the emphasis on deconstructing the language systems and meta-narratives that shape culture.

The essay then identifies several limitations in these theories that become apparent in the consideration of art that uses emergent technologies. First discussed is the divergence of world view between postmodern, deconstructive sensibilities and the essentially modernist perspectives and self-representations of researchers and technologists who believe they are working on inventing the future. Next considered is the tension between the high value the arts have traditionally placed upon real things and immediate sensual experience and the postmodern emphasis on the primacy of mediated images and signs. Finally, the essay inspects the uncertain basis for validity and justification of artistic production in a deconstructed environment in which the art world is seen as one limited discourse, and individual genius and vision are seen as illusory.

The essay suggests that some of the critical confusion about the field of art and technology derives from the variety of stances an artist can take in regard to these issues. It describes three: a practice that rejects much of this critique and seeks in a modernist sense to assimilate technological art to the mainstream art world as it was historically constituted; a deconstructionist practice that uses the skills, tools, and familiarity with the technology world to critically analyze the meta-narratives of contemporary life; and a practice that seeks to enter into the heart of the inventive process to help elaborate the culture-transforming possibilities of the new technologies.

Introduction: The Relationship of Critical Theory and Cultural Studies to Art that Focuses on Emerging Technologies

The impact of technology on contemporary life and culture is a vital issue in our age. Critical theory and cultural studies attempt to link the arts, literature, politics, sociology, anthropology, philosophy, and technology in an interdisciplinary search for relevant concepts and frameworks with which to understand the current world. Art practice and theory are being radically reshaped by this activity.

This hybrid world of culture/art criticism, which places great import on the impact of emerging technologies, has seemed unexpectedly disinterested in the work of artists who work with these very technologies. Similarly, the discourse in the art/technology world—and in the technical world in general—has not engaged deeply the concepts from cultural studies. This essay attempts to elucidate some reasons that might underlie this mutual lack of attention.

The essay has several objectives: first, it briefly reviews concepts and lines of inquiry from cultural theory that are useful for exploring the relationship of art and technology. Next, it uses some of these concepts as they are applied in mainstream art criticism to inspect the practice of artists working with new technologies, and identifies ways their practice challenges these theoretical formulations. It then considers a range of theoretical stances artists can assume in relation to working with new technologies. Its goals are to help artists define for themselves a theoretical stance toward their work with technology and to advance the ability of art theory and art criticism to contend with new technologies.

Survey of Themes from Critical Theory and Cultural Studies:

This section briefly surveys some interrelated concepts and themes from critical theory and culture studies that can be applied to the consideration of relationships between art and emerging technology.

Post Industrialism

Many cultural theorists note that the contemporary era is radically different from its predecessor, the industrial era. More workers are involved with the production, organization, and distribution of information than with the production of things. We have an "information economy" in which increasingly smaller proportions of the populace generate food and artifacts.[1] Our political and cultural structures and ideologies are seen as lagging behind the realities.

Electronic Media and Other Technologies

The pervasiveness and consciousness-transforming potentials of electronic media and other technologies are seen as a critical feature of the post industrial landscape. Television, computer, telecommunication, medical, biological, and military technologies are not just isolated industries. McLuhan[2] early noted that media had impact beyond any particular message and transformed the way we saw ourselves and the world. Culture studies are most productive as they point out far-reaching implications of technology—for example, Haraway[3] on ideological impact of biological and medical technologies, Virilio[4] on military technology, Foucault[5] on surveillance and law enforcement technology, and Baudrillard[6] on mass media, entertainment, and advertising technologies.

Poster describes the network of socio-technological impacts on ideology and everyday life:

Some analysts recognize that the study of electronic communication requires more than attention to new technologies or machines and signifies more than progressive increases in the efficiency of symbolic exchanges. In one such study, Carolyn Marvin argues that the history of electronic communication "is less the evolution of technical efficiencies in communication than a series of arenas for negotiating issues crucial to the conduct of social life; among them, who is inside and outside, who may speak, who may not, and who has authority and may be believed." She is able to demonstrate, for example, that the introduction of the telephone did more than enable people to communicate over long distances: it threatened existing class relations by extending the boundary of who may speak to whom; it also altered modes of courtship and possibilities of romance...

With this thematic she recognizes the role of cultural and social forms in shaping new communication patterns at the point of technological innovation, but she does not question some of the broader, theoretical implications of these changes. In order to discern "new events" or new communications one must problematize the nature of communications in modern society by re-theorizing the relation between action and language, behavior and belief, and material reality and culture.[7]

Baudrillard suggests that the spread of media technologies have resulted in a mediated life situation where images take on lives of their own and most people conduct their lives based on "hyper-reality." There is a bombardment of signs and an implosion of meaning . The masses respond by "reducing all articulate discourse to a single, irrational groundless dimension in which signs lose their meaning and subside into exhausted fascination."[8]

Signs have become separated from their referents to such an extent that interactions with simulcra become the dominating experience for most people. In this dark vision

implosion announces the nullity of all opposition, the dissolution of history, the neutralization of difference, the erasure of any possible figuration of alternate actuality. At the cold superdense core of this anti finale is not absolute knowledge, but rather the absolute dominion of digitized memory-storage banks, not even dimly fathomable through the aqueous screens of the video display terminals.[9]

Furthermore, all claims to universal truth dissolve when one realizes the potential lack of essentiality and authenticity of messages:

It is no longer possible to maintain the old economy of truth and representation in a world where 'reality' is entirely constructed through forms of mass-media feedback, where values are determined by consumer demand (itself brought about by the endless circulation of meanings, images, and advertising codes), and where nothing could serve as a means of distinguishing true from merely true-seeming (or ideological) habits of belief.[10]

Later sections will describe other theories—usually not considered part of critical theory—about the impact of present and future technologies that present more optimistic prognostications.

Postmodernism

Postmodernism is a theoretical approach that defines current cultural practice and ideology as being different than that of the "modern" era that preceded it. The term is being applied in a variety of fields, ranging from art to philosophy and politics, and the definition of "modern" may differ. This section divides the survey into postmodernism as a general philosophical approach and as it is applied to the arts.

Postmodernism (Philosophical Approach)

Modernism is most often defined as the period between the Enlightenment and the present. The belief in historical progress, rationalization of society, and univocal truths are seen as ideologies particular to modernity and now dysfunctional and outdated. A radical eclecticism, willingness to entertain and integrate diverse ideologies, and a wariness about truth claims have become part of the definition of postmodernism. Analysts note that the current era is marked by a lack of faith in the concept of progress and in the "truth" of ideologies, styles, and cultural forms. For example, life under both capitalist and Marxist systems is more appropriately characterized by multinational capitalism and media inter-fertilization than by ideology. Progress in science, ethics, and the arts is seen as dubious. The perspectives of third-world cultures and women are seen as offering powerful alternatives to hegemonic, male, Eurocentric views. Some see the present as the end of history (in the narrow Western sense of a unitary dominant line of progress). Discourse requires "decentering," a process that acknowledges that there is no longer one dominant cultural stream.

Postmodernism (Art and Architecture)

Progress in art is subjected to this same critical analysis. Most often modernism is defined as roughly the period of middle 19th to middle 20th century. The canons of abstraction as articulated by the international style in architecture and the works of Clement Greenberg are seen as the main line of development of modernism. The outcomes of this approach could be seen in painting, sculpture, and architecture. An intellectual base was offered by Kant, who stressed the specialized development of autonomous areas of refined practice in the fields of science, ethics, and art. The most developed art was seen as that which was self-referential, which pushed its medium to the fullest, and which resisted incursions from mass culture. Greenberg's article "Modernist Painting" embodies this stance:

The arts could save themselves from this leveling down only by demonstrating that the kind of experience they provided was valuable in its own right and not to be obtained from any other kind of activity. Each art, it turned out, had to affect this demonstration on its own account. Each art had to determine, through operations peculiar to itself, the effects peculiar and exclusive to itself. By doing this, each art would, to be sure, narrow its area of competence, but at the same time it would make its possession of this area all the more secure. Each art would be rendered "pure" and in its "purity" find the guarantee of its standards of quality as well as its independence. "Purity" meant self-definition.[11]

What were the origins of this breach of faith in this modernist view of progress in the arts? In part, new technologies such as printing, photography, and cinema made for changes in the ways art was viewed. Walter Benjamin in his article, "Art in the Age of Mechanical Reproduction"[12] noted the disappearance of the "aura" of works of art. These processes bred a disregard for tradition and demystified art works. They became easily and widely available in ways that subjected them to a wider range of audiences and critical perspectives.

Postmodern arts are characterized by "pastiche," a layering and recontextualizing in which styles quote and comment on each other, a simultaneous use of traditional and contemporary styles, a willingness to use popular culture, and a resistance to making hierarchical judgments about the styles. Detractors note this electicism as casual, schizophrenic, and devoid of artistry while others see the tension between tradition and innovation as purposeful juxtaposition.[13]

Structuralism, Semiotics, Post-Structuralism, and Deconstruction

Structuralism focuses on the underlying structures that explain belief and behavior in all cultures. Language is seen as one of the most significant indicators of the structures. Semiotics focuses specifically on linguistic and non-linguistic sign systems—for example, the relationships between signs, signifiers, and signified. Art and images are seen as important sign systems.

Analysts such as Barthes, Lyotard, Derrida have extended this framework, and look beyond language to the ways cultural exchange shapes thought and behavior. Linguistic analysis is seen as a metaphor for a more widely applicable process. In any situation individuals are acting on the basis of many "texts," which they use for self representation and communication with others. Each individual constructs his or her reality from the conjunction of texts generated from past experience and the present situation. These texts derive from experience of gender, ethnicity, race, etc. Particular institutions, disciplines, and areas of practice can be characterized as "discourses" that shape conceptualization and behavior.

Often these discourses are subtle. Analysis of subtexts and the functioning of discourses is an essential element of critical theory. Assumptions traditionally assumed to be innocent are seen as powerful influences upon thought. Members of dominant cultural groups are unaware that language, image representation, and other cultural forms conspire to maintain their hegemony. Their "privileged" discourses culturally dominate and marginalize other possible discourses. Similarly, some "metanarratives" are sanctioned, marginalizing others. This type of analysis has been applied in the art world, showing the role of museums, galleries, dealers, collectors, and critics in setting the boundaries of "valid" discourse.

Deconstruction is the term referring to the unraveling and unveiling of the interplay of discourses. It has been powerfully applied by groups outside the white, male, Eurocentric hegemony to reveal cultural politics, and by theorists to analyze other areas of culture where binary representational systems define particular world views—for example Foucault's analysis of sick and well, insane and sane, criminal and law-abiding.[14] Because of the importance of media, advertising, and photography in negotiating cultural meanings, visual language needs to be subjected to deconstructive analysis.

Even the process of analysis itself must be subjected to deconstruction. Western analytical thought as it is usually practiced in academic, intellectual, and critical communities is based on its own assumptions and discourses. It assumes a centered, authoritative voice that seems unwarranted in the postmodern world of competing world views. For example, this essay itself in its patterns of reasoning, organization, voice, and appeals to authority can be deconstructed as part of the Eurocentric academic tradition. The academic approach is not exhaustive; alternative methods must be explored. Postmodern theorists urge an attitude of playful "jouissance" that violates analytical norms and opens up new ways of presenting ideas.

The Role of the Artist and the Disappearance of the Avant-garde

The implications for artists of these theories and analyses is profound. The vision of the artist as a creative genius who uses his or her special sensitivities to cultivate awareness of important cultural themes and to invent compelling expressions for these is deeply ingrained in the Western tradition. Artists and intellectuals have been important constituents of the avant-garde, which is seen as fulfilling the function of pointing the way toward the future.

Postmodernism suggests there is no use for an "avant-garde" since there is no single dominant cultural trend in front of which to be. The succession of avant-garde art movements was a consequence of modernism's endless search for the next step on the path of progress. Octavio Paz describes the situation:

> Today...modern art is beginning to lose its power of negation. For some years now its rejections have been repetitious: rebellion has turned into procedure, criticism into rhetoric, transgression into ceremony. Negation is no longer creative. I am not saying that we are living the end of art: we are living the end of the idea of modern art.[15]

The art world showed an amazing ability to appropriate, assimilate, absorb, neutralize, and commodify gestures of rebellion into the mainstream. The high art/low art distinction is being questioned. New technologies have eroded the traditional aura of the artists, and their productions must find a place in the context of greatly expanded cultural production of mass media.

Post structuralism suggests that artists, like everyone else, bring their own set of discourses to their work. Jameson suggests that the modernist, romantic notion of the great individual artist is outdated or may have never really been accurate:

> The great modernisms were...predicated on the invention of a personal, private style, as unmistakable as your fingerprint, as incomparable as your own body. But this means that the modernist aesthetic is linked to the conception of a unique self and private identity, a unique personality and individuality, which can be expected to generate its own unique vision of the world and to forge its own unique, unmistakable style.
>
> Yet today...the social theorists, the psychoanalysts, even the linguists, not to speak of those of us who work in the area of culture and cultural and formal change, are all exploring the notion that kind of individualism and personal identity is a thing of the past; that the old individual or individualist subject is "dead" and that one might even describe the concept of the unique individual and the theoretical basis of individualism as ideological.[16]

Indeed, the art world is one among many of the sets of discourses with its own blindnesses and limited conceptualizations. Truly original production is unlikely as each person is a "screen" on which various texts are received and recombined. Roland Barthes expressed this view in his article, "Death of the Author":

> We know now that a text is not a line of words releasing a single "theological" meaning (the message of the Author-God) but a multi-dimensional space in which a variety of writings, none of them original, blend and clash. The text is a tissue of quotations drawn from the innumerable centers of culture.[17]

In the contemporary era of bombardment by mediated visual and other messages, the concept of original vision is doubtful and possibly an example of hubris.

II. Issues in Applying Cultural Theory to High-tech Art

Critical theory and cultural studies are a powerful methodology. Their perspectives are being fruitfully employed in a wide array of disciplines, including anthropology, psychiatry, politics, literature, art, media studies, and philosophy. The analyses are robust, and revolutionize the understanding of things often taken for granted.

Epistemological analyses of this sort have been fruitful when applied to the art world because it is a culture industry relatively unselfconscious about the meta-narratives it assumes and the limited sets of interests it has represented. In addition, art makes heavy use of images and representation and thus can benefit from awareness of the representational systems in which it participates. Finally, to fulfill its function, art needs to understand the challenges posed by features of contemporary culture such as mass media, popular culture, and new technologies.

Although these analyses are gaining widespread attention in the world of art theory and criticism, they have not yet been widely used to understand the work of artists who work with emerging technologies, despite the fact that high-tech art is situated in a junction of culture and technology potentially rich for insights. The technologies explored by artists are the very ones some analysts see as key to structuring postmodern, postindustrial society. These technologies are essential components in creating the mediated vortex of free-floating significations and the implosion of meaning. They are also crucial in the creation of new cultural niches in which issues such as control, the body, and war become prominent. Many of these artists have feet in both the art world and popular culture.

Later sections will suggest that some kinds of high tech artistic practice challenge assumptions of cultural theory and thus serve as a useful source for reconsideration of these theories. As compelling as critical theory and cultural analysis are, it is essential to stop to question and inspect the claims they make.

Assumptions in the Theories and Alternative Views

How much of this analysis should one accept? Can the analytical strategies and insights be used without total acceptance of the theories? What world views and emotional tones color interpretation of the observations regarding the nature of the postmodern world and what other interpretations are possible?

Significant questions and alternative theories and interpretations have been advanced. Some germane to the issues of technological art are treated in more detail below. For example, Habermas[18] suggests that the project of modernity that was started in the Enlightenment is not exhausted, although it needs adjustment: there are still processes of increasing knowledge and empowerment that can make valid claims to universality. Also, specialized areas of discourse such as science still manifest faith in the truth claims of their operations.

The postmodern decentering and diversification of ideology and styles can be seen as an enrichment of possibilities rather than the decay of meaning. For example, Collins suggests that one response individuals can make to the diversity is to simultaneously valorize multiple centers of meaning, rather than to declare meaning dead.[19] Christopher Jencks proposes that cultural productions can be "double coded" so they can be read by both specialized professional and vernacular discourses.[20] Previously marginalized voices can be incorporated into a revitalized mainstream.

The impact of media and new technologies may not necessarily lead to these theorists' characteristically dark visions of panoptical control, superficiality, and loose signifiers; other interpreters see an expansion of access, personal control, and enhanced life possibilities. Semiotic and deconstructive strategies for analyzing texts and discourses, and unveiling the unacknowledged cultural impact of representation and ideology, can expand the understanding of theorists and practitioners without totally undermining the operational integrity of these discourses.

Disjunctions Between Scientific World Views and Critical Theory

Many who work in science and technology still maintain faith in progress, the universality claims of their operations, and the independent status of the phenomena they work with outside of their discourse. They can point to an impressive record of ideas tested by methods of verification that approach objectivity, and to new knowledge, understanding, investigative tools, and technologies that have transformed life in almost every corner of the earth.

The enterprise of science and technology is by no means pure. Phenomena such as uncertainty and chaos theory have shaken some of its epistemological assumptions. Lyotard in The Postmodern Condition[21] notes that science's fundamental narratives of legitimization are in crisis, and that many of its statements can be described as "performative" utterances—i.e., they express commitment to action rather than description of external realities. The sociology of science has shown that research is rarely disinterested; it is influenced by ideology and political, military, commercial, and other interests. Grants are awarded and publications approved for ideas that fall within ideologically defined discourses. Seemingly benign knowledge and technologies are perverted to ends never intended by their creators. Gender, race and nationality influence who can do science and whose opinions have weight. Post-structuralist analysis has shown that the conceptualization of scientific research questions and professional communication are shaped by meta-narratives, just as in other fields. Thomas Kuhn in The Structure of Scientific Revolutions[22] has shown that scientific paradigms act as meta-narratives that profoundly shape theorization and research; they change slowly through a combination of ideology and experimental results. Still, it is important to note that most practitioners believe in their enterprise and do not embrace the postmodern and deconstructive self questioning typical in the humanities and social sciences.[23]

In the fields of theoretical and applied sciences, there is an optimism very different from the skepticism that marks deconstructive thought. Scientists believe they can refine theory and make universally valid discoveries, and technologists believe they can create technologies that better human life and transform culture in positive ways.

The role of computers and information technologies is one area where views of cultural critics and scientists diverge. Many critical theorists emphasize the insidious nature of pervasive, smoothly functioning information technologies that control and promote superficial thought and life. For example, Constance Penny and Andrew Ross note in Technoculture that technology is so much a part of the basic structure of society that innovations are immediately co-opted by the mainstream; thus, they dismiss the liberatory fantasies of the new technologies.[24] Jonathan Crary notes the self-delusion of those who believe in positive revolutionary effects:

> The charade of technological "revolution" is founded on the myth of the rationality and inevitability of a computer-centered world. From all sides a postindustrial society is depicted that renders invisible the very unworkability and disorder of present "industrial" systems of distribution and circulation.
>
> Most often advocacy of "alternative" uses of telecommunications and computers goes hand-in-hand with a naive belief in the neutrality of digital languages and a blindness to the immanence of binary notation with a specific system of technocratic domination.[25]

Negative analyses from some not usually considered critical theorists include Theodore Roszak, who in the Cult of Information[26] notes that fascination with information often works against real knowledge and deep thought, and Jerry Mander, in Absence of the Sacred,[27] who describes the ways in which technology distances people from essential human experience.

Other visions see the technology not running so smoothly, but nonetheless promoting a nightmare world. For example, Crary comments that Baudrillard's analysis assumes a level of functioning that is unlikely:

What his texts exclude is any sense of breakdown, of faulty circuits, of systemic malfunction; or of a body that cannot be fully colonized or pacified, of disease, and of the colossal dilapidation of everything that claims infallibility and sleekness.[28]

The movie, "Blade Runner" is often cited as an example of this cyberpunk dystopia in which technology has helped to erode order and a sense of history. It is a place exemplifying Frederick Jameson's critical characteristics of postmodernism—pastiche (simultaneous juxtaposition and mutual quotation of styles from multiple eras) and schizophrenia (the breakdown of the referents of signifiers):

the city of Blade Runner is not the ultra-modern, but the post-modern city. It is not an orderly layout of skyscrapers and ultra-comfortable, hypermechanized interiors. Rather, it creates an aesthetic of decay, exposing the dark side of technology, the process of disintegration, postindustrialization, and quick wearing out.[29]

Others, however, see information technologies as democratizing access to information, humanizing labor, increasing productivity, deepening thought, building community, and generally empowering increasing numbers of people throughout the world.[30] Stuart Brand propounds some of these beliefs in his account of MIT's Media Lab, one of the preeminent new technology research centers:

Is there any reason to believe that Personal Television, Personal Newspaper, Conversational Desktop, access to an infinite library of Electronic Publishing, a Vivarium of one's own and a fiber optic connection to a Connection Machine would encourage Personal Renaissance?

There is. We have already seen the arrival of personal computers make multitudes broader in their skills and interests, less passive less traditionally role-bound. That's renaissance. We've seen people use VCRs to stop being jerked around by the vagaries of network scheduling, build libraries of well-loved films, and make their own videos. We've seen satellite dishes by the quasi-legal million employed to break the urban monopoly on full-range entertainment...

Each violated what was known about audiences. No wonder. Each made audiences into something else-less "a group of spectators, listeners, or readers" and more a society of selectors, changers, makers.[31]

John Sculley of Apple Computer describes a related vision of the technologically enabled future in the book, Interactive Multimedia:

The book you are holding is a beacon illuminating an exciting future for American education. Technologies described in this book will give us the ability to explore, convey, and create knowledge as never before. Teachers and students will command a rich learning environment that, had you described it to me when I was in school, would have seemed entirely magical.

Imagine a classroom with a window on all the world's knowledge. Imagine a teacher with the capability to bring to life any image, any sound, any event. Imagine a student with the power to visit any place on earth at any time in history. Imagine a screen that can display in vivid color the inner workings of a cell, the births, and deaths of stars. And then imagine that you have access to all of this and more by exerting little more effort than simply asking that it appear. They are the tools of a near tomorrow and, like the printing press, they will empower individuals, unlock worlds of knowledge, and forge a new community of ideas.[32]

Those who work in any number of emerging technologies—robotics, artificial intelligence, simulation, telecommunications, virtual reality, materials science, nanotechnology, and biotechnology—would describe the probable implications of their work in similar terms. Conferences, trade shows, and journals burn white hot with intellectual foment, excitement, and eagerness to invent the future.

