

CGEMS – Computer Graphics Educational Materials Server

Frederico C. Figueiredo
INESC/IST
Lisbon, Portugal
fef@immi.inesc-id.pt

Dena E Eber
Bowling Green State University
Bowling Green, OH
deber@bgnnet.bgsu.edu

Joaquim A. Jorge
INESC/DEI/IST
Lisbon, Portugal
jorgej@acm.org

Abstract

Computer graphics has evolved considerably over the past few decades. As computer science, digital arts, and other areas of study that use computer graphics continue to evolve and gain new substance, educators have come to master new content and achieve deeper understandings of computers and imagery. As the core field becomes more mature, educators in all computer graphics disciplines have a greater need for high-quality curricular resources. Offering excellent educational materials is an important service to the community of educators. Such support will empower both young and seasoned educators alike to benefit from and contribute to the work of others. In this way, we can achieve a higher standard of teaching worldwide.

The purpose of our work is to provide tools to foster such a community of computer graphics educators. We will present a system that will act as the means for their work to be appraised, assessed and made available to others through an online server for refereed educational content in computer graphics.

In this paper we describe the basis for and highlight some of the starting requirements of CGEMS, the online Computer Graphics Educational Materials Server. This is organized around a web-based groupware application that supports the submission, review, acquisition, and archiving of curricular resources.

1 Introduction

The Computer Graphics Educational Materials Server (CGEMS) is an online system that provides curricular material for computer graphics educators. The system includes a method for contributors to submit and editors to jury and control the quality of content to ensure sound and robust materials. The shape and components of CGEMS arose from fruitful discussions around, during, and after the Workshop on Computer Graphics Education (CGE02) held in Bristol, UK in July 2002. Figure 1 shows the initial page of CGEMS.

The fast pace of change in the computer graphics (CG) field makes it difficult for educators to continually design up to date, meaningful and robust curricula that address the full potential of the technology. Although small systems and groups of people exist who are trying to address this issue, there is currently no centralized worldwide-refereed repository for computer graphics educational materials. Our system supports a way for educators to easily access quality course materials and for contributors to share and get recognition for their curricular innovations.

To achieve its goals CGEMS supports submission of, and access to a comprehensive set of materials on all subjects relevant to teaching CG. Acceptable materials range from course mechanics including syllabi, lab notes, example assignments, problem sets, annotated student

work, such as images and interactive videos, to teaching gems, presentation slides, course notes and interactive demos. To encourage maximum reusability and to promote dialogue among the community, the preferred modality of submission is the *course module*. A course module is a self-contained teaching unit including some or all of the above materials as parts to an articulated whole. Examples of these are transformations in CG, principles of texturing, shading techniques that impact the mood of a narrative, concept development, etc. Typically a course can be construed as an articulated set of modules organized according to pedagogical criteria.

Another important criterion for success is to ensure maximum usability and accessibility of materials. As such we encourage submission in vendor-neutral formats.

To ensure quality materials, the server implements a thorough refereeing process similar to that of a journal.

The current CGEMS architecture is based on a client-server communication as shown in Figure 2. The clients, end-users, authors, reviewers and the editor-in-chief (EIC), access the system through web pages that in turn interact with a console application responsible for receiving the web applications requests, including file access, database access and sending emails. The system users, the submitted modules, modules assignment, the reviews, and other important data are all stored in a relational database that is accessed by the console application when needed.

In what follows we present an overview of CGEMS in which we discuss the rationale for the policy decisions we made. Next we describe related work. After a section discussing the editorial policies in place we discuss the current status of the implementation followed by conclusions and future work.

