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COURSE NOTES 43

Implementing Virtual Reality

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Course Abstract

While virtual reality systems seem to hold great promise for facilitating the use of computers, actual virtual reality development is fraught with difficulties These difficulties include limited hardware, uncertain interface paradigms and the integration of various components and concepts into a high-performance system This course addresses these and other difficulties We begin with an introduction to the virtual reality field, both in reference to computer graphics and in terms of the current state of the art Interface hardware will be surveyed, emphasizing the performance limitations of current products The human factors impact of the limited interface devices will be discussed on both a theoretical and phenomenological level After setting this background, the external design of a virtual environment will be discussed from the point of view of how that environment is experienced by the user The objects that populate a virtual environment will be discussed both in the abstract and through examples The implications of the interactive user interface on system performance will be a primary focus The actual implementation of the virtual environment will be addressed, discussing both the software platform and the overall system The course will end with a discussion of virtual reality development on a budget and lessons learned about how to get a virtual reality project going from start to a useful application

Speaker Biographies

Steve Bryson

Steve Bryson is an employee of Computer Sciences Corporation working under contract for the Applied Research Office of the Numerical Aerodynamics Simulation Systems Division at NASA Ames Research Center In this position he is researching the use of virtual environment technology in various fields of scientific visualization primarily the visualization of fluid flow Prior to this position he worked at the NASA Ames VIEW lab developing the first fully integrated virtual environment facility Prior to that he was one of the original employees at VPL Research Inc a small company devoted to the development of virtual environment technology

Steve Bryson s formal training is in mathematical physics and he is most interested in virtual reality as a way to express abstract concepts and understand the real physical world. He currently teaches popular adult and children s classes in theoretical physics at the California Academy of Sciences He is an active amateur musician and has writ ten sound tracks for sky shows at Chicago's Adler Planetarium

Randy Pausch

Randy Pausch is an assistant professor in the Department of Computer Science at the University of Virginia His main research interests include human-computer interfaces computer graphics software environments and educa tion He is active in studying various issues of human performance in virtual reality

Warren Robinett

Warren Robinett is a designer of interactive computer graphics software and hardware He was educated at Rice University and Berkeley receiving a BA in "Computer Applications to Language and Art" in 1974 and an MS in Computer Science in 1976 In 1978 he designed the Atari video game Adventure the first graphical adventure game In 1980 he was co founder and chief software engineer at The Learning Company a publisher of educational soft ware There he designed Rocky s Boots a computer game which teaches digital logic to 11 year-old children

Rocky s Boots won Software of the Year awards from three magazines in 1983 In 1986 Robinett worked as a research scientist at NASA Ames Research Center where he designed the software for the Virtual Environment Workstation NASA s pioneering virtual reality project In 1989 he came to the University of North Carolina to direct the Head Mounted Display Project. In 1992 he became co-director of the Nanomanipulator Project at UNC which interfaces a scanning tunneling microscope to a head mounted display to allow micro teleoperation at atomic scale on the surface of a sample beneath the microscope

Andreis van Dam

Andries van Dam is a professor of Computer Science at Brown University where he has been on the faculty since 1965 and was one of the Department s founders and its first Chairman from 1979 to 1985 His research has concerned computer graphics text processing and hypermedia systems and workstations He has been working for over 20 years on systems for creating and reading electronic books " based on high resolution interactive graphics systems for use in teaching and research He was the coordinator of the Core graphics standard effort in the mid sev enties and of the PHIGS+ definition group in the mid eighties pp van Dam received the B S degree from Swarth more College in 1960 and the M S and Ph D from the University of Pennsylvania in 1963 and 1966 respectively He helped to found and was an editor of Computer Graphics and Image Processing from 1971 to 1981 and was an editor of ACM s Transactions on Graphics from 1981 to 1986 In 1967 Professor van Dam co-founded ACM s SIGGRAPH The widely used reference book Fundamentals of Interactive Computer Graphics co-authored with J D Foley was published by Addison Wesley in 1982 the greatly expanded successor Computer Graphics Principles and Practice coauthored with J D Foley S K Feiner and J F Hughes was published in June of 1990 Pascal on the Macintosh a Graphical Approach co-authored with David Niguidula was published by Addison Wesley in 1987 van Dam has authored or coauthored over 75 papers In 1974 van Dam received the Society for Information Display s Special Recognition Award and in 1984 the IEEE Centennial Medal In 1988 he received the State of Rhode Island Gover nor's Science and Technology Award and in 1990 he received the National Computer Graphics Association s Aca demic Award In July 1991 he received the SIGGRAPH s Steven A Coons Award In May 1992 Brown University named him to the L Herbert Ballou University Professor Chair He is past Chairman of the Computing Research Association Senior Consulting Scientist at Electronic Book Technologies Chairman of the Technical Advisory Board of ShoGraphics and a member of Microsoft s Research Technical Advisory Board

Course Schedule

15 min	**Introduction** Steve Bryson	1 1
30 min	**Perspectives on Virtual Reality** Andries van Dam	1 2
1 hour	**Virtual Reality Hardware** Steve Bryson	1 3
15 min	**Break**	
1 hour	**Human Factors of Virtual Reality Design** Randy Pausch	1 4
1 5 hours	**Lunch**	
1 hour	**Designing the Virtual World** Warren Robinett	1 5
30 min	**Software Development Environment** Randy Pausch	1 6
15 min	**Break**	
45 min	**The Integrated Virtual Reality System** Steve Bryson	1 7
30 min	**The Inexpensive Virtual Reality System** Randy Pausch	1 8
30 min	**Bootstrapping a Virtual Reality Project** Steve Bryson, Randy Pausch, Warren Robinett, Andreis van Dam	

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