Do these scientists and technologists live in the same world as the culture analysts? The discordance between the world views of those who work with new technologies and culture theoreticians may be an essential issue for understanding the contemporary era. One conceptualization is that one group is wrong because it lacks information. For example, a critical theorist might note that technologists delude themselves about the amount of autonomy they have in their research, the underlying meta-narratives that shape their behavior, and the ultimate cultural ramifications of technology. Or perhaps the difference is more like the proverbial cup—half full to some and half empty to others, based on experience and reference culture.

Artists working with emerging technologies are often caught in this discordance, which results in some of the critical confusion concerning their work. In the 1960s C.P. Snow identified the "two-culture problem."[33] He noted that those in the sciences and humanities were living in different worlds with different languages and norms and that the gulf was growing. It is possible that the dark interpretative tone of culture theorists stems from their experience of being acted upon by new technologies, while the optimism of scientists and technologists reflects their engagement in the processes of imagining, inventing, developing, and enabling the new technologies.

Artists who work with emerging technologies face a dilemma. They stand with feet in both worlds. On one side they are invited to help create the new technologies and elaborate new cultural possibilities; on the other, they are asked to stand back and use their knowledge of the technology to critically comment on the underrepresented implications of the technology. It is no wonder that there is critical confusion in regard to the work of these artists because of the different stances they can assume. It is easy to see why the critical community might ignore or consider naive work that entertains the world views of the technologists. The section below on artist stances details different responses artists can make to this confrontation of zeitgeists.

The Status of Substantive Things and Organisms in a World Dominated by Image and Media

A basic theme explored by critical theory is the relative importance of information, codes, images, and representations versus the material world. In a post-industrial, information economy most people are seen as working with mediated abstractions rather than with real things. Because of the power of computer representations, workers in many businesses don't see the real objects of their business during the work day. Telecommunication substitutions of mediated presence for physical presence highlight these trends. Baudrillard's conceptualization of a hyper-reality dominated by media images and by circulating signifiers and codes increasingly disconnected from their referents speaks to the questionable status of things and organisms. Virtual reality technology, which combines visual, auditory, haptic, and kinesthetic senses, promises to increase the power of representation to substitute for material experience. Some ecologists suggest that a mediated world might be good because endless production and consumption of things is suicidal. Donna Haraway's "Cyborg Manifesto"[34] points toward a future where bodies themselves might be irrelevant.

The perception and meaning of even fundamental "realities" such as disease and sex are profoundly shaped by ideology and discourse.

The assessment of the decline of the importance of the material world is a critical issue for the arts and culture at large. On a basic level the diminished importance of the physical seems overstated. Birth, death, health, disease, and the everyday realities of eating, moving, and sex still seem important parts of most people's experience. Many of the world's peoples still struggle to survive and spend their days struggling with the physical world. Even in the developed world there is a growing uneasiness about incompleteness in even the most advanced computer simulations and representations of reality.[35] Eugene S. Ferguson comments in his article, "How Engineers Lose Touch":

Despite the enormous effort and money that have been poured into creating analytical tools to add rigor and precision to the design of complex systems, a paradox remains. There has been a harrowing succession of flawed designs with fatal results—the Challenger, the Stark, the Aegis system in the Vincennes, and so on. Those failures exude a strong scent of inexperience or hubris or both and reflect an apparent ignorance of the limits of stress in materials and people under chaotic conditions. Successful design still requires expert tacit knowledge and intuitive "feel" based on experience.[36]

Historically, the arts have spanned both the material and the representational—working with image at the same time as they celebrated the substantiality and sensuality of real things as in sculpture and architecture. As Walter Benjamin noted in "Works of Art in the Age of Mechanical Representation" technologies such as photography and cinema decreased the importance of presence and "aura."

Questions of materiality are especially critical for artists working with new technologies. The imaging, communications, and information technologies they work with are key facilitators of this mediated world. The work they do helps to explore and settle new worlds of representation. Yet, it is not inevitable that new technologies only work with representation. The technologies that manipulate physical things—for example, robotics, nanotechnology, material sciences, alternative energy research, and biotechnology—have been less accessible to artists and the general public. These technologies will be increasingly important, and point toward futures where technologically mediated material things have increasing importance. Artists need not accept the inevitability of a vision in which materiality becomes unimportant.

The Difficulties of Locating a Rationale for Action in a Deconstructed Milieu

Postmodernism and deconstruction can lead to a classic double bind. If all claims to truth are invalid then why should one author's vision be privileged over any others'? If every work is a recombination of texts received from elsewhere and bounded by a limited discourse community, then why should it have meaning outside that community? If originality, genius, and avant-garde status are outdated, then what is the role of the intellectual, critic, or artist? What is the origin and justification of their need to create and what is the motivation of anyone else to listen?

Norris notes in What's Wrong with Postmodernism? that some post-structuralists used deconstruction in a way that was much more epistemologically radical than intended:

For Saussure, this exclusion (of referential aspects) was strictly a matter of methodological convenience, a heuristic device adopted for the purpose of describing the structural economy of language, that is, the network of relationships and differences that exist at the level of the signifier and the signified. For his followers, conversely, it became a high point of principle, a belief—as derived from the writing of theorists like Althusser, Barthes, and Lacan—that 'the real' was a construct of intralinguistic processes and structures that allowed no access to a world outside the prison-house of discourse.[37]

He further states that the validity of a writer's arguments depends on assumptions of truth and value even though their assumptions of validity would seem to contradict their theories. He quotes Derrida explaining this need:

(writers must) invoke rules of competence, criteria of discussion and of consensus, good faith, lucidity, rigor, criticism, and pedagogy . . . without these strictly indispensable protocols . . . deconstruction will lack all critical force.[38]

Similarly, he notes that Baudrillard's writings make no sense without some claims of truth:

his work is of value in so far as it accepts—albeit against the grain of his express belief that there is still a difference between truth and falsehood . . . the way things are and the way they are commonly represented . . . it just does not follow from the fact that we are living through an age of widespread illusion and misinformation that therefore all questions of truth drop out of the picture.[39]

All artists, critics, and intellectuals who entertain these critical theories must resolve these contradictions for themselves and their audiences. On what basis can artists claim that their productions deserve an audience and that their perspectives provide a view not generally available? What does it mean in the postmodern world to say that one person has a clearer vision than another?

III. High-tech Artists' Stances Toward Cultural Theory

Critical theory and cultural studies pose significant challenges to the artist. How should they conceptualize their work? What sense can they make of the art world and its relationship to the larger culture? With the growing prevalence of critical theory and postmodern analysis in art world discourse, artists can stake out their own theoretical stance; they must choose which assessments and theoretical propositions to accept or reject. Clarity is especially important for those artists who work with emerging technologies.

The sections below describe three possible stances, which emphasize different ways to respond to the critiques and to address the special challenges of new technologies: 1) Continue a modernist practice of art linked with adjustments for the contemporary era. 2) Develop a unique postmodernist art built around deconstruction at its core; and 3) Develop a practice focused on elaborating the possibilities of new technology. For the sake of clarity the interrelationships are de-emphasized.

Continue Modernist Practice of Art with Modifications for the Contemporary Era

Many in the art world reject substantial portions of critical theory. They still believe in the validity and cultural usefulness of a modernist, specialized art discourse that claims universal aesthetic truth. They believe art can have an avant-garde function, that individual vision and genius are still relevant, and that artists can transcend their particular niches in cultural discourse. They hold that the art world can be reformed, without fundamental change, to assimilate previously ignored voices such as those of women, people of color, and the third world. They see the high art/low art distinction as useful. They are confident that they can appropriately negotiate the inclusion of popular culture images and media and incorporate selective insights of cultural theory without necessitating revolutionary change in the nature of art.

The work of some artists with emerging technology can be viewed as continuous with the work of artists who work with traditional media. They see themselves engaged in specialized aesthetic discourse and nurture their personal sensitivity, creativity, and vision. They aspire to be accepted by the mainstream world of museums, galleries, collectors, and critics (or for some, cinema and video). They work on concerns and in modes developed for art in the last decades such as realism, expressionism, abstraction, surrealism, conceptual work. They believe that art will continue to renew itself, find ways to appropriately connect with its host cultures and develop relevant new movements in the future. In fact they see themselves as essential to progress in art, and seek to cultivate the unique and "revolutionary" expressive capabilities of their new media and tools. They believe that the art world will ultimately incorporate even unprecedented technologies and approaches such as image processing, interactivity, algorithmic systems, and virtual reality. The claim by some that these approaches so radically challenge fundamental art substructures that they cannot be assimilated will require significant critical analysis.

Critical theory, however, does suggest certain other obstacles that may be anticipated in this process of assimilation. The art world can never again be so self-righteous or naive about its cultural niche. Patterns of hegemony and participation have been unveiled. Commodification and co-optation of counter-movements are now part of the record. Artists like to believe that they can manipulate and manage their participation and independence in this world, but history suggests it is not easy. Betrold Brecht described the process in his writings even in 1934:

The lack of clarity about their situation that prevails among musicians, writers, and critics has immense consequences that are far too little considered! For thinking that they are in possession of an apparatus that in reality possesses them, they defend an apparatus over which they no longer have any control and that is no longer, as they still believe a means for the producers, but has become a means against the producers.[40]

Furthermore, it is likely that the mainstream art world will resist acceptance of new technologies, both because they are not tied to developed traditions and because certain features, such as ease of duplication, further erode a sense of aura of art works. The 100-year-search by photography (and more recently by cinema and video) for acceptance into the canon are good models of what may be expected.

The connection of some of the new technologies, such as digital imaging, to popular culture raise high art/low art issues. Because they are used extensively in mass media and in the home it is hard for artists to develop styles that are not read as derivative. Also, these technologies' use in industries such as advertising, education, and science obfuscate distinctions between design and fine arts. Artists seeking to participate in traditional art world discourse with new tools must contend with these other references. They can choose, like cinema, to develop a hybrid popular high art form, or they can seek to develop uniquely appropriate aesthetics.

Deconstruction as Art Practice

Many artists who have found these theory-based analyses compelling have been attempting to develop an approach in which deconstruction itself is a main agenda. The theories provide concepts, themes, and methodologies for creating art works that examine and expose the texts, narratives, and representations that underlie contemporary life. Even more, the work can reflexively examine the processes of representation itself within art. Barthes describes the process:

It is no longer the myths that need to be unmasked (the doxa now takes care of that), it is the sign itself which must be shaken; the problem is not to reveal the (latent) meaning of an utterance, of a trait of a narrative, but to fissure the very representation of meaning, is not to change or purify the symbols but to challenge the symbol itself.[41]

Technology and its associated cultural contexts are prime candidates for theory-based analysis because they are critical in creating the mediated sign systems and contexts that shape the contemporary world. In this kind of practice artists learn as much as they can about working with the technologies so that they can function as knowledgeable commentators. In one typical strategy, artists become technically proficient so they can produce works that look legitimately part of the output of that technology world while introducing discordant elements that reflect upon that technology. Thomas Lawson describes this approach as it might be used in painting, but the strategy applies in all media:

But by resorting to subterfuge, using an unsuspecting vehicle as camouflage, the radical artist can manipulate their viewer's faith to dislodge his or her certainty. The intention of that artist must therefore be to unsettle conventional thought from within, to cast doubt on the normalized perceptions of the "natural," by destabilizing the means used to represent it.[42]

Brian Wallis in the introduction to his book, Art After Postmodernism: Rethinking Representation notes that because of its focus on cultural construction, art is a uniquely suited location for critical theorizing. He also hints at the problematizing of the relationship of theory to practice:

The recognition that the critique of representation necessarily takes as its object those types of cultural constructions (images, ideologies, symbols) with which art traditional deals, suggests that art and art making might be one effective site for such critical intervention. From this point of view, the issue is less how art criticism can best serve art than how art can serve as a fruitful realm for critical and theoretical activity. This gives to art criticism a responsibility and political potential it is often denied. Further it shows the way to a more general critical practice which, surrounding and playing off art, might place in broader circulation an important body of issues and ideas.

. . . This new criticism would re-examine representation as a discourse, analyzing the way it produces and enforces knowledge (the institutions and operations which ensure its circulation), making clear how such knowledge is legitimated, and initiating a less exclusive and more generative means for interpreting the products of our culture. There is no possibility of operating outside the confinements of representation; rather . . . the strategy is to work against such systems from within, to create new possibilities.[43]

The worlds revolving around digital technologies are seen as ripe for critical analysis because of their self-assurance about the rationality of their directions and their totalizing pretensions. Jonathan Crary describes the opportunities for artistic action:

We must recognize the fundamental incapacity of capitalism ever to rationalize the circuit between body and computer keyboard and realize that this circuit is the site of a latent but potentially volatile disequilibrium. The disciplinary apparatus of digital culture poses as a self-sufficient, self-enclosed structure without avenues of escape, with no outside. Its myths of necessity, ubiquity, efficiency, of instantaneity require dismantling: in part by disrupting the separation of cellularity, by refusing productivist injunctions, by introducing slow speeds and inhabiting silences.[44]

This kind of practice is challenging. It requires that artists become as knowledgeable as possible about the technologies in which they are interested. It requires that they acquire expertise in theory and cultural analysis, and asks that they become conversant with intellectual work in many disciplines. It asks that they perfect skills of research and analysis in addition to expression and communication.

There are problematic issues to be worked out. The line between practice and theory can become blurred. The sophistication and depth of research underlying the work of theory-based artists can be expected to be as deeply elaborated as that of academics. Language and writing become important tools for the artists. In parallel fashion the work of theoreticians can begin to resemble that of artists as they experiment with jouissance and formal experimentation in their production of texts (as a strategy for deconstructing assumptions about authorship, academia, and the nature of texts).

The grounds for action are undermined. Radical deconstruction decentralizes and questions the acts of authorship, criticism, and art making themselves. Who is it that can purport to offer unique perspectives? From what discourses do their perspectives arise? What claim can they make to an audience? Any action in the art world can be seen as problematic given the insights of a deconstructed view of its special interests and narratives. Victor Burgin in The End of Art Theory suggests that artists and critics working on particular projects speak to specific historical conjunctions and constituencies rather than making claims to universal truth.[45]

Invention and Elaboration of New Technologies and their Cultural Possibilities as Art Practice

This century is characterized by an orgy of research and invention. Knowledge is accumulating at high speed; branches of knowledge, industries, social contexts, and technologies have appeared that could not have been anticipated. These developments are affecting everything from the paraphernalia of everyday life to ontological categories. As the pace continues, predictions about future discoveries and their consequences are impossible.

Artists can establish a practice in which they participate at the core of this activity rather than as distant commentators, even while maintaining postmodern reservations about the meaning of the technological explosion. Some analysts see scientific and technological research as the central creative core of the present era. As Paul Brown suggests in his essay in the SIGGRAPH '92 Visual Proceedings, historians may ultimately see aspects of science as the main art of our era:

> I believe that the art historian of the future may look back at this period and see that the major aesthetic inputs have come from science and not from art... Maybe science is evolving into a new science called art, a polymath subject once again.[46]

As this author has described in previous articles, "Research and Development as a Source of Ideas and Inspiration for Artists"[47] and "Industrial Research Artist: a Proposal"[48] artists can participate in the cycle of research, invention, and development in many ways. They can learn enough to become researchers and inventors themselves. From the time of Leonardo until recently, the merger of scientific and artistic activity was not uncommon. The claim that this unified method of functioning is impossible now because scientific or technological research requires mastery of too much specialized knowledge and access to an elaborate research infrastructure must be critically scrutinized.

Artists can function in other ways. Free from the demands of the market and the socialization of particular disciplines, they can explore and extend the principles and technologies in unanticipated ways. They can pursue lines of inquiry abandoned because they were deemed unprofitable outside established research priorities. They can integrate disciplines and create events that expose the cultural implications, costs and possibilities of the new knowledge and technologies.

This practice does not accept the output or the conceptual frameworks of the science and technology world as givens. Rather it seeks to update the notion of the arts as a zone of integration, questioning and rebellion to serve as an independent center of technological innovation and development. This idea has precedents in earlier parts of this century. For example, Gregory Kepes in New Landscape in Art and Science described the need for artists to work in a proactive way with developing science:

> Rapid expansion of knowledge and technical development have swept us into a world beyond our grasp; and the face of nature is alien once again. Like the forest and mountains of medieval times, our new environment harbors strange menacing beasts; invisible viruses, atoms, mesons, protons, cosmic rays, supersonic waves.
>
> The images and symbols that can truly domesticate the newly revealed aspects of nature will be developed only if we use all our faculties to the full—assimilating with the scientist's brain, the poet's heart, and the painter's eyes. It is an integrated vision that we need; but our awareness and understanding of the world and its realities are divided into the rational—the knowledge frozen in words and quantities—and the emotional—the knowledge vested in sensory image and feeling. Artists and poets on the one hand, scientists and engineers on the other, appear to live in two different worlds. Their common language, their common symbols, do not exist.[49]

This kind of practice demands that artists educate themselves enough to function non-superficially in the world of science and technology. It requires they be connected to both the art and technical worlds—for example, by joining the information networks of journals, research meetings, and trade shows. It asks artists to be willing to abandon traditional concerns, media, and contexts if necessary. It challenges artists to develop new systems of support and access to the contexts and tools relevant to their investigations. Ironically, with success in becoming innovators, these worlds may seduce the artists to forget art agendas and to fully join the ranks of technologists and developers.

How does this kind of practice relate to the issues raised by cultural theory that were described earlier? On one hand, the willingness to go outside traditional art world definitions of problems and arenas does represent a kind of postmodern opening up of discourse. On the other hand, this practice manifests a more problematic position in regard to the more radical deconstruction. While these artists may share an interest in deconstructing the texts and narratives of the technical world, be skeptical about its self-representations, be involved in elaborating the unappreciated cultural implications of the technology, and be wary of the ways research and technologies get co-opted; many share an underlying openness to the possibility of science-based progress. They believe that some research, invention, and development may transcend the cultural contexts in which it arises. Furthermore, they believe in a kind of avant-garde in which researchers and artists can develop genuinely new knowledge that creates new cultural meanings and possibilities rather than just circulates old signs.

Also, this practice can fail to address issues of gender and cultural hegemony raised by cultural theorists. Some artists may buy into the assertions of the science world that at its core its work is potentially universal and gender/culture neutral instead of being an instance of the modernist domination patterns. The extent to which scientific and technological research concepts, practices, and values are themselves intrinsically gender, and culture bound is an open question that invites analysis by theorists and artists alike.[50]

An example from just one area of technological ferment will illustrate. Many electronic artists are interested in the new possibilities created by telecommunications technology and seem interested in inventing and extending the technology. Certainly, they are interested in the issues cultural theorists might raise: for example, Who controls and has access to this technology? How is it represented to consumers and to developers? What larger cultural movements is it part of? What fantasies does it tie into? Even though these topics might be substantive focuses of their work, their tone is basically optimistic about the potential meanings of these developments.

Roy Ascott, a long time pioneer in this work, illustrates this optimistic outlook in his article, "Art and Education in the Telematic Culture":

But the art of our time is one of system, process, behavior, interaction... This is precisely the potential of telematic systems. Rather than limiting the individual to a narrow parochial level of exchange, computer-mediated cable and satellite links spanning the whole planet open up a whole world community, in all its diversity, with which we can interact... With electronic media, its flow of images and texts, and the ubiquitous connectivity of telematic systems this isolation and separateness must eventually disappear, and new architectural structures and forms of cultural association will emerge. And in this emergence we can expect to see, as we are beginning to see, new orders of art practice, with new strategies and theories, new forms of public accessibility, new methods of presentation and display, new learning networks—in short, whole new cultural configurations.[51]

Telecommunications is just one of many fields of techno-scientific research that promise culture-transforming possibilities. Taking advantage of unique traditions of the arts, such as valuing iconoclasm and interdisciplinary perspectives, artists can choose to be a part of the efforts to create these new technologies and fields of knowledge. Furthermore, this artistic stance calls for artist participation in other fields beyond the digital technologies that are focused on in this essay such as new biology, materials science, and space exploration.

Crossing Boundaries

The artistic stances described above outline a range of responses artists can and have taken toward emerging technologies. Real practice, of course, is not so clearly demarcated as these categories. As they go about their work artists cross over. For example, consider how this analysis might be applied to artists' work with virtual reality (VR) technology.

Many artists seem to want to work within historically recognizable artistic traditions, with virtual reality seen primarily as a new medium. They want to create highly interactive compositions that will be judged by their thematic, dramatic, visual, and sound accomplishment just as traditional media have been. New aesthetic categories focused specifically on the interactivity and kinetic engagement will no doubt be developed but the social niche of VR as entertainment or art form is not that different from what already exists. The interest expressed in this technology by the entertainment industry attest to its readiness to assimilate this technology to traditional forms. And as with traditional media, independent artists are developing works based on this technology, which elaborate poetic, expressive, craft, sensual, or conceptual directions likely to be ignored by commercial interests.

One direction for artists using the VR technology in a conceptual or social commentary mode might be to use it reflexively on the technology itself. For example, they might explore the origins of the technology in military simulation, the language used to promote it, or the social niches in which it is adapted. They also might use its unique potential to offer new perspectives on body or gender (for example, allowing individuals to constitute themselves to other VR travelers in any gender desired). These explorations pass over into the deconstructive, theory-based practice described above.

Other artists might be interested in pushing the functioning of the technology—for example, by extending the ways it senses body motions or the way it represents worlds. Alternatively, they might work on inventing or investigating new non-commercial applications such as ways of experiencing being in two locations at once or experiencing the life of animals or inanimate objects.. This work passes over into the technology extending practice described above.

Summary: How Can the Arts be Part of a Technological Era?

There is an acknowledged danger that technology is advancing much faster than the culture's ability to make sense of it. The arts have traditionally been a place where understanding, integration, and preparation for future developments takes place. There are several competing visions of how artists can most fruitfully work with emerging technologies: treat them as new media, deconstruct their cultural implications, or participate in the processes of invention and extension.