2 Motivation

Keeping up with the rapid changes in computer graphics

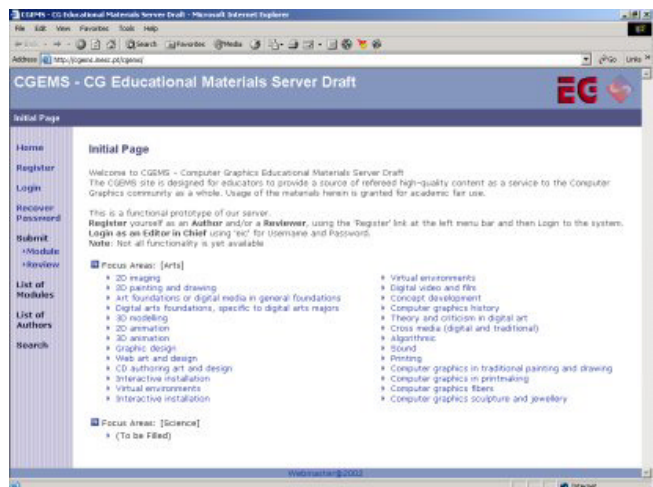


Figure 1 - CGEMS Initial Page

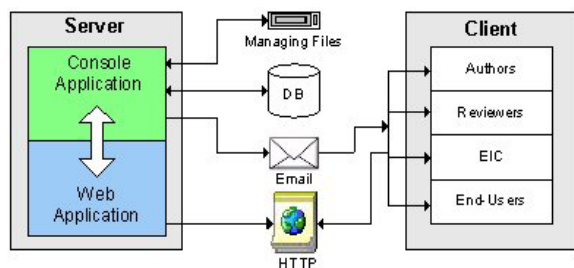


Figure 2 - CGEMS Architecture

and digital media alone present a challenge, but became even more formidable for those who teach others how to use it for artistic or scientific goals. Not only do educators need to understand digital media and what to do with them, but they also must help others to achieve that vision and discover innovative approaches to computer graphics and creativity. To add to this complexity, many digital innovations afford ways of thinking that not only extend what has come before, but also provide novel functions that invoke unique ways of thinking. So, along with understanding the medium and how to be creative with it, computer graphics educators must also discover innovative ways of thinking that new technology arouses. Once they master the latest technology and its implications, educators must invent assignments and lessons to convey that innovation to their students.

The task of CG educators entails developing the appropriate language to describe what new digital media are and how they can be made useful. Lev Manovich in *Language of New Media* [Manovich01] describes this as an attempt to create "... both a record, and a theory, of the present." He further states that the aim of such an endeavor is "... to describe and understand the logic driving the development of the language of new media."

Describing new media is especially important to people in the computer graphics field, both in the sciences and the arts. The impact on digital artists lies in grasping the meaning, because the description elicits an understanding, and that understanding, in turn, allows artists to either make commentaries about digital art with the medium or successfully use it as a tool. In either case, a technical landscape that changes every six months does not provide much time for educators to produce useful courseware in a timely manner.

The role of professional associations is then to support educators in their core activities. This has been recognized both by Eurographics and SIGGRAPH since the 80's in a series of workshops and activities related to CG education.

During the Eurographics / SIGGRAPH Workshop on Graphics and Visualization in Education (GVE '99) held in Coimbra, Portugal, art educators stressed, among other things, that curricula should focus on creative and technical concepts, over simply teaching hardware and software [GVE99]. Computer science educators also see a changing role in their fields. Indeed, as CG as a whole matures, much of the emphasis shifts away from teaching the minutiae and foundations of the discipline to the interrelations of latest developments and their applications. Still, the changing hardware and software influence, and in some cases transform, the way these are used and what creative expressions can be borne out of them. Whether in arts or science, new technology does not change creativity. Rather, it changes our understanding of art or science problems and enables us to observe things that we did not see before [Lovejoy97]. Because of this, and for

pedagogical reasons, computer graphics educators need to stay current with new CG trends and incorporate them in their curricula. The CGE'02 workshop held in Bristol [Bristol02] recognized this need and set the foundations to develop CGEMS.

3 Editorial Policy and Structure

Many debates took place during and after CGE02 to shape the structure and policies of CGEMS. To serve the community of CG educators worldwide, we wanted to ensure (a) timely submission, (b) regular updates, (c) rigorous quality control, and (d) peer recognition. This led to establishing a journal-like system with several review cycles without a fixed deadline. This enables flexible review workflow and encourages timely updates of content. However, there will be regular calls for submissions possibly at the end of each academic semester in fall and spring. In this way, we hope to get notes, assignments, and examples from successful courses.

Authors can update their materials in subsequent editions. These get assigned a new version number to differentiate from older versions. The new versions will also be refereed and do not replace older versions. Users will be able to make comments and rate modules, which will help authors with newer versions and other users to identify useful materials.

Authors will submit work only after they have registered in the system, which will issue a password via email that the author will use to submit and modify submissions. Although this is not fully secure, it will discourage would-be hackers. Authors will also be required to ensure that all materials are free from copyright and can be used and downloaded by users. Table 1 lists a subset of most commonly used formats.