Critical theory and cultural studies offer compelling tools for understanding some aspects of contemporary technological society. Furthermore, these theory-based approaches offer powerful concepts and methodologies for practicing artists to use in responding to the realities of an electronically mediated world. However, while these approaches are useful for understanding what exists, they are problematic for envisioning what might be. Furthermore, these approaches, in their skepticism about progress and about the possibility of innovation to transcend specific contextual discourses, are at odds with values of the researchers and inventors who believe they are working to create new cultural possibilities. Artists who work with emerging technologies are faced with the challenge of positioning themselves in these conflicting world views. *

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Tomorrow's Realities

Tomorrow's Realities Introduction

ENRIQUE GODREAU III

Tomorrow's Realities Committee Chair

Tomorrow's realities is a specially designed, non-traditional gallery that demonstrates the latest in new and emerging technologies and establishes a framework in which to consider the social, economic, cultural, and political implications of computer graphics. The exhibits not only recognize achievements in the computer graphics industry, but also raise awareness of the impact of these technologies. Attendees explore demonstrations in hypermedia and virtual reality as these media address such issues as computers in education and the mass media, cultural dissemination, changes in language and communication, and the emerging new media literacy.

For the past 20 years, SIGGRAPH has played a prominent role in the electronic visual communications revolution. This year, tomorrow's realities joins in the celebration of SIGGRAPH's 20th anniversary and provides the audience with an opportunity to witness the impact that computer graphics has had on people and the way they work, interact, and communicate both with computers and with each other. What separates this year's program from previous year's is the attention we have placed on providing more than simple technology demonstrations and encouraging you to consider the implications and opportunities of computer graphics. Our fondest hope is that as you tour the exhibit and reflect on what you see, hear, and feel you will be reinvigorated to participate in the development and dissemination of the technologies that bring us together and move us toward a global village.

The tomorrow's realities committee worked well as a group. We kept a keen focus on accepting submissions that were technically the best in their field yet also supportive of our overall thematic objectives. Our selection process involved assessing each submission individually with the following criteria: cultural, educational, entertainment, and social value; and originality, innovation, creativity, presentation of the finished piece; and significant technical advancement. We are very happy with the breadth of submissions in tomorrow's realities and are particularly pleased with the diversity of the presenters—from one-person studios to leading academic research facilities. Indeed, what better metric exists to measure global progress toward the technological realities of tomorrow than by reflecting on the origin and affiliation of this year's presenters. Please join us in the celebration of tomorrow's realities and the prospect for even broader, richer, and more effective visual communications technologies in the future!

Planning and presenting a program like tomorrow's realties is a significant task and one that could not be accomplished without numerous contributions from many, many people. First and foremost, I would like to acknowledge the support I have received from the Aldus Corporation during my involvement in this year's tomorrow's realities program. I would like to especially thank Mark Cutter, Dan Gallivan, and Skip Walter for their assistance. I would like to express my gratitude to the tomorrow's realities committee and the excellent work they have done to bring this all together. In particular, I must acknowledge the Herculean efforts of Colin Griffiths aimed at making this program a success. The production and general assistance provided by Garry Beirne was an invaluable asset, particularly during critical times in the project. Thanks to the SIGGRAPH 93 committee for the continuous support that allowed us to develop and deliver the message contained in this year's tomorrow's realities program. Priscilla Bell, my assistant, helped keep me on track and played a vital role in bringing all of the necessary pieces together. Finally, I would like to acknowledge the love and support of my wife, Lillian, who has survived being a SIGGRAPH Widow with honor. Honey, I'm coming home!

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- Administrative Assistant: Priscilla Bell, Aldus Corporation

ALIVE:
An Artificial Life Interactive Video Environment

PATTIE MAES

MIT Media Lab

The ALIVE interactive installation brings together the latest technological breakthroughs in vision-based gesture recognition, physical modeling, and behavior-based computer animation. The user experiences a physically based computer graphics environment and is able to interact with the artificial creatures that inhabit this world using simple and natural gestures.

More specifically, chroma-keying technology is used to overlay the image of the user on top of a real-time interactive computer animation. The composited image is displayed on a large screen (10 feet x 10 feet) that faces the user, the resulting effect being that of looking in a "magical mirror." Using natural gestures interpreted by a vision-based pattern recognition system, the user can interact and communicate with the animated creatures in the mirror and as such effect also their behavior.

The goal of the ALIVE system is to demonstrate what recent research achievements in the area of vision-based gesture recognition, modeling autonomous agents or "artificial creatures" and physically based modeling have made possible. The ALIVE system represents one of the first (if not the first) artificial reality systems in which users can interact and communicate with semi-intelligent autonomous agents using natural gestures.

One of the component technologies demonstrated in the ALIVE system is a vision-based algorithm that tracks hands and faces and can recognize the spatio-temporal patterns or gestures a user may perform (Darrell and Pentland, 1993). During a short training phase, several examples of the pattern or gesture are presented. The system automatically builds a view-based representation of the object being tracked (for example, a hand) and uses the resulting search scores over time to store and match gestures. The system relies on correlation search hardware for real-time performance.

The second component technology is a toolkit and set of algorithms that make it possible to create "autonomous goal-seeking agents" by specifying their sensors, motivations, and repertoire of behaviors (Maes, 1991; 1991b; 1993). For example, for the ALIVE creatures, the sensor data include the gestures made by the user and the positions of the user's hands as well as the position and behavior of other creatures in the world. Motivations (or goals) include the desire for creatures to stay close to one another, fear of unknown things/people, and curiosity. Examples of behaviors are: move towards the user, move away from the user, track the user's hand, etc. Given this information, the toolkit produces an agent that autonomously decides what action to take next based on its current sensor data and its motivational state. The model also incorporates a learning algorithm that makes the agent learn from experience and improve its goal-seeking behavior over time.

Hardware

- Sun IPX workstation w/ Cognex Vision Processor
- Silicon Graphics Indigo w/ Elan board
- 10 feet x 10 feet backlit screen
- Color camera (for chroma-keying and gesture recognition)
- Light valve
- Chroma-keying system

Software

- All software is written by the contributors in C and C++. We employ SGI's Inventor and GI software packages.

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The third component technology is ThingWorld, a simulation system that uses modal dynamics for high-performance simulation of non-rigid multibody interactions (Pentland and Williams, 1989; Pentland et.al., 1990; Sclaroff and Pentland, 1991). The version demonstrated here is Distributed ThingWorld (Friedmann and Pentland, 1992), which uses several novel strategies for allocation of processing among networked computers to achieve a nearly linear increase in efficiency as a function of the number of processors.

The relation of the ALIVE installation to the theme of the tomorrow's realities' show is an indirect one. The installation makes users and viewers aware of what is possible with the latest techniques. It does so through an entertaining and evocative interactive demonstration. In addition to the demonstration, informational posters describe the technology used and reflect on its potential impact upon education, the workplace, training, and entertainment.

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"The ALIVE system represents one of the first (if not the first) artificial reality systems in which users can interact and communicate with semi-intelligent autonomous agents using natural gestures. One of the component technologies demonstrated in the ALIVE system is a vision-based algorithm that tracks hands and faces."

B*rbie's_Virtual_Playhouse@CityOfTheFuture.node.entertainment: *A Very Low-Tech Pseudo-Immersive Reality*

HENRY SEE

Independent Artist—Montreal, Quebec

"We are gullible, and we want to believe. Now we want to buy into the myth of virtual reality. Not only has an industry spawned around the development of the technology, but another is spawning around the propagation of the myth. The promises are being made. The dowry is being paid. The marriage bed is being laid."

The Ad from Late-night TV

B*rbie's Virtual Playhouse brings all the excitement of virtual reality to your home! No longer is virtual reality (VR) a question of high-end graphics computers, fancy goggles, and data-gloves! You can experience real VR on your home computer! No fuss! No muss! No messy keyboards!

Through the revolutionary new Hot-Date-A-Glove, you have access to all the mysteries, all the adventure, and all the sexual intrigue that make B*rbie's Virtual Playhouse the cyberspecial place to be! Don the Hot-Date-A-Glove, choose your character, and become an active participant in this world of the not-so-distant future!

- Change your sex as easily as you change your socks!
- Experience the existential angst of existence as a hypertext link!
- Investigate the philosophical implications of two-dimensional reality!
- Have fun and influence pseudo-people!
- It's the entertainment sensation for the entire family!

And not only that! If you act now, you and your friends can play together in B*rbie's Virtual Playhouse! At BVP, there's always room for one more![1]

Brief Description from the on-line Mall

B*rbie's Virtual Playhouse is a very low-tech, pseudo-immersive environment. Visitors to the Playhouse become either B*rbie or her playmate K*n and can play alone or with each other. Putting on the Personal Pseudo-Goggles and the Hot-Date-A-Glove™, they cease being passive observers and are transported across time and space to become active participants in their own pseudo-lives.

Important visual cues, such as the in-world representation of the Hot-Date-A-Glove™, forcefully locate the pseudo-B*rbie or pseudo-K*n in the rockin', riotous pseudo-world.

Once ensconced in their new home, visitors to the Playhouse move through the 3D pseudo-space (x-axis, y-axis, and time), exploring different paths of navigation, and may even come into direct contact with household objects. When two or more Playhouses are on a network, pseudo-B*rbie and pseudo-K*n can go visit their pseudo-friends in other modules. Is it B*rbie or is it K*n? Or is it just the pseudo-world playing games with your pseudo-mind?

The Fine Print

Simple programs such as "Eliza" have demonstrated the seductive power of our relationship with computer technology. We are gullible, and we want to believe. Now we want to buy into the myth of virtual reality. Not only has an industry spawned around the development of the technology, but another is spawning around the propagation of the myth. The promises are being made. The dowry is being paid. The marriage bed is being laid. And if the emperor has no clothes it doesn't matter because in VR you leave the body behind.

The coherence and believability of alternate worlds emerge from the coherence of the internal structure and organization of the work of which they are a part, not by means of photo-realistic or rendered representation of images nor reproduction of 3D space. Works in other media, such as books or animated films, are able to create such worlds and use neither of the aforementioned techniques: books through the written word and many animated films through the most simple of images.

If books and animated films can create alternate worlds without the use of 3D space or even images, why are virtual realities caught in the 16th century?

The Technical Fine Print

The environment runs on Macintosh computers with color screens. It was developed in HyperCard, using Director for certain animations and special color effects.

The Hot-Date-A-Glove, the input device, was laboriously constructed in our labs from a mouse, an oven mitt, and velcro.

[1.] *Multi-user capability is available via networked computers. Batteries not included.*

Hardware

- 2 Mac IIci or Centris 650 computers with 13" Apple RGB monitors
- 2 sets of power-amp speakers to plug into the speaker port of each Mac
- Ethernet boards for each Mac and appropriate cabling

Software

- HyperCard

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Books of Change:
Meditations on Metamorphosis

TIMOTHY BINKLEY

School of Visual Arts

"You cannot step twice into the same river." — Heraclitus

"Tempora mutantur, et nos mutamur in illis. Times change, and we change with them." — Anonymous

"The philosophers have only interpreted the world in various ways; the point is to change it." — Karl Marx

"Naught may endure but mutability." — Percy Bysshe Shelley

Books of Change is an interactive installation that seeks to be both entertaining and though-provoking. It encourages participants to meditate on the scope of their personal voyages through time and to contemplate the contributions they make in directing its course, both as individuals of a particular species and as members of a society organized around specific cultural practices. Each of us occupies a unique situation in the large-scale drama of evolution, and together we all make an impact on its future course. The purpose of Books of Change is to invite users to reflect on their dynamic and symbiotic relationship with our environment, both locally and universally. It is also designed to challenge us to think about our links with the rest of intelligence, and in the process to confront practical issues of moral and political responsibility as well as philosophical issues about the nature of consciousness. As we perch on the chaotic cusp of the third millennium, Books of Change reminds us that change is constant. It asks us to take a long look back to our cosmic origins to contemplate our insignificance and to take a long look forward to an uncertain future to contemplate our potency. The installation plays on the themes relating to our animal origins as well as our intellectual achievements. It poses questions about the relation between culture and nature and the impact of machines on the course of evolution. It also stimulates thought about how our civilization is changing through the increasingly rapid implementation of intelligent technology. It invites us to survey both the ephemeral and the eternal effects of our progeny. Computers are our playthings but also our assistants. Digital technology heightens the ephemerality of images, but also enhances their ability to open new vistas to knowledge and understanding.

Books of Change also aims to amuse. It offers intriguing and humorous metamorphoses on site and provides a printed version for the participant to take away for future fun. Most people are familiar with computerized metamorphoses only on impersonal subjects played across the implacable television screen. Here the user can interject herself into the process. She is able to straddle two key frames and morph herself between them A memorable transformation can be output as hard copy in the form of a flip book. The experience brings together several entertaining activities in a computer installation: playing with pictures of one's self, bathing in the recent proliferation of morphs in movies and TV, and sharing funny flip books with friends. Morphs are becoming hackneyed purveyors of special effects and advertising pitches. This installation aims to personalize them in a way that invites contemplation of deeper issues.

Hardware

- Macintosh
- Video camera
- Laser printer
- Quadra 950

Software

- Gryphon Software

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DesignSpace

WILLIAM L. CHAPIN

Center for Design Research

DesignSpace exhibits a conceptual application of future design media drawn from work at Stanford University's Center for Design Research (CDR) that facilitates collaborative design between remote stations through a shared virtual space. CDR was founded in 1983 as an industry-academia collaborative and interdisciplinary R&D center to improve the engineering and product design process. The Center accepts design problems from industry and government, and confronts them with creative design teams for the purposes of design process observation and study, experimental design practice, and new design tool development. A long-term CDR goal is to aid the design process so that problem complexity does not impede creativity, reuse of design knowledge, and human skill. While modern design tools make productive use of computer assistance, computer interfaces often interfere with the designer's creative thought flow and manual skills. To overcome these interferences, CDR researchers and designers collaborate on projects to develop devices and interfaces to better map manual skills to data operations, experiment with alternative means of design knowledge storage and retrieval, and investigate design tool effectiveness. DesignSpace encapsulates developing technologies from some of these CDR projects into a conceptual design environment.

DesignSpace exhibits four key emerging technologies, demonstrating either advances or unique applications by CDR: dexterous manipulation, virtual presence, telecommunication, and auditory display. Dexterous manipulation technology encompasses sensing, encoding, and interpretation of both static poses and dynamic actions of the human operator to manipulate data in computer-based media. DesignSpace showcases the highest precision in both virtual hand-space recognition and physical hand-space representation. With hand-space recognition, operators may control the environment or command the system with static and dynamic gestures. With accurate hand-space representation, operators may skillfully manipulate virtual objects and controls. Virtual presence technology creates a consistent psychological effect that makes computer-based media believable and intuitive. Unlike an immersive virtual environment with a head-mounted display, which attempts to give the user a presence in a virtual place, DesignSpace attempts to give virtual objects a presence in the user's physical space. Telecommunication technology provides access to and transmission of remote information. DesignSpace uses 3D visual and audio graphics to present remote individuals and objects, with an interactive viewpoint for selective information access, all within the bandwidth of a standard telephone line. Auditory display technology encodes information in auditory cues such as localization to present data uniquely, or to reinforce other sensory displays (commonly visual). DesignSpace supports multiple listeners sharing an acoustic environment with multiple dynamic, directional, and spatially located audio sources.

Several CDR projects form the basis for DesignSpace:

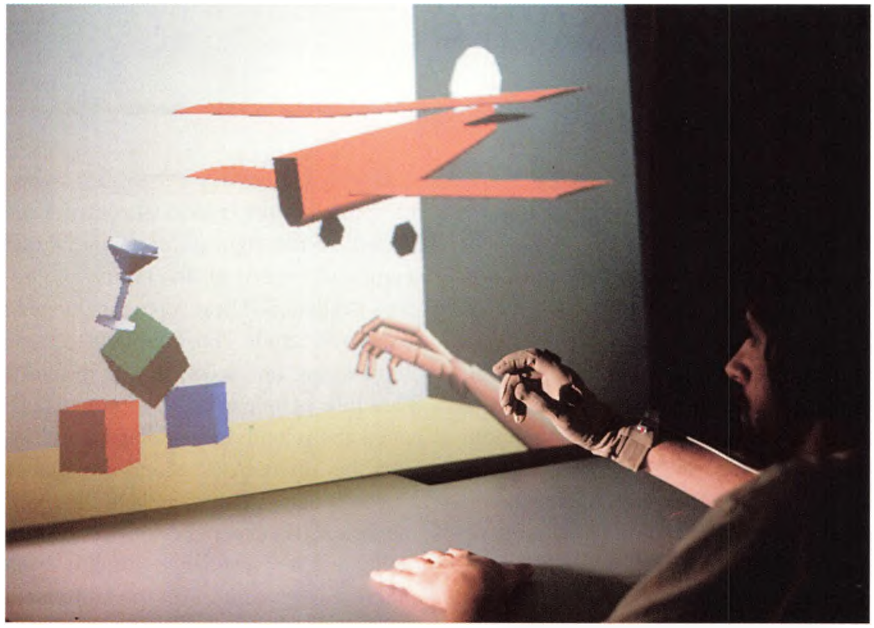
- Talking Glove (J. Kramer and L. Leifer)—An assistive communication device for non-speaking deaf individuals, which recognizes American Sign Language (ASL) finger spelling to generate text or synthesized speech. At the core of the Talking Glove system is an instrumented glove and neural net recognition algorithm for mapping dynamic hand formations into a digital command stream. Virtual Technologies further developed the patented technology into a hand instrumentation system called the Virtex CyberGlove.
- Cut Plane (L. Edwards, W. Kessler, and L. Leifer)—A 3D CAD interaction metaphor, displacing the need for orthonormal projections, command line input, and menu command selection, while providing continuous access to all three dimensions on a standard CAD workstation with mouse. A CDR spinoff enterprise, Beyond Technologies, developed and implemented the Cut Plane metaphor in a conceptual design tool product called 3Form.
- Virtual Hand (W. Chapin and J. Kramer)—A dynamic simulated hand model driven by the instrumented glove developed for Talking Glove.
- TeleSign (W. Chapin, J. Kramer, E. Macken, C. Haas, and L. Leifer) - a collaborative design effort between CDR and the Center for the Study of Language and Information, leveraged from the Talking Glove and Virtual Hand projects to develop a system for visual expression and manual communication. Two or more TeleSign stations share a locally maintained virtual environment across standard low-bandwidth telephone channels.

At each DesignSpace station, a participating designer works in a physical studio environment, with access to one shared virtual 3D space. The "semi-immersive" aural, visual, and dexterous interaction within the virtual environment frees the user to work in both the physical and virtual DesignSpaces. Hand and wrist instrumentation empowers each DesignSpace designer with system control, manual communication with collaborating designers, and use of dexterous design skills. Participants may use dexterous interaction to compose 3D MIDI music, create colorful 3D designs, communicate in a manual language, and modify the design environment, in addition to issuing pre-trained, macro-type system commands using hand gestures. Linked stations maintain the environment locally and bi-directionally share their participants' interactions.

Diverging from traditional CAD tools, DesignSpace does not require the designer to channel design interaction through a command interface, and attempts to put creativity back in the "hands" of the designer. Being a "semi-immersive" virtual environment system, DesignSpace permits the use of traditional design media, such as paper or clay, while bringing computer-based design media into the design studio, virtually into the designer's hands, and extending the experience to remote collaborators.

While a major motivation to create a CDR exhibit was to suggest useful applications for these new technologies, the multi-faceted DesignSpace application inherently provides other values as well. Educationally, DesignSpace is a creative platform for students to experiment with assembling shapes and sounds. The system enables a wide range of fun, interactive activities for remote participants, exploiting dexterous skill in competition or collaboration. As a communication medium, DesignSpace increases social accessibility to ideas, concepts and emotions, and may provide more cultural depth and value than sense-deprived media such as print, the telephone or e-mail. The design intent behind the DesignSpace application is to provide industrial value within CDR's goals: to increase accessibility and productivity to computer aided design (CAD), to better communicate ideas between individuals, and to integrate interactive design, simulation, and testing into a single facility to expedite design iteration. The DesignSpace exhibit provides CDR the opportunity to test these new developments against their goals.

Crystal River Engineering, Inc. (Groveland, CA) directly supported CDR/Virtual Space Exploration Lab and furnished audio equipment and miscellaneous virtual environment hardware. Division Ltd., Bristol, England/Division Inc. (Redwood City, CA) has donated computing facilities, projectors, and miscellaneous exhibit materials. Polhemus Navigation (Colhester, VT) has committed to support the exhibit with position trackers. Giugi Design (Palo Alto, CA) loaned miscellaneous materials for the exhibit and development.



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- Crystal River Engineering: Scott Foster, Kristine Sansavera, and Andy Wilson
- Giugi Design: Chris MacMurdo and Richard Luzzi

Electro-Healing

JOANN GILLERMAN

California College of Arts and Crafts

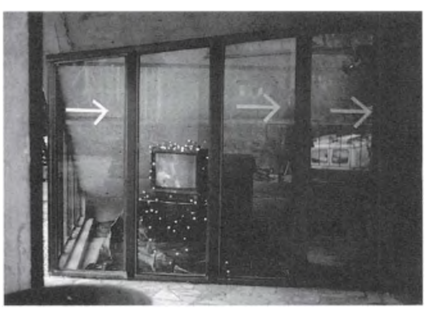
Electro-Healing is a collaborative interdisciplinary interactive and virtual healing environment. It deals with communication and new technologies. As a group, we decided to work with universal concepts that could accommodate a changing multi-cultural world view, as well as deal with political, social, ethical, and aesthetic concerns. The collaborators of this installation represent a diverse group of people of varied ages and ethnic backgrounds from at least four different countries and cultures from around the world. The text is multi-lingual.

Healing, our common ground, has been translated loosely and covers a broad spectrum of ideas. It has been personally interpreted by the individual contributors of each of the eight different individual segments comprising the entire interactive installation. These segments range in scope and include: "Basic Black"—a game commenting on racism that is designed for white people who have not experienced the relentless humiliation and insults that many black people experience on a daily basis; "Kundalini and Baseball" - an interactive experience of virtual spirituality and transcendence through seven chakra energy centers as the stimulated Kundalini Serpent rises up and is finally released through the thousand-petal lotus of Bindu; "Aura Massage"—healing and channeling through Barbie Dolls; message therapy; healing powers of music and water; and others.

The interactivity of the audience is of primary concern and an important factor around which the environment was designed and without which the installation does not function. The individual segments are accessed through virtually touching any one of the eight "active trigger points" that appear as icons surrounding a circular mandala image on the main display screen. Each section allows a moving video image from laser disk to accompany and superimpose with the computer graphics onto the display screens.

The process used to determine the final design of the event included many group discussions and considerations. We decided on "healing" as a concept to which we all could relate in some form. Background, political/social biases, and personal statements could be expressed through this concept. We went on many field trips to see relevant media-based works including performances, installations, and exhibits to provide a broader perspective and more "enlightened" input for our technical and aesthetic concerns. We also invited several visiting artists who use interactive technologies and virtual reality into our class for discussion and viewed their work. After participating, watching, discussing, and examining many different interactive works over a semester's time, we collectively decided to carefully consider the quality and method of interaction. We wanted to get the interaction off of the computer keyboard or mouse, opting for a more natural interface of real space and movement through time. It should be easy, fun, comfortable, and able to accommodate more than one person at a time.

To this end, the Experimental Media Class at the California College of Arts andCrafts has designed and produced the Electro-Healing Installation—a virtual environment that we believe is cross-cultural, deals with some relevant political and social issues in a refreshing way, and is technologically unique and friendly for its participants.



Hardware

- 3 Amiga Computer systems w/peripherals (A2500 w/multiple serial card, A1000 or A2000 w/A-square LIVE digitizer and one genlock)
- Memory requirements = 4-8 Mbytes RAM
- Videodisk player w/ serial port (LDP 1000)
- MIDI synthesizer
- Video switcher
- Video camera w/tripod
- 7 color monitors for audience display and interaction
- Stereo sound system (amp, preamp, speakers and small 2-4 channel audio mixer)

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- JoAnn Gillerman, Director of Installation, Instructor of the Experimental Media Class, California College of Arts and Crafts, Oakland, CA: "Kundalini and Baseball"
- Susanne Hewitt: "Eye"
- Beth Katz, Shem Slobin: "Drums"
- Jayson Lamb, Leila Godowsky: "Taboos"
- Barbara Lee Federle, Renate Buchgraber, Jeffrey Darby: "Hand"
- James Redd, David Pounds: "Basic Black"
- Rob Terry: provided custom software used in the installation
- Jonas Thorvaldsson: "Time"
- California College of Arts and Crafts

Special Thanks To

- Sara Roberts and Don Day

Formal Elegance and Multi-modal Command Objects

DANIELLE EUBANK

Dickson Art Center, UCLA

Technology has spawned the growth of societal, national, and global relationships. Consequently, one-on-one information dissemination is rare. The method of mass communication has stifled the possibility for multi-personal interaction on an intimate level. That is, we receive movies, TV, radio, periodicals, and public advertisements without the option to directly respond. The result is a feeling of helplessness. No voice. No room for action. We sallow in the shade of the media giants.

Using interactive software for direct communication with mass media would make it easy for people to ask and speak for themselves and their society. With equality through voice, the quality of life is improved. Empowering individuals to communicate across cultures and national boundaries will allow us to share our diversity and become less self-centered in our planning.

Cross-cultural interaction requires well designed recognition oriented interfaces that perform the diversified tasks computers perform. The buttons, slides, levers, and layout of interfaces should make the use of interactive computer software transparent. Present GUIs provide only anemic representations of the interactive tools needed by users. Thus, communication is hindered; the advance of broad human interaction is stalled.

This series of six posters investigates multi-modal command objects as they exist in our current environment. Formal and visual communication design are what make command objects valuable tools. Ultimately, I will apply this understanding to interactive human-computer interfaces. More intuitive, better functioning interactive tools are desired.

Definition

A command object is any mechanism, mechanical or otherwise, which when manipulated directs an action. Usually, these controllers will have at least one movable piece. They perform a variety of functions such as access information (TV dial), produce a desired effect (typewriter key), enable/disable an object (turn on/off a drill press). Command objects must directly communicate with another object: light switch, steering wheel, door lock. This excludes drawer pulls, inactive objects such as a screwdriver, and crescent wrenches. (If attached to a nut, the wrench would qualify because when turned, it affects the nut. However, alone the wrench doesn't command anything).

"Multi-modal" refers to the functionality of the command object. Each object has a minimum of one "mode" or program setting such as "on" or "off." Usually multimodal infers a physical differentiation between the "on" position and the "off." Of course, there are exceptions. A three-way lamp switch designates the brightness of the bulb by the number of times it is turned; each turn ends where it began.

Design Decision

Why depict the results of this research in poster form? The shape of command objects and what functionality they graphically communicate is the focus. When abstracted and put into 2D, they can be evaluated without concrete associations of feel and actual functionality.

Size

We take common command objects for granted. When an object takes on exaggerated proportions our concept of its functionality and individual physical attributes also is exaggerated.

Production Method

Researching command objects in our urban environment for subsequent translation to the computer monitor requires both physical research and a comprehensive understanding of design for light-emitting substrates. Thus the marriage of photography and computer created graphics is ideal.

Substrate

Translucent film is a mediator between reflective 3D objects and light-emitting media, such as video or computer monitors.

Display Method

In harmony with a translucent substrate, transparent media on both sides of the graphic allow light to come from behind. Hanging the graphics away from the wall forces the viewers to interact with their dimensionality and furthers the exaggerated size-functionality relationship.

Printing Method

Creation via a computer, the translucence requirement, limited production, and natural time constraints all point to electronic printing.

Environment

The environment where a command object exists affects the type of object used. Obviously, switches and buttons in a machine shop will require different safety features than those in a nursery. The type of object used is sometimes indicative of its environment. For this reason, controllers were researched by their environment. Homes, schools, offices, video arcades, transportation vehicles, and public areas are the most common zones where we habituate and/or use controller devices.

The definition of interactive command objects for children needs to be slightly adjusted. Obviously, high-powered, intuitive, trigger-oriented mechanisms will leave a child lost, confused, or disinterested. Leaving a child with the responsibility of a powerful, non-intuitive command object is not commonly considered wise. For this reason, children are first introduced to simplified versions of command objects and gradually progress to more advanced objects requiring more dexterity and understanding.

Intuitive

"What are intuitive command objects for children?" is an invaluable question whose answer sheds light on "What are intuitive command objects for adults?". Researching tactile objects for young children in the classroom makes it apparent that "intuitive" for adults is not "intuitive" at all. Rather, what we think of as being "intuitive" are really those objects we've been familiar with since we were young. Toys and learning tools are comprised of simplified versions of what adults use. Steering wheels are colorful, larger; buttons are bigger and require exaggerated energy to manipulate. When designing command objects for computer interfaces, closely observing those children regularly use is invaluable. Exaggerated movements, intuitive applications, wise color usage, and powerful graphics are important factors for successful command object representation.

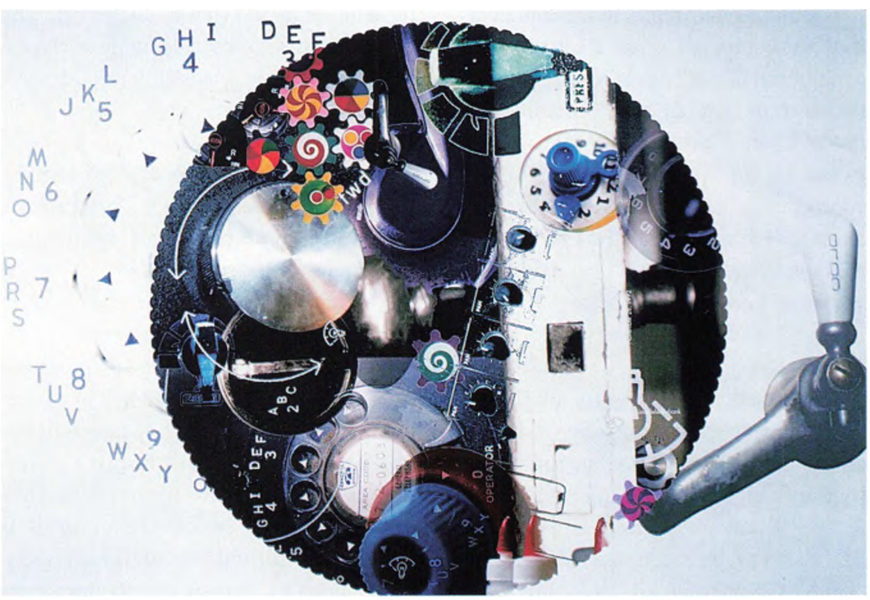
Functional Categorization

How can command objects be categorized functionally? In other words, how can the way we interact with them be differentiated? The most basic way to define the different types is in terms of their movement in space. Those that move mostly along the z axis are items that we "push," "pull," or "insert." "Slide" and "dial" move within the x and y axes. Circular pivotal motion includes "flip, push, pull, dial, and crank." Command objects that use a "ball joint" are of the joy stick and digitizer variety. Another type of object that can move in 3D is a squeezable item such as an atomizer. Other common titles for command objects are navigator,controller, stick, rod, lever, crowbar, pry, prize, jimmy, button, fastener, handle, winder, key, indicator, gauge, joy stick, glide, (steering) wheel, switch, and knob.

Ultimately, command devices are categorized here, not mathematically, but in terms of how their function is commonly labeled. Because the physical space definition is so basic, a more defined definition is in terms of the way we are familiar with them. Ten groupings were discovered: slide, crank, ball joint, squeeze, sensor, push, insert, dial, pull, and flip. The most commonly used objects are push, insert, dial, pull, and flip. Thus they are given the most attention in this study. These groupings need to be viewed as elements (which often work together) that create command objects. Rarely do they work alone; however, one element often dominates. For example, inserting a key into the ignition is one action, turning the key is another. "Insert" creates the connection, turn triggers the spark. Insert initiated the process and thus dominates the command.

No command object is an island. For successful understanding and use, visual and formal graphic communication are paramount. It is important to remember that sophisticated command devices work together. For translation to a computer or video monitor, as expected, the variety of controller resources has not been tapped. Successful design for human-computer interaction relies on a great understanding of current effective command objects and superior transference of that knowledge to a computer or video monitor.

The Formal Elegance and Multi-modal Command Objects poster series was developed at UCLA with the guidance of the Department of Design and its outstanding faculty. All photography and design of the series were created by Danielle Eubank. The original photographs were scanned with a Microtek ScanMaker 600zs. They were collaged on an Apple Macintosh IIci and printed to poster size from SyQuest disks by a Cannon Color Bubble-Jet Copier A1.



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Hands on Hawaii

CARRIE HEETER

Michigan State University

Comm Tech Lab research on users of virtual reality (VR) systems has consistently found that nearly 90% of VR users surveyed indicate they would prefer to see their real hands rather than computer-generated hands appearing in the virtual worlds. People want to experience a strong sense of self when they enter a virtual world.

Our Hands on Hawaii experience features an interface that lets users sit down at a custom-designed whale-shaped kiosk, slip their hands under a curtain, and watch their hands appear in a virtual Hawaii on a screen in front of them. Both their life-sized hands and the virtual world are photo-realistic. Users can "touch" video-graphic objects to explore the islands and to learn about the associated ecosystems.

It is natural to look down and see the backs of your hands in the real world. Here, the dividing line between real and virtual world is marked by the curtain you slip your hands under to enter the virtual world. We expect the interface to create a compelling and involving sense of presence in a virtual world, and we will be studying user reactions to examine the impacts.

The "Hands on" interface is well suited for public installations—there are no moving parts or delicate equipment that users touch directly; no supervisor or guide is needed to manage use, and the hygiene issues associated with goggles or gloves are not a concern.

Hands on Hawaii is a "guided discovery learning" infotainment experience based on actual for-college-credit three-week learning experiences in the Hawaiian Islands. Users can explore the extinct and active volcanoes on Hawaii and Maui. They can explore the coastline or visit sites that show human impacts on the island ecosystem at different points in history. They can control a 70-million-year animation of the birth of the islands. Grabbing the guide of their choice, users can zap down to the surface from the aerial interface to explore.

Guided discovery learning is a powerful educational paradigm in which it is clear to students that what they are learning is related to the real world, and is not merely academic abstraction. Learning is not dissected by artificial boundaries that obscure the interrelationships between events and objects. Instead of learning botany, social sciences, geology, and meteorology as separate subjects, students see them as different perspectives to apply to an ecosystem. This is similar to the case-study approach used in medical education, and is exceptionally well suited to the study of ecology. Learning is an integrated experience, not the study of unrelated, isolated subjects. The learning environment is much like an ecosystem—all subjects are interconnected and have an influence on one another, and boundaries between things are blurry. For example, goats imported to the islands by people (history) devour the plants covering a hillside (ecology), causing a dramatic increase in the erosion rate (geology) of a valley.

Hardware
- Macintosh Centris 650
- CD ROM drive
- Macintosh CI
- Amiga 2000
- Pioneer 8000 videodisc player

Software
- HyperCard, Mandala, Photoshop, SuperPaint, SuperCard, Director, Wavefront

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Expert naturalists are available to help steer students toward interesting aspects of the environment. This prevents students from becoming overwhelmed and confused by the richness and complexity of the environment, or from overlooking subtle inter-relationships. It does so in a way that allows students to pursue their own interests. Providing students with choices about what they learn about is an exceptionally effective way to motivate students. This combination of providing a rich environment in which students learn through discovery as well as an informed expert guide to help foster and steer their inquiries is referred to as "guided discovery learning."

Virtual reality and hypermedia are effective ways to bring this experiential learning situation home and to a wider audience, because they bring the richness and complexity of the environment to the user, both in terms of the multiple sensory media (pictures, sounds, videos, animations, diagrams, maps, text, and narrations) and in terms of the interconnectedness of things within the environment (embodied in the web of links between pieces of information and ideas that hypermedia provides). Complexity and inter-relatedness are key aspects of field experiences that make them special; hypermedia is better suited for capturing these aspects than are texts, videos, etc.

Learning can be presented as an experience, not just as a series of subjects. The medium is, however, flexible, and enables students to access material both on the basis of what case it is part of and in terms of what academic subject(s) it is associated with. It allows students to explore freely, following their own interests.

Using the islands as an interface, Hands on Hawaii presents a grounded spatially based interface, letting users navigate around the Hawaiian Islands in a virtual travel experience as they follow the journey of the students who went there for a field learning experience or choose their own path. Hands on Hawaii is a prototype for a more involved CD-ROM and virtual reality infotainment experience that we are currently seeking funding to develop. The prototype is based on a set of 2000 slides taken during numerous field learning experiences. These slides have been enhanced using computer graphics packages to add interface elements and then pressed to videodisk. A full implementation would incorporate a larger content base, full-motion video, and sequences captured specifically with this interface in mind. Hands on Hawaii is part of the Comm Tech Lab's ongoing research on human interface design for hypermedia and virtual reality.

The exhibit uses a Macintosh CI, an Amiga 2000, a Pioneer 8000 videodisk player, and video equipment housed in the whale kiosk. HyperCard and Mandala software are used to create the interactivity, and Photoshop, SuperPaint, SuperCard, Director, and Wavefront were used during postproduction phases.

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- Michigan State University
- Richard Grove, Animator
- Steve Sneed, Freelance Designer

"Virtual reality and hypermedia are effective ways to bring this experiential learning situation home and to a wider audience, because they bring the richness and complexity of the environment to the user, both in terms of the multiple sensory media and the interconnectedness of things within the environment."

An Interactive Exploration of Computer Music Research

DAVID WAXMAN

IRCAM

The understanding of sound and music—essential aspects of the human experience—has progressed considerably in the last 20 years. This is due in part to the growth of computer music as a field of musical as well as scientific experimentation. With computers, composers can explore and manipulate sound and musical structure on both the micro and macro levels, and psychoacousticians can provide models that help us understand cognitive and perceptual processes.

In our presentation, the visitor participates in a series of interactive situations based on work realized at the Institut de Recherche et Coordination Acoustique/Musique (IRCAM) of the Centre Georges Pompidou in Paris—a leading international research and production center for new music. The aim of this set of musical examples is to illustrate in an inviting and game-like fashion how the computer makes it possible to realize three aspects of ongoing research at IRCAM: psychoacoustics and perception of musical pitch, rhythm, nuance, timbre and space; digital signal processing (DSP) as a means to realize sound synthesis transformations; and compositional concepts and structural transformations.

The interactive setup helps to catalyze the pedagogical aim of the examples. At the same time, the emphasis on real-time realization reflects exactly the basic underlying methodology of research at IRCAM. In this way, the visitor discovers and learns in the same ways as our researchers and composers. The exhibit is comprised of a series of interactive "situations," inviting the visitor to explore the different categories outlined above via a common interface scenario.

The Exhibit

The visitor is briefly introduced to the theme of the particular situation, then is presented with some pre-recorded examples to be used as models, and is finally invited to explore on his or her own. S/he will primarily interact with the system either by moving the screen cursor, by playing on a real piano keyboard, or by speaking/singing into a microphone. The computer responds in real time by transforming the sound of the piano or his/her voice, and extending them with synthetic sounds. On some occasions, the piano itself will also be controlled by the computer.

The front end, or interface-to-user input, is the Max real-time environment on the Macintosh (originally developed at IRCAM and published by Opcode Systems). The back end, where sounds will be transformed and synthesized in real-time, is the IRCAM Signal Processing Workstation (ISPW), a hardware/software package (developed at IRCAM and distributed by Ariel) comprised of a series of dual Intel i860/Motorola DSP56000 cards and a real-time scheduling kernel.

The Musical Situations

▪ Psychoacoustics and room acoustics:

In the first situation, audio techniques applicable to virtual reality are explored. The visitor travels in virtual spaces by moving the mouse around an architectural plan. S/he can choose between the sounds of footsteps, a looping melodic pattern, or his/her own voice, to hear a real time simulation of acoustical changes as s/he navigates through the space.

The psychoacoustics situations help the visitor to learn about streaming and spectral fusion/fission. In audio streaming, the perception of a loop of notes with equal durations and single pitch can be altered by changing the nuance (amplitude) of selected notes. Human perceptual processes group the notes according to their nuances. This results in transformations of perceived rhythm, while the actual physical rhythm is still one of equal spacing and duration. In the situation about fusion or fission of sound spectra, one single sonic object explodes in two discreet sounds by controlling different vibrato on even and odd frequency domain partials.

▪ Signal processing, sound synthesis, and transformation:

The DSP situations give examples of real-time sonic transformations and draw parallels with similar effects in the graphics domain. One situation shows the effect of time stretching or expansion, on either pre-recorded sounds or on the visitor's voice. The source material can be transposed without altering the timbre or can be either shortened or lengthened in time without changing its pitch. Textural effects based on the visitor's voice can be achieved by layering several of these transformations.

A dramatic audio process that has a close parallel to computer graphics techniques is timbral interpolation, the computer music equivalent of morphing. Gradual or rapid shifts of spectral content from one sound to another can be realized, all under interactive control of the visitor. For example, the visitor can record his/her own voice, and have the computer interpolate between it and a trumpet sound. The visitor is also able to select two sounds from a menu to hear timbral interpolations between them.

▪ Composition and musical structure manipulation:

Finally a compositional situation invites the visitor to learn how these computer processes can be applied at a macro-structural level. S/he can input a theme upon which an automatic improvisation is generated. The visitor exercises parametric control over the thematic development. Possible transformations are orchestration, rhythmic changes, and melodic variation. The micro-level audio effects from the other examples above can be applied here by the user, to create his/her own "piece."

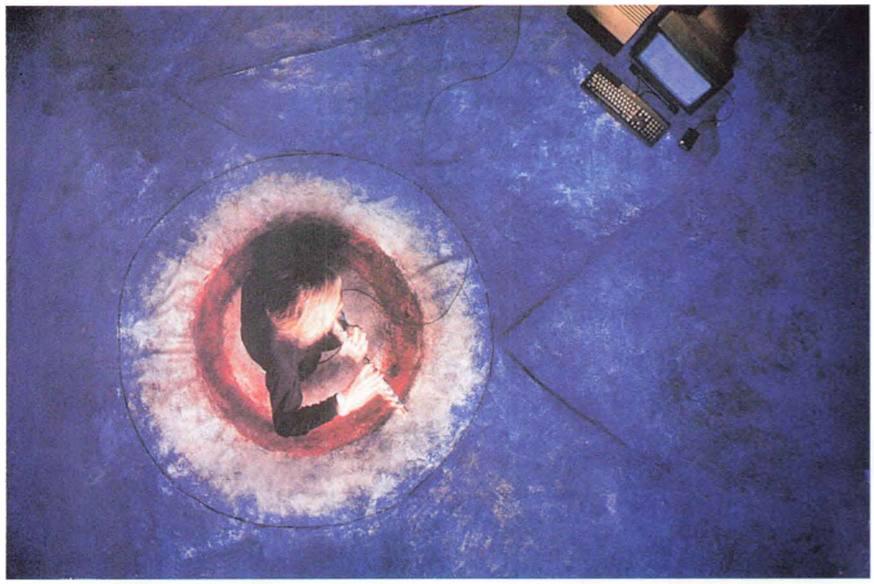
Concepts introduced above can also be applied at this level. The visitor can apply the notion of interpolation to rhythm or melody. One rhythmic pattern can be given as a point of departure and another as a destination, and the computer will repeat the first pattern as it gradually transforms into the second one. Finally all interpolations, micro and macro, can be combined to make a super-interpolation on multiple dimensions.

Interactive Tour of IRCAM

A second computer is set up in the exhibit, running a multimedia tour that introduces visitors to IRCAM. The visitor takes a tour of the building, and by entering each department, learns about the different research projects ongoing at IRCAM. Finally, as the visitor enters the Espace de Projection, our concert hall, s/he is able to audition excerpts from various musical pieces composed at IRCAM.

Conclusion

This exhibit demonstrates interactivity and virtual reality in the audio domain by providing examples that are themselves interactive. By exploring areas such as psychoacoutics interactively, the visitor learns by actually applying his/her own perceptual processes. This kind of user involvement, we feel, stimulates the learning process, and helps the visitor to grasp in a humanistic way subjects that are otherwise complex and technical.



The interactive form of presentation is particularly apt to present the work of IRCAM, because the research is in fact carried out exploiting the same techniques used to create the presentation. The visitor, then, shares in the exploration process. Instead of just reading about it, s/he is able to actively participate and make discoveries using the same tools we use at IRCAM.

Finally, by presenting those signal processing techniques that have interesting parallels in computer graphics, we hope to provide the visitor a familiar handle by which s/he can explore musical applications of computer technology. By presenting our work at SIGGRAPH, we hope to introduce the computer graphics community to new developments in computer music, and to provoke discussion about how our respective disciplines might come closer together.