While most if not all the materials currently assembled are written in English, we envisage and encourage both localizations and submissions in different languages, including Portuguese, German, French, Spanish, etc.

The general editorial structure of CGEMS includes one or more editors-in-chief (EIC) and an editorial board. The editorial board will both review submissions in their given expertise and solicit outside reviewers in specific disciplines for input. Additionally, as explained in detail later, a volunteer reviewer can register through the CGEMS system and members from the editorial board will deny or accept and place her or his application.

The editorial board will also be responsible for soliciting content submissions as well as advising the EICs on quality control of the server and identifying needs for under-covered curricula.

Text / Slides	Images	Video	Interactive media
HTML	GIF	RM	VRML
PowerPoint	JPEG	MPEG	Director
Word	PNG	AVI	Java
LaTeX	TIFF	Quicktime	Flash
PDF	SVG		

Table 1: Some of the more common formats

4 Related Work

In recent years many systems have been developed to support electronic submissions and peer-review of scholastic work, most notably for conferences as well as journals. These usually take the form of on-line web sites, which provide some degree of support for many editorial

tasks traditionally done using paper and conventional communication media.

Among the systems commonly available, many are devoted to managing conference submissions, although many systems support journal publication. The main differences between conference and journal management lie in workflow and deadlines. Conferences typically have submission deadlines and a shallow review pipeline due to rigorous timing constraints. These limit review and acceptance cycles to one or two at most. Moreover, conferences tend to set limits on the number of accepted technical contributions due to a limited number of presentation slots. As a result, selective conferences may reject technically sound, quality papers. On the other hand, journals tend not to operate on pre-set deadlines (save for special issues), but rather on absolute technical merit of submissions. Resource limits arise from publication and distribution schedules on paper journals, which constrain the maximum and minimum number of printed pages per issue. An on-line journal, on the other hand, is free of such limits. Because consumers pay for distribution costs when downloading, the fixed charges are just the space occupied on physical disks. Given the ever-shrinking cost per megabyte of storage these tend to be marginal. In this manner, journals tend not to set rigid deadlines, but can afford long review cycles and “deep” pipelines, where a given submission may be refereed several times before being accepted for publication.

On-line submission systems for conferences tend to be available more or less free of charges to the academic community, while most on-line journal management systems require some form of licensing and payment of fees. This is due to the different uses and needs of the different communities. While conferences tend to be organized by academicians and scientists on a voluntary basis, journals are traditionally run by publishers who, naturally expect to run a profitable venture.

After considerable discussion, we decided to adopt the journal model for CGEMS, including possible special issues. Indeed, while there are a few “natural deadlines” affecting educators in the field (end of academic year, semesters, professional conferences such as Eurographics

and SIGGRAPH, etc), forcing the conference model on submissions could result in lesser opportunities for interaction between authors and reviewers with a negative impact on the quality of final submissions.

Among the many systems available [ACM98], Cyberchair [CYC96] is among the best known and used. One interesting feature is that it offers support for most of the editorial/administrative tasks that we intended to support from the start. Further, the source code is freely available for academic use. However, many of the tasks are hard-coded into modules and the system proved difficult to adapt to our needs. Another excellent reference is Conference Review [CR02], which provides an excellent user interface but is not available as open source. Journal refereeing systems [SPARC02] in principle would be available as a basis to support our development. However as we mentioned above, these tend to charge fees, even for academic purposes, let alone providing access to their source code for modification.

For a fee, systems such as Bench>Press [BP01] claim to be customizable although this may take several months and can only be done in-house by the original developers. Other systems such as AllenTrack [AT02] are only accessibly remotely from a corporate server, which does not make them particularly useful for our purposes. Systems such as EditKit [EK01] and BioMed Central [BMC] seem to have been custom-developed for special applications and the support for editorial workflow is not clearly developed. Other systems such as Rapid Review [RR00] do not offer on-line support for many editorial tasks. The systems that seem to offer more complete support for the editorial and review process such as Bench>Press and Editorial Manager (EM) [EM02] do not make it clear how submissions are circulated to reviewers. Nor are details provided concerning workflow management and how to handle conflicting reviews. Another important criterion is browser and platform independence, which are usually glossed over by most systems.