Hardware

- Apple Macintosh Quadra 950
- 16" RGB display, RasterOps and Digidesign cards
- Apple Macintosh IIci w/16" RGB display
- NeXTcube 040 computer
- Ariel IRCAM Signal Processing Workstation (ISPW)

Software

- IRCAM NeXT Max
- Opcode/IRCAM Macintosh Max
- Macromind Director

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Thanks To

- Espaces Nouveaux

ITeN:
Egypt Prototype Program

LYNN HOLDEN

Carnegie Mellon University

New multimedia technologies and computer systems now allow the design and development of multi-disciplinary learning environments that can enhance knowledge retention and enjoyment for undergraduate students in classrooms, studios, and labs.

The Ancient Egypt Prototype program of the ITeN Project will develop new interactive learning environments based on using interdisciplinary knowledge sources, especially artworks in the broadest sense, to provide unified and integrated learning experiences about human culture, its meaning, and its evolution.

The Egypt program will be a powerful learning application, providing a broad range of in-depth materials organized in a flexible matrix, which can be used both by students doing research and instructors preparing presentations or doing research. There will also be developed sample materials for electronic publishing, which will go beyond what is possible with ordinary printed media or linear video formats.

The Egypt program will explore and address the pedagogical issues and problems of interactive-multi-disciplinary learning that include:

- Instructional system design for computer-aided instruction.
- Linking structures in hypermedia systems.
- Instructional utilization of computer-driven videodisk systems.
- Recontextualization of widely separated artworks.
- Exploration of multi-sensory learning environments.

This proposal gives a brief overview of the intentions, issues and opportunities, present state, and developmental stages for completing the Egypt program of the larger project, which would encompass a series of related programs offering knowledge synthesis for at least 15 central cultures within human history: Africa, Americas, Australasia, Byzantium, China, Egypt, Europe, Greece, India, Indonesia, Japan, Korea, Rome

The objectives of this project are to develop and apply within a curriculum the prototype program for interdisciplinary learning. This program would consider the needs of Carnegie Mellon University's undergraduate students and incorporate original approaches to learning about human culture through artistic creations.

The approaches taken include interrelating elements of different knowledge sources across different media and disciplines, which are then related to universal themes common to all historic cultures. Focus is on the purpose and meaning of art forms as a reflection of traditional cultural aspirations. Interactivity permits multiple accesses to the knowledge sources, relative to the areas of interest and perspectives of the user. Pathways can be taken that follow broad thematic sequences across disciplines and media, or within disciplines, though depth sequences leading to specific study areas. Particular subjects can also be directly accessed through a subject-theme index.

It is intended to offer any interested user a flexible, aesthetic, stimulating learning environment with the highest possible quality of individualized educational experience.

With sufficient support it is possible to complete the prototype program in about one to one-and-a-half years assem-

Hardware

- Apple Macintosh Quadra 700
- 13" color monitor
- Spigot digital video card
- Videodisc player Pioneer LDV-4200
- 13" Sony monitor

Software

- Spinnaker Plus
- Adobe Photoshop
- Macromind Director
- Quick-time Movies

bling all the essential materials necessary for an elementary comprehension of ancient Egyptian art and culture.

Necessary support includes: video source 60-minute videodisk, image source 240-1000 slide images, text source 100-250 essential pages, graphics source 100 plans—drawings, audio source 1-2 hours commentaries also music-drama performances, Animations to revivify ancient scenes. Learning reinforcement—task or game; use assessment system: printout—copy-to-disk capability as possible within existing levels of technology.

The materials will be organized to permit adaptation to museum and library environments, as well as home learning and business applications. The methods of this project will focus on completing the hypermedia prototype on the art and culture of ancient Egypt. The knowledge materials are to be organized in a HyperCard-like computer environment that permits linking of program segments in many different ways. The interface design of the program reflects the ancient Egyptian aesthetic, so that even though you are in a modern computer, your senses will better accommodate the artworks being encountered.

The first half of the project development will be focused on creating the working core of video and still images, text, and graphics, and addressing design issues. The program will use original materials, as much as possible, to avoid copyright charges and problems. This will, however, require at least one field trip to complete the gathering of necessary materials, to complement existing resources. The positive side of this is that we are able to create a blend of knowledge materials that have never before been available.

The second half of the project will develop the indigenous learning catalysts and synthesis visual essays, as well as the learning reinforcement task/game, the use assessment system and the printout and floppy-copy capabilities.

The development of this program depends on the creativity of the team members and their ability to perform multiple tasks. The needed team members are: project director, full-time; design input, half-time; image and text input and edit, half-time; programmer, half-time; external consultant, half-time; video production, quarter time; administration, quarter time; student assistants, two, at a quarter time each.

The scope of this project is to focus on producing a complete working program that can be applied to the educational curriculum at the undergraduate level, providing a measurable improvement in the quality and retention of learning about the nature and history of human culture.

The present state of the prototype program is that a specific group of related sample learning segments have been created focusing on the language, science and technology, and design and architecture of ancient Egypt. There is also a reference (text-based) section and a videodisk section offering ten five-to six-minute documentary-style scripted video presentations.

Each section offers an integrated mix of images and text moving through a depth sequence of three to eight screens, presenting eight to 12 study images and from ten to 25 minutes of informational text. System icons together with object and text hyper links inter-relate materials from different disciplines and key information about people, places, ideas, objects, and events.

The existing materials are only a sample to show the possibilities using off-the-shelf technologies, whereas the larger program will have much greater breadth and depth of materials and experiences.

Essential areas to be explored include recontextualizing dispersed artworks using computer reconstructed monuments, animations of ancient reliefs and wall paintings, use assessment systems, learning reinforcement systems, and copy and printout capabilities for students to create presentations or documents.

The use assessment and learning reinforcement elements would involve adapting existing intelligent systems and developing new components to catalyze the higher learning processes and strengthen learning retention, as well as to improve the attention holding capability of the program.

The ideal working group for the development of this project would be a consortium of our educational institution (research and application to curriculum), an educational foundation (providing support), private companies (developing technologies and products), and public institutions (museums, libraries, public schools).

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The Exquisite Mechanism of Shivers

BILL SEAMAN

The College of Fine Arts

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The Exquisite Mechanism of Shivers is an interactive videodisk installation that combines poetic text fragments, modular music segments and image sequences. The work incorporates a videodisk and computer to facilitate the combination and recombination of a set of specific word/image/sound modules. Each module is presented as a word (or words) superimposed over a related visual image, accompanied by a musical fragment. A linear video, 28 minutes in duration and edited to an audio recording consisting of 33 short musical "movements," forms the foundation of the work. Each of the 33 sections presents a sentence comprised of 10 sentence fragments. I composed the music, read the text, and played all of the instruments (synthesizers and samplers) except the cello, which was played by Suhanya Raffael. The music was constructed on an SSL computer-controlled analog mixing desk.

The installation functions in the following manner. The viewer can select "Words" from a poetic text on a Macintosh menu generated with HyperCard 2.1 and the Voyager Press VideoStack. This is facilitated by scrolling through the Voyager Press VideoStack, through ten lists of word variables. There are 33 word (or short phrase) variables for each of the ten slots in the sentence. These words/phrases function as modular linguistic sentence fragments in a preconceived sentence template. The viewer uses a mouse to select these words on a Macintosh menu and subsequently triggers corresponding images, words, and sounds housed on a videodisk. The computer facilitates the instantaneous substitution of work/image/sound segments within the sentence template structure as derived through viewer choice. Thus the viewer experiences the active navigation of a series of changing poetic audio/visual sentences. The work explores pluralistic meaning through the presentation of material in numerous alternate contexts. A catalog of work/image relations is presented, exploring a variety of linguistic possibilities. Humor, literalisms, visual puns, work/image/sound play, modular musical composition, 'canned chance,' sense/nonsense, and a variety of other relations are explored. The viewer takes an active role in the construction of meaning by forming a personal connection between each word and image, as well as through associations that arise during navigation of the sentences.

HyperCard menus allow the viewer to watch for as long as they wish, exploring the material at their own rate. The participant is presented with a series of options through various linked menus. They are able to explore the linear material as one option, a selection of linguistic variables from the template structure as another option, various sentences that they build through their selection process as a third option, and image/sound/language poetry that (if selected) is generated by the computer. This semi-random poetry is generated by having the computer randomly select one choice from each stack of specific sentence function variables, making sure to maintain the proper order, to derive new sentences. These word/image/sound modules are called up from a videodisk using sets of random numbers tied to specific locations (segments) on the disk (one set for each segment's function in the sentence). The computer facilitates the instantaneous search and play of the appropriate text/image/sound fragments on the videodisk, maintaining the correct sentence syntax. In this mode the work functions as an automatic poem generator.

A non-interactive installation has also been constructed using the linear version of the image/sound modules. Video wall technology has been used to position the words in sentence format, across ten monitors presented side-by-side. The video wall displays the sentence one module at a time while the linear soundtrack plays. After each motion segment plays on a particular monitor, the system grabs the last frame and holds the five word/phrases, then the next monitor is activated playing the next word/phrase, and so on through the piece. After ten segments, the next sentence will begin from the first monitor, replacing one segment at a time until all 330 segments have been played. At this point the process transparently starts over.

Hardware

- Mac IIfx w/ hard disk including Mac 13" monitor, System 7
- Mixer w/effect send and equalizer
- 1 reverb: Alessis Midi Pro-verb
- Amplifier, Cables, 2 speakers
- 1 Sony Superbright video projector
- 1 constructed Kiosk
- PAL disc player: Sony LDP 1500P

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- Music produced by Seaman in conjunction with the Listening Room, ABC Radio Sydney

KA-O-RI

KEN ANJYO

Hitachi Ltd

The interactive computer graphics theater offers a challenging trial for making future play or drama both exciting and interactive through real-time 3D computer graphics. It is the collaborative project of Hitachi Ltd. and Fuji Television Network Inc.

KA-O-RI is the name of a virtual actress appearing on a monitor screen in a presented play. The texture data of KA-O-RI's face were based on the photographs of an actual person and were mapped onto the polygonal face model. Then her face was arranged so that it looks more realistic and of high quality.

The virtual actress "plays" according to the scenario, whereas she is practically manipulated by an actual actress and a few operators. In the demonstration the real actress talks, her voice reaching the audience by microphone. Using the originally developed lip-synchronizer, the movements of her lips are then translated into those of KA-O-RI's lips. Some of KA-O-RI's facial expressions—such as smiling, perplexed, and funny faces—were typically made in advance. Then, according to the story, an operator selects the typical facial expressions using the dial button box, each button of which corresponds to one of the typical facial expressions. The algorithms for real-time facial animations were newly developed and are used in generating and interpolating these emotional movements. Eye contact or movements of head are also controlled by an operator.

The first performances of "KA-O-RI" were made in Tokyo during 11 to 14 March of this year. The original play was then 100 minutes long, whereas the SIGGRAPH 93 version is rather shortened.

The impact of this trial will emerge as the interaction between actual persons and the virtual actress of high quality, which has never been experienced. The trial will demonstrate the great potentials of virtual actors in a future play or entertainment. It should also be noted that this is the result of interaction between the state-of-the-art software and hardware technologies.

Hardware
SGI Onyx
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Software
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Mandala:
Virtual Village

VINCENT JOHN VINCENT

The Vivid Group

The Mandala system, produced by the Vivid Group of Toronto has established a unique position in the virtual reality/multimedia field since its release in 1989. Using a camera-based interface, the system allows the user to interact with graphic images within video worlds, completely unencumbered by goggles, gloves, or other tracking devices. Through "video gesture" the user can manipulate animated graphics to trigger various events—graphic, gravitational, audio, or sequenced. The Mandala system is presently being used by corporate and private clients around the globe, in applications ranging from performance and presentation to education and communications.

The Mandala Virtual Village is an urban design application allowing two locations to mutually plan the development of a 360° panoramic virtual environment. It is based on an existing multimedia learning resource kit developed for an international cultural exchange project between junior high and secondary school students in Canada, the U.S., and Italy.

This exhibit has been adapted for the tomorrow's realities gallery at SIGGRAPH 93 from the "Virtual Cities" regional discovery project, which is an integrated multimedia learning program produced by the National Film Board of Canada in collaboration with The Vivid Group. Designed to provide young people with the means to explore the elements of their urban environments with their peers from other countries, the program linked three international classrooms to exchange multimedia data including still and motion pictures of their environments. These images were ultimately used when the students linked-up in a "video conference" via satellite, to plan their ideal urban environments together.

The Virtual Cities project was designed to establish a network of young people in a number of countries to investigate the environmental and social effects of accelerating urbanization, and the need to develop strategies for sustainable cities that include the concerns of local populations.

The Mandala Virtual Village allows two remote sites in the SIGGRAPH 93 tomorrow's realities gallery to link up in a virtual world where the participants can plan the development of a 360° panoramic environment together, through the placement of 24-bit full color graphic images. Another challenge the users face is the "greening" of a virtual desert.

Hardware

- 2 video projection systems (suggested Sony VPH-1042Q)
- 2 minimum 26" monitors (33" preferred)
- NTSC output

or...

- 4 minimum 26" monitors (33" preferred) NTSC output
- Mandala VR system and software to be provided by The Vivid Group

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Mandala:
Virtual Cities

JULIE STANFEL

National Film Board Of Canada

The National Film Board of Canada and the Vivid Group, a Toronto-based company involved in the development of virtual reality systems, are collaborating to produce "Virtual Cities," a series that explores urban environments and the design of "green" cities. The "Virtual Cities" project will establish a network of young people in a number of countries to investigate the environmental and social effects of accelerating urbanization, and the need to develop strategies for sustainable cities that include the concerns of local populations. The computer-human interface will allow students to step into and control virtual worlds of their urban environments.

The study of an urban environment provides perspectives and information to assist in the development of understanding one's sense of place in a larger community, as well as developing a sense of what that community entails; heart, home, our relationship to the land, and our interdependence with other peoples of the world. Students are then better equipped to make informed decisions about changes that will occur in their urban centers through time, enabling them to assist in the construction of habitable spaces that consider human physical and mental well-being, other living species, the environment, and the cultural legacy of the world's distinctive, multiethnic population.

Virtual Cities will provide junior high school students with opportunities to work together to design the cities in which they want to live, enabling them to visualize and document their findings and share them with young people in their own communities, and around the world.

The Mandala system provides students with opportunities to interact with graphic images within video worlds without the use of goggles, gloves, or other tracking devices. Through "video gesture," students manipulate animated graphics to trigger various graphic, gravitational, audio, or sequenced events. Standing in front of large television screens, students submerge their full bodies into a computer world via the video camera and manipulate various elements drawn from their urban experience.

By exploring the elements of their own urban environments and then defining with their peers from other countries the parameters of habitable urban spaces, the interdependence of urbanization issues at the global level unfolds.

By linking young people in separate parts of the world through the use of existing telecommunications systems (i.e., satellite transmission and fiber optic networks), students are able to interact with one another in a common virtual reality to design the cities of the future—together.

Interactive technologies revive the old idea of "the common"—land that was jointly owned or used by an entire community. Ideas and information, when jointly used in an interactive setting, assist in successful problem-solving. "Virtual Cities" will provide an information common where groups of students can meet to explore urban issues together to design their common future.

"We don't want only to reflect reality, we should shape it. We should not only adapt to the future, but configure it and make a better choice between futures."

— Federico Mayor,
Director General, UNESCO,
Interact Conference, Geneva 1988

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"The study of an urban environment provides perspectives and information to assist in the development of understanding one's sense of place in a larger community, as well as developing a sense of what that community entails; heart, home, our relationship to the land, and our interdependence with other peoples of the world."

MATRIX:
Women Networking

ANNA COUEY

Arts Wire

Matrix is an ancient word that has many meanings. The archaic meaning of matrix is womb. In *Neuromancer*, William Gibson's book about cyberspace, matrix is used synonymously with computer network. Combining the ancient and modern meanings matrix can be seen as a net and a vessel—malleable, capable of containing, yet at the same time flexible—with the ability to grow and change in shape. In other words a matrix can be seen as a nurturing, flexible, and creative environment where change and growth are possible within the web of the matrix itself.

The matrix of computer networks now spans seven continents. Though still in a raw form and even today accessible to a minority of the world's population, the matrix portends a potential revolution in the structuring of our societies. Unlike previous forms of mass communication, computer networks provide both a public and participatory forum for communication—a potential paradigm shift from a few to many, to a many-to-many communications structure. The impact of such a construct to our conceptions of identity, culture, education, and community is as yet largely unknown; it will depend on the vision of those who use it, as Roy Ascott aptly noted (*Art + Telecommunication*, 1983):

"The creative use of networks makes them organisms. The work is never in a state of completion, how could it be so? Telematique is a decentralizing medium; its metaphor is that of a web or net in which there is no center, or hierarchy, no top nor bottom. It breaks the boundaries not only of the insular individual but of institutions, territories and time zones. To engage in telematic communication is to be at once everyone and nowhere. In this it is subversive. It subverts the idea of authorship of the works of imagination. It replaces the bricks and mortar of institutions of culture and learning with an invisible college and a floating museum the reach of which is always expanding to include new possibilities of mind and new intimations of reality."

Whether the matrix develops as Ascott envisions or simply recreates the values and practices of global acculturalization may still be up for grabs, but not for long. Civil rights have not yet been clearly defined in legal terms, but law enforcement representatives, computer professionals, and civil libertarians are tussling over turf. Varying levels of access to technology across the world, and even within post-industrial countries, are serving to limit participation in the matrix. Interface and economics further enforce the use of this decentralized communications medium to those with a high level of technical skills and western literacy. In the U.S., budding commercialization and pure survivability bode ill for the ethic that "information wants to be free" and raise serious issues about the future development of the "information age."

The level of technology governing the matrix of worldwide computer networks is determined not so much by the technological capabilities of discrete systems, but by connectivity, the standards of interoperability among diverse systems, and the bandwidth to connect them. The capability to read text across platforms (ASCII) has been standard for quite a long time in network terms; likewise graphics transmission standards also exist (GIFF, TIFF, JPG), though are not yet ideal. Current technological challenges are the ability to seamlessly exchange images, video, and audio across platforms—without requiring users to have specialty software to decode transmissions. This work has taken two tracks—the high end requiring tremendous bandwidth and resources and the low end focusing on currently available bandwidth and working toward general availability. Matrix: Women Networking will demonstrate low-end developments, such as NAPLPS, a standard that allows for the online display of graphics files that take up very small amounts of disk space and are configurable downward to the end user's system. Similarly, in terms of connectivity, Matrix will highlight systems and projects that are readily available to anyone with a computer and modem—whether they be in rural or urban locations. In order to ensure the broadest access possible, most of the projects in Matrix are text-based, and employ interactivity as a means of directly engaging the public in the creative process. Our goal in focusing on the low end is to call attention to the technological disparities that exist in our society, and to raise questions about their impact. We hope to expand the concept of technological advances to include their social and cultural underpinnings and affects.

Matrix as an online cultural event utilizing computer networks will involve SIGGRAPH participants in interactive works of electronic literature, computer graphics, games using incription and virtual performance. Matrix features works by women of differing cultures and artistic backgrounds who are working with computer networks as a means of creating collaborative works with artists and non-artists alike, to decentralize the creative process, to educate about and preserve their distinct cultures and communities, and to provide online access to population groups who would otherwise be the have-nots of the information age. The work of the participating artists is grounded in the inclusive art process and distribution. It involves community building, economic development, and equitable and open participation in the evolution of the matrix. In these projects art is at once a mechanism of cultural exchange and a means of education and historification of cultural identities through technological communications media.

Like the network itself, the Matrix events are generally loosely defined more as potential rather than clearly defined events. The artists assume that once these ideas are seeded on the network they take on a life of their own, guided by all those on the network who wish to participate.

Four of the artists will be exploring text-based interactive online projects. For example, Lisa Cooley, a poet and activist for women's rights, freedom of expression, and government-funded art will be organizing and experimenting with the concept of doing an online poetry slam. Anna Couey, a telecommunications artist who works with computer networks as a means to engendering new cultural and social constructs, will be facilitating a virtual panel. Judy Malloy is a pop-conceptual artist whose recent works employ computer programming and computer networking systems to explore information, memory, and collaborative production. Her project will involve the collaborative creation of an encryption art work. Aida Mancillas is a book artist, painter and writer. Her projects involve art, technology, and multicultural education and community work. Mancillas, as a Chicana artist living in the border city of San Diego, is using computer networks as a way of allowing immigrants to tell each other their own stories.

The two other artists will be exploring graphics on the network. Lucia Grossberger Morales is an interactive computer artist who addresses multicultural and multilingual issues. Morales will be creating simple chained animations that people on the matrix can collaboratively work on and add to. Because of the nature of the matrix, the piece will never be finished and will always be available for people to add to the piece. Lorri Ann Two Bulls, an Oglala Sioux artist, lives in an isolated city in South Dakota. The community doesn't have enough people to support an artist, so Lorri creates images of her artwork and puts them on the network, which broadens her potential buying audiences, and brings native art to communities that wouldn't otherwise be exposed to it.

Hardware

- 2 PCs, each equipped with 40 Mbytes hard drive minimum, a 3.5" floppy drive, with modem & printer cables, VGA output capability, mouse and DOS operating system.
- 2 Hayes compatible 9600 baud modems
- 1 color/b&w laser printer
- 1 MAC, 40 Mbytes hard drive minimum, with modem and printer cables, and operating system.
- 3 Phone Lines.

Software

- NAPLPS software for MAC and PC
- Qmodem software for PCs
- Microphone software for MAC

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- Lorri Ann Two Bulls (Oglala Sioux) uses computer networks as a way of distributing her work from rural South Dakota. She works in NAPLPS and in traditional media to represent her culture and experience. Her NAPLPS graphics are distributed online as "shareart" and also serve as a marketing mechanism for prints.

The Mohawk:
A New Concept in Architectural Representation

AUREA DE SOUZA

ACME Design

The goal of computers in design is becoming more the enhancement of the design process and less the simple documentation of decisions. Most architects, though, are not following this revolution: they are using computers as drafting systems, only for the production of traditional drawings, with no change in the design or representation process. Architects haven't started thinking with the computer: instead, they are designing first and then trying to adapt it to the existing software. In order to become successful with computers, architects will have to reconsider their fundamental notions on how to approach a project, solve, and present it.

The Mohawk project differs from the traditional architectural representation methods. It makes use of hypermedia to display different kinds of information that, when put together, assume a complex result that is impossible to achieve by any media other than the computer.

The project consists of an interactive multimedia installation that combines architectural design, different computer systems, 2D and 3D techniques, interface design, and videodisk technology. It explores the newest technology available in computer graphics focusing on architecture: how the architect realizes the design and the way this process is presented to the client. It demonstrates how one can experience a space before it is actually built without having to "read" and visualize plans and elevations. It also helps clients understand the design in a deeper way by showing elements other than traditional drawings, like history and renovation details of a building. Exploring all this information on their own, clients feel they are part of it and become much more involved in the project.

The project is separated into three modes:

- Walk-through: One can approach the hotel building from the square located right in front of it, enter the hotel, explore the lobby and take the elevator and get into one of the guest's suites, being able to choose where to go and where to look at.
- History: In this mode the user is able to see a video that shows the building as it is today, both inside and outside. At the same time there is a narration of what is being shown on the screen, together with information on the building's history.
- Restoration: This mode allows the user to see a slide show that compares photographs of the destroyed building's details today with computer-generated images of how they were originally built, always focusing on the elements that have been badly restored.

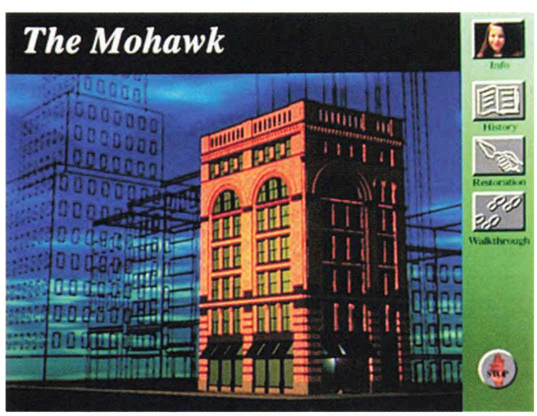
The Design Concept

The concept for the design of the Mohawk is the building's location in relation to the grid in which the streets of New York City fit: for midtown and uptown, such a grid is very regular, with streets and avenues forming perfect squares. As we approach downtown, it starts changing its shape, looses parallelism, and starts going in every direction.

The building's site plan well illustrates the downtown's loss of grid. Because of its location (on the corner of Hudson Street and Duane Street, which are not perpendicular), the building assumes a trapezoidal shape instead of a rectangular one. To emphasize this shape even more, the design lines were kept parallel to both facades, creating a very dynamic space.

Technical Notes

The animation of the building was done on a Silicon Graphics computer, using Alias 3.1 software. Because of the amount of data involved, the lighting is mostly fake by coloring polygon faces in different tones. The animation was transferred to a videodisk, together with live video footage. This videodisk is accessed by HyperCard external commands. Because of its capabilities, it can be played back and forth, giving the user a sensa



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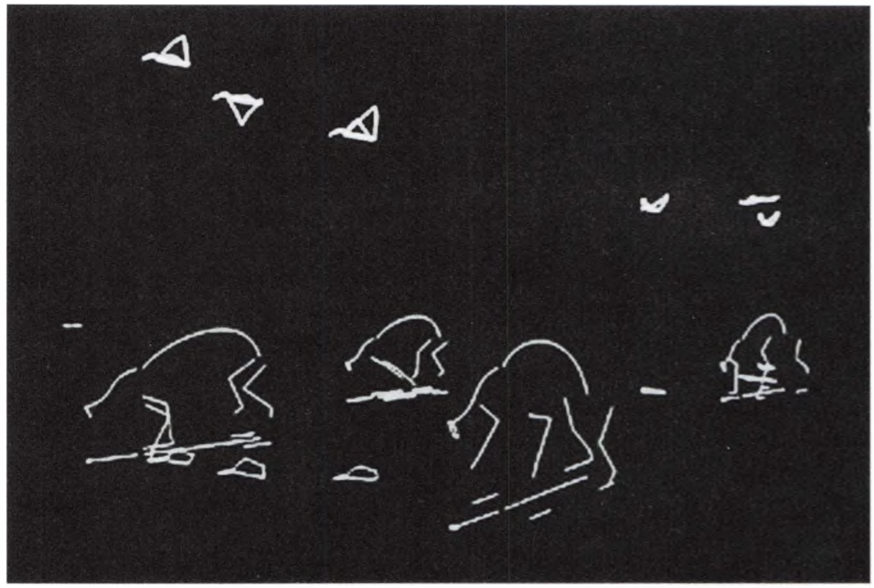
Menagerie



SCOTT S. FISHER

Telepresence Research, Inc.

Beyond Simulation: Telepresence and Virtual Reality

Telepresence and virtual reality (VR) are terms used to describe technology that enables people to feel as if they are actually present in a different place or time. Other names include "cyberspace," "tele-existence," and "tele-symbiosis." The current state of telepresence technology has evolved from a rich multidisciplinary background of developments in many different fields and for a wide spectrum of applications. In particular, the steady increase in knowledge describing how humans sense, process, and act on information about the world around them has in turn led to the development of technologies that can provide a rudimentary but adequate sense of presence in a synthetic or remotely sensed environment. As this convergence of disciplines evolves, the experiences and applications possible through telepresence will become more and more compelling.

Designing Virtual Experiences

Telepresence is a medium. Two definitions of the term "medium" are appropriate in this context: 1) a channel or system of communication, information, or entertainment, and 2) material or technical means of artistic expression. Examples of other media that meet these definitions are painting, sculpture, film, television, and personal computers. A key feature of a medium is that it can be employed to represent a variety of different kinds of content. The television medium, for instance, supports diverse content and forms, including drama, documentary, news programming, sports, and advertising.

Today, the medium of telepresence is in its infancy. In most laboratories and institutions where people are working with telepresence, the emphasis is still on technology and engineering. A rudimentary language of telepresence is beginning to emerge, and people are beginning to envision a variety of applications. These ideas are beginning to influence the direction of technological development by suggesting new performance criteria. They are also giving birth to methodologies and tools for the design of telepresence experiences. The technologies developed so far provide the capabilities to give people a sense of presence in a wide variety of worlds, with compelling sensory richness.

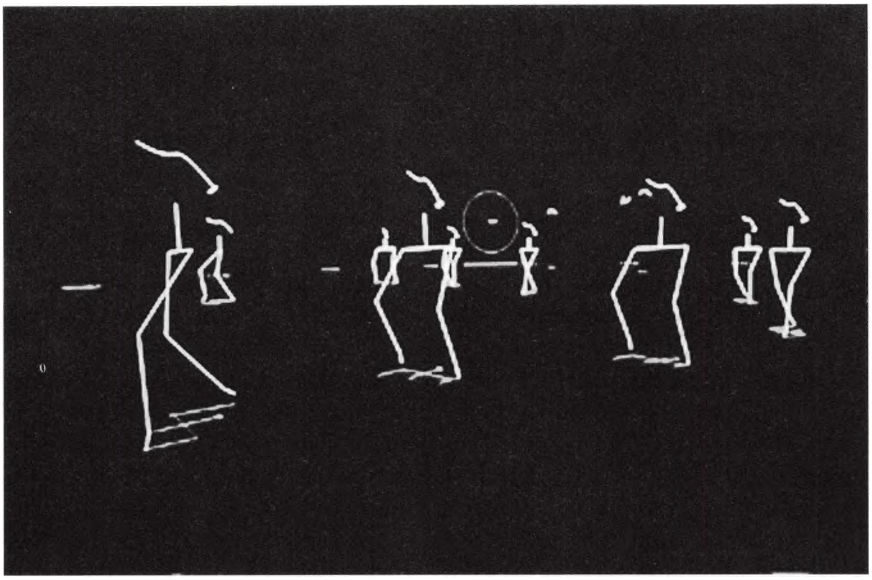
But it is not the hardware that people might use that will determine whether telepresence becomes a powerful and popular medium—instead, it will be the experiences that they are able to have that will drive its acceptance and growth. The central challenge for telepresence remains: What do you do when you get there? What actually occurs in a virtual world? What kinds of actions can a user take there? How does the world respond to what someone does in it? What kinds of things might happen? and What makes and keeps a virtual world interesting? These are issues of experience design. Exploring the boundaries of these issues will launch this new medium far beyond its origins in photo-realistic computer graphics and traditional simulation.

Menagerie: A Virtual Experience by Michael Girard and Susan Amkraut

The goal of this effort is to demonstrate one of the first fully immersive virtual environment installations that is inhabited by virtual characters and presences especially designed to respond to and interact with its users. This experience allows a visitor to become visually and aurally immersed in a 3D computer-generated environment that is inhabited by many virtual animals. The animals enter and exit the space through portholes and doors that materialize and dematerialize around the viewer. As a user explores the virtual space, s/he will encounter several species of computer-generated animals, birds, and insects that move about independently and interactively respond to the user's presence in various ways.

For example, if the user moves towards a group of birds gathered on the ground, they might take off and swirl around the user with realistic flocking behavior, fly off into the distance, and return to the ground in another location. Several four-legged animals will approach the user with different gaits and behavioral reactions. The visitor might also turn toward the 3D localized sound of other animals as they follow from behind.

The hardware configuration of this installation includes a head-coupled, stereoscopic color viewer that is comfortably



used like a pair of very wide-angle binoculars looking into the virtual space (Fakespace "BOOM-2C Viewer"). Realistic, 3D localized sound cues are linked to characters and events in the virtual space by means of special DSP hardware (Crystal River Engineering "Beachtron"). And the virtual environment and characters surrounding the user are generated by a high-performance, real-time computer graphics platform (Silicon Graphics "Reality Engine").

Following is a description of the artists' objectives and algorithms:

"We know how an animal moves, not just what it looks like. In our computer simulations of 'virtual' animals, the geometric representations are deliberately designed to be simple in order to emphasize the motion of the animals, rather than the details of their appearance. For us, the essential expression is in the abstraction of the motion and what it suggests to the imagination of the viewer.

"The motion of the animals is modeled with computer programs that simulate the physical qualities of movement. Many of the techniques employed are inspired by the robotics field. Legged animals respond to simulated gravity as they walk and run in various gaits. They are able to spontaneously plan footholds on the ground so that they appear to be dynamically balanced. Birds and other flying creatures accelerate when flapping their wings and bank realistically into turns. Flocking and herding algorithms direct the patterns of flow for large groups of animals.

"All animals maintain a degree of autonomy as they adaptively alter their motion in response to their surroundings, avoiding collisions with both other animals and the virtual environment user. Animals may follow general goals, such as "walk along any path from door X to door Y" or "fly toward region Z and land on any unoccupied spot on the ground." However, their precise movements are unpredictable since they depend on the constantly shifting circumstances of interaction between each of the animals and the user."

Supported by Magic Box Productions, Inc., including the contribution of "Virtual Clay" modeling software. Additional support from Fakespace, Inc. and Crystal River Engineering, Inc.

Graphics System
- Silicon Graphics, Inc.
- CRIMSON/Reality Engine system
- Silicon Graphics CRIMSON/Reality Engine system with:
- 2 Raster Managers

Software Development Option
- 1/4" tape drive
- 64M memory
- 380 Mbytes disk

Display System
- Fakespace, Inc.
- BOOM 2C

3D Sound System
- Crystal River Engineering, Inc.
- Beachtron cards
- 486 PC and Monitor
- Headphones
- Headphone Amp

Video Projector
- (SONY, Barco, etc.) to display virtual world and user interaction for those waiting and/or observing.

Software
- Michael Girard/Susan Amkraut: Custom Simulation Software
- Fakespace, Inc.: BOOM Software VLIB-SGI
- Crystal River Engineering, Inc.: Beachtron Software

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- Mark Trayle: Sound Design and Software Development

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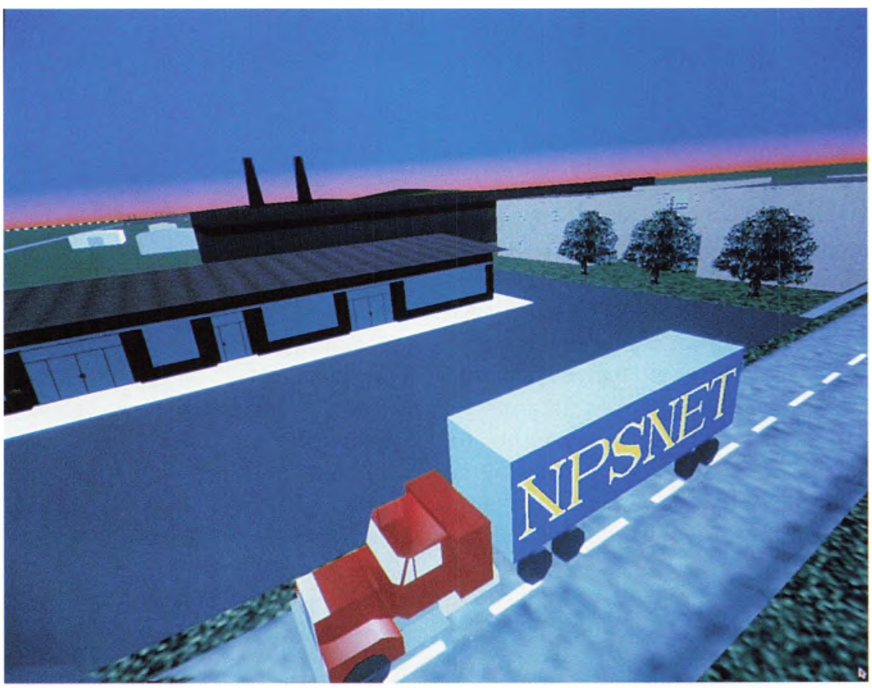
- Ron Fischer, Hirofumi Ito, Mark Bolas, Ian MacDowall, and Scott Foster.

NPSNET and AFIT-HOTAS:
Interconnecting Heterogeneously Developed Virtual Environments

DAVID R. PRATT

Naval Postgraduate School

This joint Naval Postgraduate School (NPS)/Air Force Institute of Technology (AFIT) demonstration shows two separately developed virtual environments interoperating using a common communications protocol, a common terrain/model/agent database, and multiple user interaction paradigms. NPSNET has been developed at the Naval Postgraduate School as a real-time, workstation-based, 3D visual simulation system capable of displaying vehicle movement over the ground or in the air utilizing Distributive Interactive Simulation (DIS) networking protocols. The Air Force Institute of Technology has been conducting research in various applications of head-worn display devices in support of immersive virtual environments. Specific applications include operating an air vehicle and independently viewing the virtual environment from any viewpoint. This exhibit shows the interconnection of these heterogeneous projects and consists of six networked nodes.



Hardware
- One Boom
- One HMD
- One LCD shutter glasses
- One Spaceball
- One Ascension Bird
- One Throttle/Stick
- MIDI Sampler
- Four Speakers w/wire
- Ethernet system
- Four Silicon Graphics IRIS 4D Reality Engines w/64Mb, 4.0.5F Development DAT drive or 150Mb cartridge tape drive
- Two IRIS Indigo Elan 4000 w/32Mb, 4.0.5F Devepment System, C++ compiler version 3.0 and either DAT drive or 150Mb cartridge tape drive
- Four 1.2 Gig disks, one each for the four Reality Engines
- Two 435Mb disks, one each for the Indigo Elans
- One 70 inch color monitor (or projection system) w/cables and encoder/decoder for hookup to Reality Engine
- Two color repeater monitors for Reality Engines w/cables

Conference attendees see and interact with three other attendees and numerous autonomous agents in a shared virtual environment. Each of the first four user nodes interact using a different paradigm: BOOM with buttons, Head Mounted Display (HMD) with throttle/stick/buttons, LCD shutter glasses with Ascension Bird/buttons, and Out The Window (OTW) on a workstation monitor with Spaceball. Attendees can also view other attendees using these interaction paradigms and see the virtual world view via monitors. Attendees are able to see the social and cultural implications of interacting in a shared virtual world populated not only with intelligent users but also autonomous agents while using multiple interaction (view and input) paradigms. They are able to see and experience the strengths and weaknesses of the different paradigms. In addition, the virtual world being experienced by the BOOM user is visible on a large-screen projection system and heard from speakers spaced throughout the exhibit area.

Each station is able to interact with other stations on the network using DIS protocols. The terrain is a custom design 25km x 25km complete with models. Each quadrant of the terrain contains a separate theme: mountain area, farmland, town with small airport complex, and wooded area with lake.

At the BOOM node, a Fake Space Systems BOOM2C-C high-resolution monochrome display is used to view the environment. The viewpoint can be attached to a participant's location or interactively controlled by pointing the BOOM and using the buttons to move about. Weapons firing is via buttons.

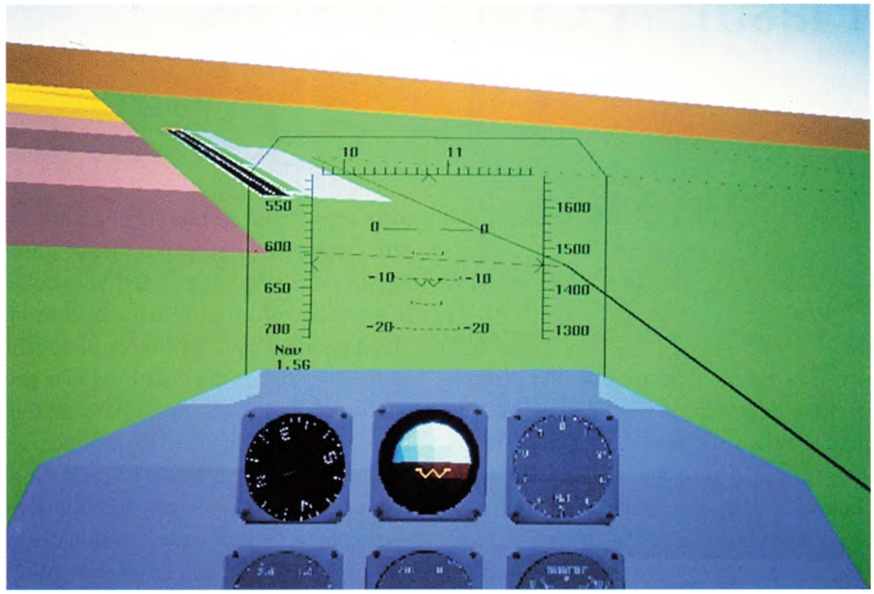
The HMD node uses a Polhemus Laboratories Inc. "looking glass" fiber optic-based head-worn display with a throttle and stick for a "virtual cockpit." The throttle and stick allow the user to move through the environment and to fire weapons. A simplified cockpit display is provided.

Stereographic's LCD shutter glasses are used at the LCD node to provide a 3D view of the environment. User input is via Ascension Bird six Degree Of Freedom (DOF) device using the eye-in-hand metaphor.

The Out The Window (OTW) node presents the user with a 3D monitor view of the environment. Basic vehicle control is via a Spaceball. This serves as the baseline model of the system.

Two additional nodes are part of the network. One is the Autonomous Agent controller. The autonomous agents populating the virtual environment respond to users at specific locations. Two to four trucks drive along the roads. These trucks stop at lights and avoid running into each other and user-driven vehicles. The lake has a sailboat out on a nice day. Several aircraft fly around and interact with the user-driven aircraft. In addition to these vehicles, there are several special entities that interact with the users at specific locations. For example, the Abominable Snowman comes after slow-moving ground vehicles in the mountains. Over the lake, the Loch Ness monster goes after low-flying aircraft. The Autonomous Agent controller display is a simple 2D map showing the location of all the entities in the virtual world, both autonomous and live. The second additional node is the sound server.

The networking protocols used are a subset of the DIS Protocol Data Units (PDUs). To facilitate the use of the PDU's, a modified coordinate system is used. All PDUs are broadcast utilizing UDP/IP. The system is written in ANSI-C and AT&T C++ using the Silicon Graphics Performer API. All databases were developed utilizing Software Systems MultiGen. The system runs on Silicon Graphics IRIS workstations in all its incarnations (Personal IRIS, Indigo Elan, GT, GTX, VGX, RE).



This system is unique in several aspects. The social interaction of the participants using different paradigms in a common virtual world provides an exciting technological, entertainment, and educational demonstration. As was demonstrated in the tomorrow's reality gallery at SIGGRAPH '91, NPSNET is an exciting and informative exhibit. This system is several generations more advanced.

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- John Switzer

Plasm: A Country Walk

PETER BROADWELL

The 3DO Company

This interactive art installation presents a large-screen dog leash draped in front. When the viewer first encounters the screen, it shows a sleeping dog (or a bouncy, yelping one, depending upon how long it has been since the last walk). Picking up the leash wakes the dog, and off you go on a virtual ramble. You find yourself walking down a photo-realistic country lane, led on by the bouncy puppy tugging on your leash. Chirping birds, crickets, and the crunch of gravel beneath your feet lend a fuller sense of presence in the animated world into which you are strolling. The leash serves as a common channel for input and feedback, as the dog strains to explore the enticements that lie in your path. Depending upon how much you allow your walking companion to follow her nose, the less predictable the adventures become. Over time, image processing effects and fractally generated scenery eat away at the photo-realistic setting, leaving you on a course through a stranger and stranger landscape. There is no limit to how long you can walk, as scenery is constantly generated to suit your pace. Of course, the dog does get tired after a while. This installation introduces its audience to a novel force feedback mechanism. Participants steer their virtual walk by pulling and slacking the leash, but the computer/pooch tugs back! Viewers should also be engaged by the live interactive blend of photo-realistic imagery, as their actions evolve a very unusual world indeed.

Plasm: A Country Walk employs the 3DO set-top computer to present an interactive virtual world composed of real-time 3D-projected graphics, photo realistic imagery, live generation of scene elements and visual effects processing, and high-quality audio tracks. The 3DO platform represents a breakthrough in computer graphics price/performance, offering an unprecedented visual vocabulary in a package affordable to home consumers. This new class of highly accessible technology opens the door for a new generation of artists seeking to manifest their own interactive visual experiences. A Country Walk is the most recent in an ongoing series of Plasm: installations. Each piece in the series establishes its own interactive, living environment, exploring contemporary issues along the advancing edge of virtual world interfaces. Country Walks' leash is the latest in the series development of custom, first-person input devices. Plasms input inventions, coupled with leading-edge reactive graphics, and investigate increasingly transparent, increasingly kinetic human-computer experiences. While video games have led the way in popularizing interactive computer graphics, the Plasm pieces seek to expose the public to richer, more experiential applications of this technology. We strive to offer a less goal-oriented vision of this emerging medium; one without cross-hairs or trigger buttons.

Hardware

- 3DO Interactive Multiplayer
- Dyno-Leash, a custom force feedback I/O device
- Panasonic large rear screen projection TV

Software

- Custom behavioral code (approx. 5,000 line of C and C++)
- 3DO Support libraries

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"This new class of highly accessible technology opens the door for a new generation of artists seeking to manifest their own interactive visual experiences… …While video games have led the way in popularizing interactive computer graphics, the Plasm pieces seek to expose the public to richer, more experiential applications of this technology."

Portraits of People Living with AIDS

HAZEN REED

Hazen B. Reed Productions

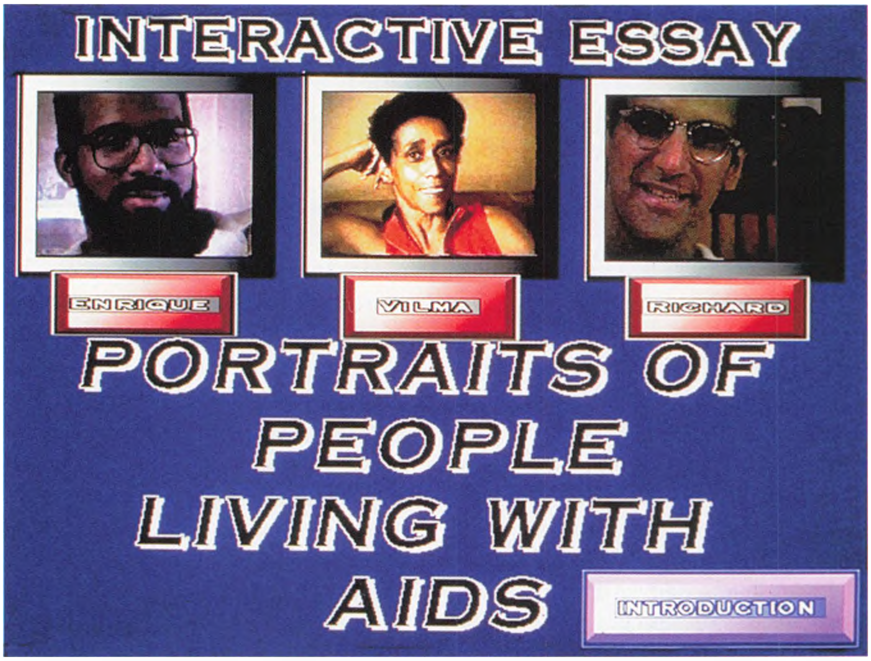
"The interactive documentary is a new medium... ...We have a long way to go before computer-interactive systems fully simulate the randomness that makes our daily conversations invigorating and lively; however, this project illustrates a first step toward interactive 'computer conversations.'"

Portraits of People Living with AIDS seeks to involve users in an active understanding of the AIDS (Acquired Immune Deficiency Syndrome) condition. This interactive documentary introduces participants to three people living with AIDS (a male painter, a woman activist, and a male inner-city AIDS counselor) via audio, video clips and photographic essays stored digitally on a Macintosh computer. The portraits are grouped around conversations with each person, and topics, as in all conversations, are far-ranging. Because the interactive documentary is non-linear, a viewer may move from portrait to portrait allowing a more comfortable approach to this difficult topic. At any time within the portrait viewers may make their own personal observations by leaving a digital video message (via a video camera and digitizing board on the computer kiosk) for one of the three people or any of the previous viewers. In this way, each viewer continues the evolution of the documentary, allowing both interviewee and end users to have a voice in a personalized, intimate atmosphere of a computer kiosk.

The interactive documentary is a new medium that is based on a well-established communication mode, the dialog. Technologically, we have a long way to go before computer-interactive systems fully simulate the randomness that makes our daily conversations invigorating and lively; however, this project illustrates a first step toward interactive "computer conversations."

The interactive essay Portraits of People Living with AIDS opens the door to this type of personal communication for several reasons. First, because it is game-like, users are put at ease—at least with the topic, if not the hardware. The now-familiar video-game format places the documentary in a readily accessible environment. Yet, while the computer interface is game-like, interactive essays are not predicated on the often destructive notion of winning. There is no right way to proceed in the program and, obviously, no wrong way. (This is an important reminder for face-to-face interaction, as well—without cautious and careful participant attention, conversations all too often turn into unbalanced monologues.) The non-domineering feature of the interactive format involves its participants in thoughtful regard of the information presented without chaining one to an unforgiving structure.

Portraits of People Living with AIDS recognizes AIDS as a human condition requiring human understanding. Such an understanding can come only through repeated efforts on the part of everyone involved, which in the case of HIV (Human Immune-deficiency virus) and AIDS includes almost everyone in our various communities. No human being on the planet is completely immune from this condition, yet we have all seen and heard the definitions of AIDS that serve to hold certain groups above the disease's reach while focusing attention on others as though they were more susceptible. We have come to know AIDS as a disease of "this community" or of "that group." These definitions have served to churn up the waters of prejudice and hatred. Despite attention-grabbing and often divisive public reactions, one fundamental element of the disease has been missed—AIDS is a human problem. In the words of Vilma Santiago, one of the people living with AIDS who appears in the piece, "AIDS does not discriminate." Reaching out to a larger community to educate and inform poses a problem because of discriminatory definitions of AIDS. We must find ways to educate everyone without alienating them. We must make it clear



Hardware

- Macintosh Quadra 800 with a RAM disk
- 200 Mbytes hard drive
- 24 bit color display card
- 13" color monitor (Apple or Sony)
- Large-screen projector or large-screen high-resolution television monitor and signal converter
- Syquest 88mg removable drive with at least one cartridge
- Amplified speakers
- Microphone

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that people with AIDS are part of our community. In short, we must come to see that each of us is as much a part of this disease as are the people who suffer directly from it.

Another important aspect of interactive essays is the opportunity for users to leave their own on-screen video messages. Participants can respond to any of the ideas or statements contained in the essay. This message-leaving aspect provokes an interesting reaction in the users. While they may feel comfortable listening to and watching the video clips, once they find they are an integral part of this expanding documentary, they may develop a more powerful recognition of the extent of their potential in the educational task of understanding AIDS. Likewise, this permits the participant to realize immediately the influence he or she has over the production of the essay. Thus the essay takes on a collaborative quality.

Interaction is nothing new; it is part of all communication. What is new is the interactive computer environment and how it involves the care and attention of all its participants. Understanding that viewers are part of the creation of meaning is an important notion in all communicative acts, be they face-to-face conversations with other human beings, interactions with the environment, or dialog with an interactive computer system. Communication, built on the notion of a caring self, results in a diligent acknowledgment of the contingent events that inform our lives. Computer interactive systems, designed with this human recognition in mind, may help us to better understand ourselves and the world in which we live.

Projecto ESE

(Electronically Simulated Environment): An Interactive Virtual World of Ancient Aztec Temples in a Sculpture Garden plus a Contemporary Mexican and Chicano Museum

GREGORIO RIVERA

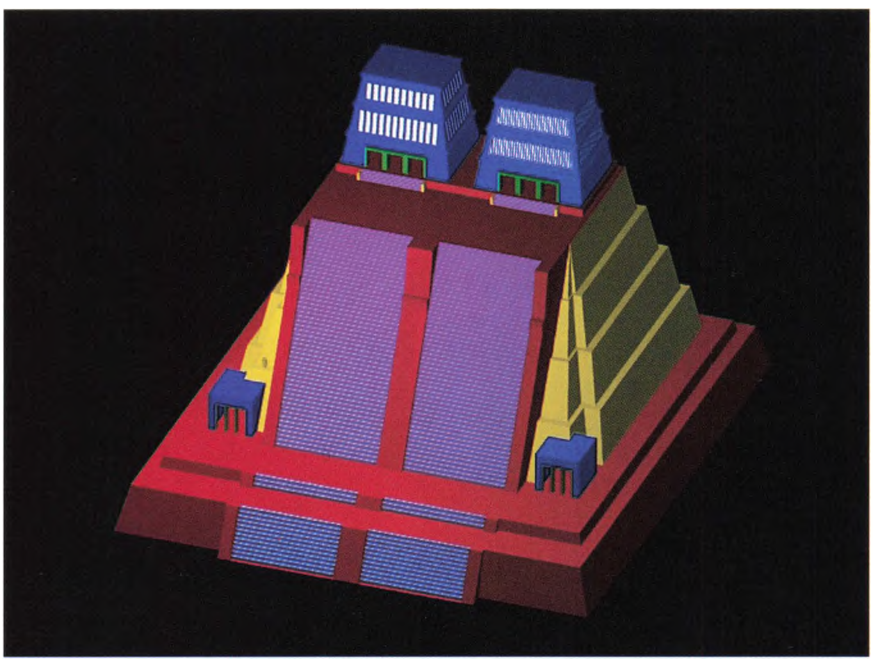
and MICHAEL JOLY

LEEP Systems, Inc.

Projecto ESE is an electronically simulated architectural/landscape "walk-through" space: a virtual reality world of ancient Aztec temples and a contemporary museum of Mexican and Chicano art, design, and culture. Projecto ESE creates a sense of audio and visual immersion, giving the viewer an idea of the scale and sound of the ancient sites and the richness of contemporary Mexican and Chicano culture. The walk-through can be directed by the user through the computer-generated environment, and viewers will be able to manipulate both visual and audio components within the temple enclosure.

How the Material will be Presented

Cyberface 3, LEEP Systems' virtual reality (VR) workstation, will be used to present the virtual world of Project ESE with the display mounted on an articulated mechanical arm. Members of the audience standing in line will see on a monitor what the "immersed" viewer sees in the virtual software. As the line moves forward, each person will experience the visual and audio virtual world, interacting with this world by means of a virtual wand. Approximate time for each individual to complete the walk-through is two to three minutes.



Hardware and Software

- Intel-based PC architectures, Cyberspace Developer's KIT, Virtual Environment Navigator, Cyberface 3, High Performance video adapters, 3D Studio, AutoCAD, LightWave, Animator Pro.
- LEEP, Cyberface 3, and World Switch are registered trademarks of LEEP Systems; Cyberface Developer's KIT and Animator PRO are registered trademarks of Autodesk, Inc.; Virtual Environment Navigator is a registered trademark of Mocro-Green, Inc. LightWave is a registered trademark of NewTek.

Bilingual project staff will be available to assist the audience in and out of the VR workstation, to brief and debrief participants, and to discuss the social and cultural implications of Projecto ESE. The viewer will travel from the ancient city of Tenochtitlan at the height of the Aztec Empire to modern Mexico City's Zocalo, which grew up on the site of Tenochtitlan. The museum of contemporary Mexican and Chicano art, design and culture, located in a giant sphere in the VR Zocalo, will allow the viewer to experience another kind of bridge between the past and the present. It consists of one big gallery; other galleries in the museum are "closed, due to lack of funding."

The visual and audio information created in cyberspace software allows the study in detail of various aspects of preconquest sites: structure, shape, scale, hieroglyphs, sculptural motifs, urban design, the meaning of light and shadow, and the world of sounds both inside and outside the temples.

Arte Chicano and Projecto ESE

Projecto ESE will create in the viewer a sense of visual and audio immersion in an electronically simulated architectural/landscape "walk-through" space—a virtual reality world of Arte Chicano. Projecto ESE includes both indigenous geometric shapes and forms and sound elements: voice recordings, pure sine wave tones and native flute music arranged in non-linear form.

Arte Chicano is widely perceived as being tied only to traditional Mexican imagery and sixties political icons. In reality, it has a much broader conceptual and international base. Chicano artists are intellectual and aesthetic migrants endeavoring to create polarities and/or syntheses of widely divergent cultures, whether technological or social. In Projecto ESE, our aim is to create crossroads in a computer-generated environment for the convergence of abstraction and representation, and to do this in a socially relevant framework. Through technology, we are able to connect with the past in an almost physical way: to ascend, descend, and circumnavigate in a past culture.

We have chosen the great city of Tenochtitlan, hub of the Aztec Empire, on the shores and islands of Lake Texcoco, as the site of the first of Projecto ESE's virtual worlds. Tenochtitlan flourished between 1325 A.D., and its conquest by the Spaniards in 1521. It is the work of the architects and sculptors of the vanquished city that the viewer will see in the virtual world. Rather than presenting Tenochtitlan in simulated granite and marble, we have chosen to use primary colors, in part to make the site more vivid and enticing for children to explore. This world will embody concepts as abstract as a fractal fountain and as concrete as a temple, and make sound an integral part of the virtual world.

The second of Projecto ESE's virtual worlds is the Zocalo of present-day Mexico City, where the cathedral and the national palace occupy the exact site of Tenochtitlan. This will allow the viewer to journey along a then-now continuum, arriving ultimately at the third virtual world of Projecto ESE, a Mexican/ Chicano Museum. This museum and its surrounding sculpture garden have been conceptualized in accordance with the "Quinto Sol"—the five spheres of Aztec cosmology. It hovers above the virtual Zocalo, about 20 stories high.

Future evolution of this project includes scientific visualizations of remedies for the fragile ecosystem of Mexico City. Our present aim, however, is to inspire the viewer's imagination, bringing each user into an interactive environment to manipulate both the visual and audio components of Projecto ESE. The user's focus on a particular point of interest will depend on the associations the user brings to Projecto ESE. It is hoped that many of the users will be sensitive to the cultures of the Americas, and therefore, by interacting with Projecto ESE, will experience interactive world-building as art.

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- Mark Thompson, Computer Graphics Animator
- Kintek, Inc.; Crystal River Engineering, Inc.; Intel; Autodesk, Inc.; Micron-Green, Inc.; LEEP Systems, Inc., Newtek World's Best; Boston Computer Society

Funding and Support

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- Special thanks to the Boston Computer Society for its support.

"In Projecto ESE, our aim is to create crossroads in a computer-generated environment for the convergence of abstraction and representation, and to do this in a socially relevant framework. Through technology, we are able to connect with the past in an almost physical way: to ascend, descend, and circumnavigate in a past culture."

Surface Tension

> *"Our piece uses surface tension as a metaphor to shed light on the boundary between cognition (the interior, the real) and experience (the exterior, the virtual). The human cognitive apparatus may be described as a collection of surfaces: the retina, the skin, the sheet of taste buds, the tympanum, the neural net."*

RAFAEL LOZANO-HEMMER

Introduction

Surface Tension is an active and responsive installation designed to investigate the boundary between the virtual and the real. Using custom-made technology orchestrated by an ultrasonic-wand input device, the piece consists of interactive animation and interactive music, both triggered by dance. There are two segments: a) a 45-minute performance where trained dancers use the installation to follow a theatrical narrative, and b) an undefined amount of time for the audience to jam with the system. The performance segment of Surface Tension consists of a dramatic visual, musical, and textual narrative. The thematic focus is not on representing reality or virtuality, but on the effects of "crossing" from one to the other. Is there a boundary between the Virtual and the Real? If so, what is its resistance to transgression? How does the body react to the displacements? The piece resolves with the delegation of judgment to the spectators, by offering the environment for their use.

The Environments

There are three electronic environments in Surface Tension, one for each of the acts of the performance. The actors wear the ultrasonic wand and control the scenes following a narrative (verbal reality). At the end, the spectators are invited to wear the wand and control the environments themselves:

- Surveillance: With frightening precision, a huge eye looks at the person on stage (actor or spectator) using the ultrasonic wand. The interactive animation consists of over 300 photos of a real eye. Events such as blinking, opening in surprise, disappearance of the pupil, and responsiveness of the eyelid can be controlled and randomized.
- Oratory: A virtual 3D map for the stage that lets the wand trigger and control words and sentences in sampled sound and in an enormous animated mouth. By dancing around in the space one can actually make speech.
- Identification: The image of the three actors is the canvas for alterations, blurring the line between representation and identity. The scene contains interactive mutations that happen at real-life scale; also, the index finger of a very large fist follows the person on stage, pointing and gesturing "NOT YOU!" or "YOU'RE OK".

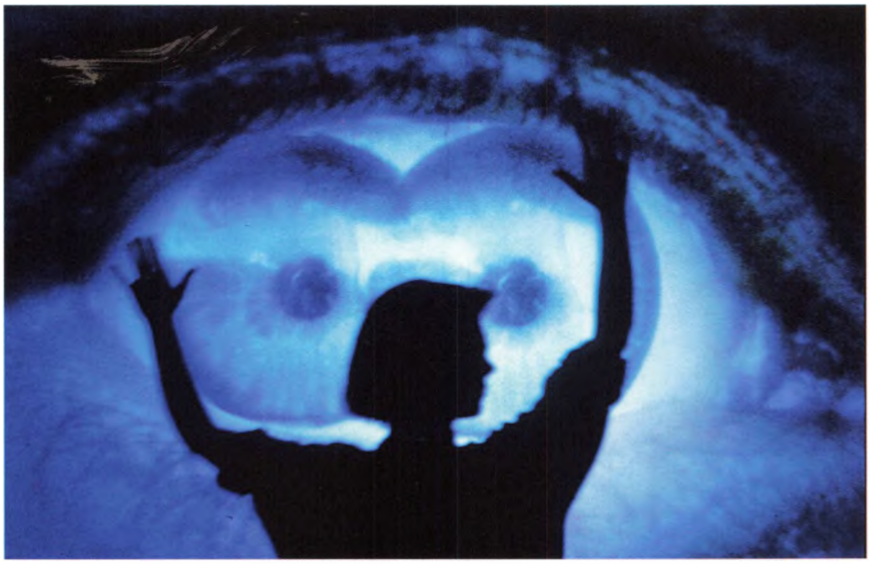
The Technology

Surface Tension features two innovative technologies:

- The Gesture and Media System (GAMS): The main source of interaction in Surface Tension is dance, as monitored in 3D by our custom-made ultrasound device GAMS. The user holds a small wand that affords very accurate computer data about his or her position, velocity, and acceleration, throughout the stage. The device is susceptible even to small movements (two inches), generating music and affecting computer animation in real-time. With GAMS the actor/spectator becomes the mouse for a network of computers.
- Surface VR: A superficial approach to VR, where experience is made out of proximity maps and restricted paths. Surface VR consists of hierarchical hypercube navigation of previously-rendered routes. In Surface Tension the visual feedback is given by large screen retro-projection and the wand is used for driving the environments.

The Subject

The physical-chemical term Surface Tension refers to the puzzling force that exists at the interface between two immiscible substances (typically two phases of matter), such as water and oil, mercury and air, or iron and milk. The force resists the



Equipment

- Macintosh IIci 36/2,400 Mbytes with Daystar accelerator
- Custom-made MIDI slide transparency controller
- Akai S1000 sampler
- Spx 900 effects processor
- Macintosh running MAX software
- 12-channel mixer
- Electrohome ECP 3000 digital graphics projector
- Covid Interface
- GAMS, Gesture, and Media System (9 to 16, and 20)
- 386 PC with GAMS software and MIF IPC card
- Motorola MC68HC11 chip
- Ultrasound pulse generator
- Sonar pulse preprocessor
- Radio receiver and antenna
- Amplifiers, Speakers, Slide Projectors, Screens, P.A. speakers, Stereo music outlet
- GAMS wand

Contacts

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- Susana Ramsay: Choreographer, Co-creator, Dancer
- Will Bauer: VR Tools
- Twenty-four artists and scientists from the faculty of Information Sciences of the Complutense University in Madrid
- Transition State Corporation: Ultrasound VR Wand Wave environments

extension of the boundary of a substance by an amount related to the difference in intermolecular forces in each of the substances. Our piece uses surface tension as a metaphor to shed light on the boundary between cognition (the interior, the real, whatever that may be) and experience (the exterior, the virtual, whatever that may be). The human cognitive apparatus may be described as a collection of surfaces: the retina, the skin, the sheet of taste buds, the tympanum, the neural net. Likewise, the media interface is usually superficial: the screen, the glove, the speaker. Is there surface tension at the juncture of these surfaces? By focusing on the interface, by visualizing it, by literally grabbing it with a wand, we hope to cause a disturbance in the way we understand cyberspace. Surface Tension is about a fully-militarized family searching to communicate with each other in the time when everything has been said, done and recorded.

VActor Animation Creation System

STEVE GLENN

SimGraphics Engineering Corporation

The VActor Animation Creation System (VACS) is the first commercially available real-time character animation product. SimGraphics developed VACS in order to offer an interactive, cost- and time-effective means of creating computer animation. With VACS, actors wear special input devices for their heads, faces, and bodies, allowing them to control the corresponding features of broadcast resolution, computer-generated characters ("virtual actors" or "VActors"), live and in real-time (24 or 30 frames per second). In addition to supporting realistic lip-synch and other special effects, VActors can morph into different characters or objects.

VActors offer significant time and cost advantages over traditional computer animation production techniques, since animation is created in real-time. As a live, interactive medium, VActors can be "directed," providing animation producers with a higher level of control over the production process. Finally, VActors enable a new application of computer animation, one that cannot be achieved with traditional production techniques: live, interactive public performances.

SimGraphics developed VACS to address both the live performance and recorded media production markets. VACS includes three applications:

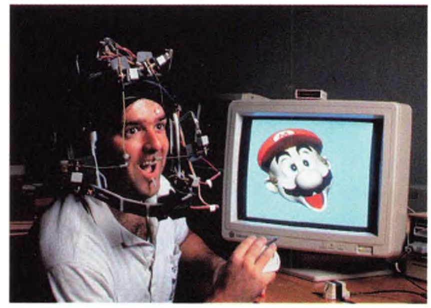
- VActor Creator, a set of software tools that SimGraphics uses to create VActors. VActor Creator is not currently available as a product, but is available through SimGraphics as a service.
- VActor Performer, a turnkey system that includes VActor Performer Software, specialized input devices including the Facial Waldo, and a Silicon Graphics Crimson VGXT. VActor Performer is used to provide live performances of VActors for trade shows, corporate presentations, concerts, live TV, stadiums, and theme parks. VActor Performer is available as a product or through temporary lease from SimGraphics (production/broadcast companies) and Iwerks Entertainment (permanent entertainment installations).
- VActor Producer, a turnkey system that includes the features of VActor Performer as well as recording and channel editing capabilities. VActor Producer is used to produce high-quality animation for recorded media such as film, TV, video, and multimedia.

With VACS, SimGraphics has completed a variety of live performance projects including interactive exhibits at trade shows (Dentsu, Videovision, Nintendo, Ricoh), mall tours (Nintendo, Fujisankei Television), concerts (Charles Fleischer at COMDEX), hospital research (Loma Linda), corporate presentations (Nintendo), and live TV interviews (Nintendo). SimGraphics has also completed a number of production projects that include animation for an HDTV television commercial (NHK), "Whatz up," a pilot for a children's variety show (The Disney Channel), five laserdisks (Nintendo), and Interplay Production's "Mario Teaches Typing" CD-ROM

At tomorrow's realities, SimGraphics will demonstrate a variety of VActors including "Mario" and "Wario" (developed for Nintendo), "Tarbo" (Fujisankei Television), "Hot Dog" (NHK), and "Eggwardo" (SimGraphics and Mark Sorrell).

Hardware and Software

- 3/4 inch tape deck with looping
- 25 inch or larger monitor(s)
- Headphones
- Microphone, LAV or headset
- Digital audio delay unit (the VActor operator's audio must be delayed at least 200-250 milliseconds to properly align with the video image)
- SGI Crimson VGX or VGXT with multibuffer board and VideoLab board (with tape drive and at least 32 Mbytes of RAM)



- Powerstrips and two separate power lines
- Power conditioner/surge protector
- Monitor or projector
- Twin speaker with preamplifier and amplifier
- Microphone
- Camera
- VActor Performer software
- Face Wald
- Joysticks
- Flying Mous
- Data Acquisition System
- Foot pedal

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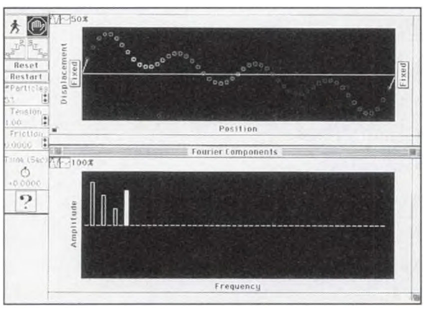
WaveMaker:
A Computer Simulation for the Classroom of Tomorrow

FREEMAN DEUTSCH

Harvard-Smithsonian

Center for Astrophysics

The Science Education Department of the Center for Astrophysics has been working on interactive graphical computer simulations that can help students learn physics. One example, WaveMaker, exploits the type of technology that should be available in the classroom five years from now. WaveMaker is a highly graphical and interactive computer simulation that is used to teach about waves and oscillations. Graphical representations like WaveMaker show promise of being an excellent way to connect physical systems to the sophisticated equations that describe them. With WaveMaker the user may gain intuitions on how waves work without having to learn all of the mathematics.



Hardware and Software

- Macintosh II w/ floating-point coprocessor and 1.4 Mbytes drive, 4 Mbytes of RAM, System 6.7 or later, 32-bit QuickDraw
- 13" color monitor, VCR and monitor
- WaveMaker

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Why not simply use laboratory experiments to teach these ideas? Laboratory exercises are essential to learning science. They have limitations, however, especially when it comes to modern physics and other advanced topics, because the experiments are either too expensive, too difficult to carry out, or too difficult to visualize. Computer simulations can supplement laboratory exercise if they are designed to focus attention on formal variables, parameters, and frames of reference. A simulation can bring the student close to a process by eliminating irrelevancies, providing real-time plotting of data following the user's specification of variables, and permitting the student to interrupt the event being represented. The students can then update decisions about the selection of parameters and the nature of the data being collected. The decisions needed to operate a simulation require the student to make predictions and confront his or her own theories.

Students in high school physics courses may have some experience with waves through classroom demonstrations. Phenomena such as reflection may be familiar to them, but most will possess many misconceptions about waves. In interviews with high school students, we have found that many believe:

- Waves are made up of matter traveling in the direction of wave propagation
- Wave packets can collide and annihilate each other (no conservation of energy)
- Superposition does not work
- Harmonic systems can vibrate at only one frequency
- Initial displacements will always produce two pulses propagating in opposite directions

What are the building blocks of understanding waves? Wave mechanics courses begin by treating the free oscillation of simple linear systems. A typical development might include:

- One degree of freedom: period is independent of initial displacement
- Two degrees of freedom: symmetric and anti-symmetric modes
- Many degrees of freedom: dispersive systems
- Continuous systems: non dispersive systems

Normal modes for uniform systems may be displayed and the student may search for eigenstates of non-uniform systems. Various types of boundary conditions may be selected and they can give rise to reflection and interference. Superposition leads to Fourier analysis. Advanced topics that can be explored with WaveMaker include dispersion, driven systems, properties of reflection and transmission, and tunneling.

Many parts of the WaveMaker interface react with one another. When you move the Fourier graphs amplitude, the wave shape changes, and when you change the shape of the wave, the Fourier graphs change. When you touch the phase space diagram, the velocity and displacement graphs change. When you move the velocity or displacement graph, the phase space graph diagram changes. WaveMaker was a winner of the 1991 Computer and Physics Software Contest.

Virtual Environments for Public Exhibitions

MARK BOLAS

Fakespace

To enlighten, educate, entertain, elevate: museums of art, science, and history have used many methods to achieve their goals, all of which are designed to entice and immerse the visitor in the experience presented. Virtual reality is ideal for this purpose, either as a tool, or as a new medium for public exhibition. This piece presents two examples of such systems, each highlighting different types of worlds that can be created. The first uses virtual environment technology to expand an existing museum mainstay, the diorama. The second explores the fundamental nature of virtual reality as a medium for public exhibition.

"Early North America: A Virtual Site Reconstruction" was created for the Smithsonian Institution's National Museum of American History by the Visual Information Technologies Program at George Mason University. This piece updates the purely visual and static experience of the 'diorama' into an interactive, immersive exhibit.

Before, the visitor might have walked past a series of scenes portraying specific aspects of American Indian life. Now, the visitor is actively involved in the exhibit when he or she moves the handles of the BOOM2C viewer, peeling back time, layer by layer, to see changes to an American Indian site over the years. This brings to the experience an interesting and enlightening juxtaposition of concrete and abstract, of visual and tactile, of silence and sound while learning about a culture's history and way of life.

"Tango Texture" was created by Fakespace Inc.'s Ian McDowall and Mark Bolas. Here, bits and pieces of our 'real world' everyday experiences are sampled, scrambled, and stapled onto the alien whitewashed landscape of the virtual environment. This is done through "texture mapping"—a process of pasting polygon-based models with flat photographs to create the illusion of a highly detailed model. This technique adds a powerful dimension to the palette of the virtual environment world designer. It enables the designer to convert surreal and often bland polygon-based worlds into rich and visually intricate places that are quickly accessible and immediately engaging for the visitor—an important requirement for public exhibition works. Using textures in non-traditional ways, this piece tries to converge the conventional with the unconventional, providing a perceptual conflict while retaining kinesthetic harmony.

Hardware and Software Providers

- George Mason University: custom software and world designs
- Fakespace, Inc.: BOOM, VLIB-SGI software, custom software and world designs
- Silicon Graphics, Inc.: SGI Reality Engine, IRIS Performer
- Software Systems: Multigen software

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- David Allison, Curator of Information Age Exhibition, Smithsonian Institution, National Museum of American History
- Tamar Cohen, Research Assistant, George Mason University, Visual Information Technologies, Master's Program

Virtual Environments for Public Exhibitions,

or 'Look Ma, I'm Flying'

Visitors to the Virtual Reality Laboratory will get a front-stage and backstage look at virtual reality (VR) by both experiencing and manipulating a VR world. Visitors learn, through hands-on manipulation, that everything in a VR world—lighting, colors, objects, atmospheric effects, gravity, collisions, etc. is completely synthetic and can easily be altered. This presentation was designed by Art Technology Group and Fakespace, Inc., and is based on the Virtual Reality Laboratory Exhibit developed by Art Technology Group, the feature of the new exhibit "Imaging, The Tools of Science" at the Chicago Museum of Science and Industry. The VR Laboratory is unique in providing both a highly detailed immersive experience as well as the ability to manipulate the virtual environment itself. The exhibit places a short narrative experience within a laboratory setting where visitors can experiment with the various elements that comprise a virtual reality environment that someone else is in.

The VR Laboratory consists of three stations: an immersion station and two manipulation stations for external participation. The immersion station is a Fakespace BOOM that puts the visitor into the virtual world, while the other two stations are console-type computers that allow visitors to manipulate the world in different ways. The view of the world that is rendered on the immersion station is repeated on a large projection screen above the station and twice again on screens at the manipulation stations. These repetitions allow all of the visitors in the space to observe the virtual environment and how its participants are interacting with it. The external controls provide access to virtual world parameters such as lighting sources, atmospheric effects, physical model parameters, actions, scripts, animations, etc. Visitors learn that everything we take for granted in the real world must be carefully thought out and modeled in a virtual one. The effects of wrongly modeling these factors can create very entertaining situations, such as reversals of gravity or objects passing through each other instead of bouncing.

The content of the VR experience is designed as a symbolic illustration of the acquire, process, and display stages of the image processing "loop" that is then reinforced elsewhere in the exhibit. The journey begins in a model of a room and follows the travels of a face as it is acquired into a video camera, processed in a "circuit city," and finally displayed back into the real space. The sequence shows a number of very different looks and feels to convey the diversity that a virtual environment can provide. Visitors go beyond merely experiencing a VR demo. Rather, they interact with the underlying concepts and technology of VR. The VR Laboratory will be greatly entertaining for the participants as well as for those who want to look over the shoulders of others at the manipulation stations.

The project was partially funded by the National Science Foundation, Chicago Community Trust, Howard Hughes Medical Institute, and the Radiological Society of North America. Modeling software was donated by Software Systems and Softimage. 3D Datasets were donated by Viewpoint.

Hardware

- SGI Reality Engine
- BOOM2C or RGBOOM viewer
- Video Projector

Software

- Fakespace VLIB-SGI
- Art Technology Group
- Custom Software
- Illustration courtesy of Art Technology Group and Fakespace, Inc.: montage photo of BOOM and screen example

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Virtual Table with Lamp

ELLEN SANDOR

(Art)ⁿ Laboratory

Computer graphics has revolutionized new ways of thinking, creating, and communicating. An entire industry has evolved around digital 3D imaging, replacing the traditional tools used in science, engineering, architecture, design, and other fields. The advantages of 3D computer graphics enable a scientist, for example, to visualize a group of atoms, an engineer to study simulations of the stress on a bridge design, and product developers to view their prototypes without the time-consuming creation of physical models.

While 3D computer graphics tools have many advantages, there is one unique problem that hasn't quite been resolved. Short of a finished product, how can professionals present their work without losing the effects achieved by 3D software?

Animation, 2D black-and-white or color prints, stereo slides, stereolithography, and computer-generated holograms are options, though animation and prints are limited to representing imagery in two dimensions while stereo slides require cumbersome glasses for viewing. Stereolithography and holography are also limited in supporting realistic color.

There is however, a new alternative called PHSColograms (pronounced skol-o-grams). PHSColograms are 3D back-lit images that are created directly from digital data, and can be viewed without glasses, or other 3D viewing devices. They have full color and high resolution. This newly-patented technology is the product of (Art)^n Laboratory, a Chicago-based collaborative art group based at the Illinois Institute of Technology, founded in 1983 by sculptress Ellen Sandor. The first PHSColograms produced by Sandor and her crew were created by an optical photographic process, producing 3D images of sculptures with a room-sized camera.

On the technical side, our process is quite simple. A series of images is created, each showing a very slightly different view of the same 3D scene. We use 13 images, since it is a good trade-off for a number of different criteria, but other numbers (at least three) are acceptable.

The images are broken up into vertical scanlines, (similar to the horizontal scanlines comprising a television picture), and interleaved (similar to shuffling a deck of cards). We start with the first scanline from the first image, then the first line from the second image, and so on, for all 13 images. We then continue with the second line from the first image, and all of the second lines in order, then all of the third lines, and so on, for all of the lines in all the images. The process creates a single image that is output on a Crosfield scanner or full-color device, such as the Kodak LVT, Premier, or Iris printer. To the naked eye, this image seems blurry, as if the 13 images had been simply blended together.

This "blurry" image is then laminated onto the back face of a piece of Plexiglas, or in the case of our high-resolution images, a very thin piece of Mylar. Onto the front, we laminate a linescreen (barrier-screen), an image comprised of black vertical lines with transparent areas between them. This linescreen may be made on the same device as the image, or mass-produced.

When the finished piece is illuminated from behind, as in a lightbox, the black lines block 12 of the 13 images. Depending on where you stand, a different image is visible through the slits. Since your eyes are arranged horizontally in your head, each eye sees a different image, creating the 3D effect. The image is visible from nearly any distance and any angle, appearing to follow the viewer around the room.

If rear illumination is impractical, a lenticular may be used in place of a linescreen. Lenticular material is a series of vertical plastic cylindrical lenses that have virtually the same effect as a linescreen. No back lighting is required, but the price for this is paid in a less striking, "plasticky" image, and the added expense of creating suitable lenticular material. This cost of course, becomes insignificant in mass quantities, and we are engaging in research to produce better lenticular material.

Barrier-screen and lenticular images have been produced by photographic means for nearly 100 years, but PHSColograms are created digitally. The difference in quality is like the difference between CD and 8-track; the advance in flexibility is like the difference between Gutenberg's printing process and a modern laser printer.

The current research focus is to streamline the post-production process. PHSCologram prototypes have been produced using Kodak's LVT and Premier full color imaging output devices and Scitex's Iris ink jet printer. The LVT and Premier systems eliminate the darkroom step from the process, and offer a five-fold increase in resolution. While LVT and Premier images cannot be larger than 16 inches by 20 inches, the higher resolution removes the need for 1/4-inch thick Plexiglas. In place, the barrier screen and full color output are laminated to a very thin piece of Mylar. The LVT and Premier prototypes are so thin in contrast to the existing Plexiglas pieces, that they easily clip into the light boxes used in hospitals. One of the LVT experiments was produced from MRI volume visualization data.

Consider a surgeon using virtual reality tools to prepare for surgery. S/he discovers a number of scenes that are significant to the procedure. Several PHSColograms are created to document the surgeon's discoveries. The finished images are illuminated on the light box in the operating room for the surgeon and his or her team to refer to. After the surgery is performed, the surgeon can use the PHSColograms to review the operation with his or her colleagues. Additional post-operative PHSColograms may also be created to evaluate the patient's prognosis.

The Scitex Iris printer also offers full-color output with ink jet technology. However, Plexiglas is still required. The resolution is not as high as either the Crosfield, LVT or Premier systems, and of course, the issues of color matching with ink are a concern. Nonetheless, the results show that PHSColograms can actually be produced from a printer.

When PHSColograms become easily and inexpensively available, hard copy will never be the same as we know it. Scientists will see complex data directly and be able to easily share it with their colleagues, and doctors may visualize the exact location of a tumor inside of a patient. The advertising industry is already impatient to see these images in retail environments, and mass-printing applications for publication are currently being researched.

Space Station Freedom

■ 1993/30"x40" Stealth Negative PHSCologram

■ Daniel D. Mazenek, NASA Langley Research Center

■ In collaboration with (Art)^n Artists: Stephan Meyers & Ellen Sandor

This image documents a close-up of Space Station Freedom with a Space Shuttle docked to it. Freedom is being designed to provide a permanent human presence in space, and will be occupied by an international crew of astronauts and scientists.

The virtual model of Space Station Freedom depicted in this PHSCologram was designed in Wavefront software on a Silicon Graphics 440 TTX at the NASA Langley Research Center. PHSCologram, created by (Art)^n at the Electronic Visualization Lab on Silicon Graphics VGX/T and IBM RS/6000 with custom software.

Virtual Bust

■ 1993/30"x30" Stealth Negative PHSCologram

■ Brad Maher and Brad deGraf for Ramon Castan

■ In collaboration with (Art)^n Artists: Stephan Meyers, Ellen Sandor and Janine Fron.

Virtual Bust is a PHSCologram of a character that was designed for the Spanish Pavilion, Expo '92, Seville, Spain. Roscoe is a three-minute animation produced for laser disk playback. Roscoe is created with Alive, deGraf Associates software, and Silicon Graphics workstations.

Wondrous Spring

■ 1993/30"x40" Stealth Negative PHSCologram

■ Charles Csuri, Artist, Ohio State University

■ In collaboration with (Art)^n Artists: Stephan Meyers and Ellen Sandor

A personal view of a magical world of light and color. Imagery created with custom software by Steve Anderson and the Advanced Computer Center for Arts and Design, Ohio State University on a Sun Sparc Station 10.

Transportacion

■ 1992/30"x30" Stealth Negative PHSCologram

■ (Art)^n Artists: Stephan Meyers, Ellen Sandor, Janine Fron, and Craig Ahmer

Created for the Spanish Pavilion of Expo '92 to represent the future of transportation, this piece depicts a computer-generated AVE (Alta Velocidad Espana), a high-speed train that was designed to run at 200 km/h, competing with air travel. Since April 1992, it travels from Barcelona to Seville, carrying over 300 passengers in under three hours. This travel time is comparable to an equivalent airplane flight, yet uses 1/5 as much fuel.

Rhinovirus Ion Channel

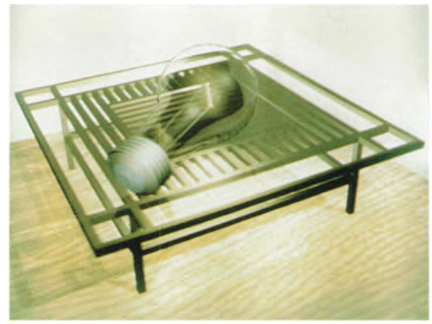
■ 1992/30"x30" Stealth Negative PHSCologram

■ Dr. TJ O'Donnell of O'Donnell & Associates

■ In collaboration with (Art)^n Artists: Stephan Meyers and Ellen Sandor

Ionic strengths and pH influence the assembly and disassembly of virus particles. This model of a putative ion channel in Human Rhinovirus may help in the design of antiviral and anti-AIDS drugs.

Imagery created with custom software and a Silicon Graphics Iris at O'Donnell & Associates.



Virtual Table w/Lamp

■ 1992/30"x30" Stealth Negative PHSCologram

■ (Art)^n Artists: Stephan Meyers, Ellen Sandor, Janine Fron, and Craig Ahmer

This piece documents a real-life art object in the virtual world, juxtaposing a virtual light bulb with a computer-generated model of Coffee Table, 1990/1991 Series V, #2, by Minimal, Sol LeWitt. (Art)^n's virtual light bulb could not be placed on LeWitt's table in the real world. Alternatively, the table was re-created in virtual space.

Coffee Table, 1990/1991 Series V, #2, was created by Sol LeWitt, based on wall drawings.

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Tomorrow's Realities

SIGGRAPH 93 Visual Proceedings Colophon

This book in itself represents a pioneering effort in the electronic design process. It is a showcase of electronic media, computer-aided design, artistic expression, and the implementation of tomorrow's technologies. Using soon-to-be-released PageMaker 5.0 and the KEPS Photo-CD image processing system, in less than four weeks a 240-page book took shape and was shipped to the printer in four-color film form.

When SIGGRAPH 93 decided to publish the *Visual Proceedings,* Aldus agreed to provide the materials and services for the color prepress, giving Aldus an opportunity to demonstrate the new color technologies and "additions" that have added functionality to PageMaker 5.0.

The project began with the gathering of images (including black and white artwork and several hundred color slides) and raw text by the respective chairs of designing technology, the electronic theater, machine culture, and tomorrow's realities. In parallel, all of the text was edited by Ann Redelfs, the artwork was scanned at 300 dpi resolution, and the images were digitized onto five Photo-CDs by Argentum of Seattle, WA. Doug Peltonen and Michael Bourgoin at Aldus along with Jim Abbott and Jodi Slater at KEPS conducted a series of process control tests and established the primary work flow procedure for the project. The project was handled by the electronic designer, Jeff McCord, of Free-Lancelot and his team of two design/production artists, Rosemary Woods and David Cox.

The production steps for the *SIGGRAPH 93 Visual Proceedings* were as follows:

1) Using a Macintosh computer, raw Photo-CD images were acquired into Adobe Photoshop with KEPS PCS-100 software.

2) Color transformations were performed using the KEPS plug-in filter.

3) Minor color level and sharpening adjustments were made to images.

4) Images were saved as RGB TIFF files.

5) Cropped images were saved in a single folder; the folder was dragged and dropped into Aldus Fetch to create a catalog of images.

Step 1: *Raw image as aquired from Photo-CD using KEPS software*

Step 2: *Color transformation using KEPS plug-in filter*

Step 3: *Minor adjustments in Adobe Photoshop*

6) Images were imported into PageMaker through the Library Palette Addition and combined with the page layout for final page composition.

7) The Precision Color Place addition was used with the Replace Graphic feature to preserve image crops.

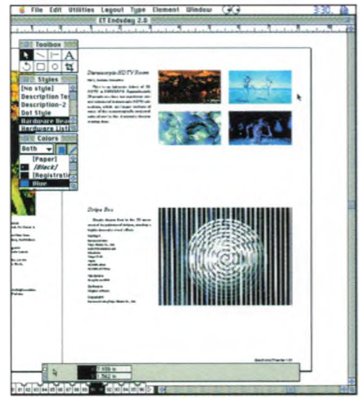
8) PageMaker documents were printed to disk for a specified page range.

9) Film output was done on an Agfa SelectSet 7000, and Fuji Color proofs of all color pages were created.

10) Four-color film was shipped to the printer, and the *Visual Proceedings* was printed on a Web press.

Creating the *Visual Proceedings* in this way was a significant task. The team was convinced, however, that a high-quality color book could be completely digitally produced with the new desktop publishing technologies. There were some problems, but for the most part, PageMaker proved to be lightning fast and stable in printing the resulting separations.

The contributions of the companies and individuals who made these proceedings possible are graciously acknowledged.



Step 6: *Images imported into final layout in PageMaker 5.0*

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- Art Direction/Creative Director: Jeff McCord, Free-Lancelot
- Project Coordinator: Enrique Godreau III, Aldus Corporation

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THE EYE OF TECHNOLOGY