In sum, most systems reviewed exhibit different shortcomings. We could find no general-purpose freely available system that we could readily adapt to our purposes. Therefore we decided to implement our own

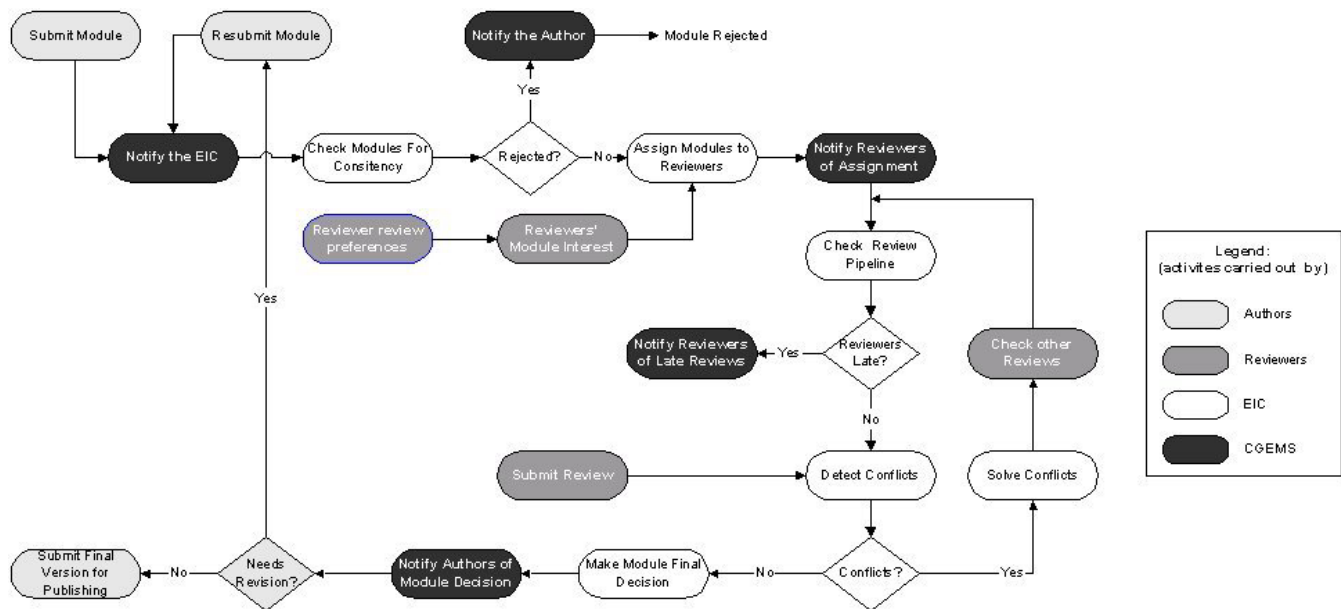


Figure 3 - CGEMS Overall Workflow

review and publication system. In the next section we describe the reviewing system and workflow.

5 Managing Workflow

In the following text we briefly describe the workflow and the information involving the *authors*, *EIC*, *reviewer* and *maintainer*, which are the four major roles in the process of submitting, reviewing and publishing educational content in the CGEMS server. Figure 3 shows the overall workflow of the tasks involved in the CGEMS submission and reviewing system.

Generally, the reviewing process starts when registered *authors* submit modules (understood as courseware materials) for future publication in the refereed server. The *Editor-in-Chief* (EIC) starts by checking modules against a set of minimum requirements related to content and style. The EIC selects for review those modules that satisfy a minimum of acceptability criteria, e.g. subject and scope. Modules thus selected are then assigned to at least three *reviewers* selected by the EIC, according to their declared preferences and experience. After all assigned reviewers have produced and submitted their analysis of content (reviews), the EIC decides whether a submission is accepted, whether it must be revised according to comments from reviewers, or whether it will not be accepted. Modules accepted for publishing are submitted once again by authors. The revised submissions get sent to the *maintainer* who makes the necessary arrangements to make them available to all CGEMS users. We will now present in some detail the main tasks to be performed by *authors*, *EIC*, *reviewer* and *maintainer*.

5.1 Authors

Before being able to submit modules into the CGEMS server, the *authors* first have to register on the system by filling in the *author registration form* (shown in Figure 4). The system then generates a unique identifier, or password, and sends it to the *author* through an email message that includes the username the author chose on the registration form. After successfully registering on the system and logging in to their personal web pages, the *authors* are able to: submit modules, change their login password, change their personal details, check their submissions status and info, resubmit modules, or interact with the editorial board concerning their submissions.

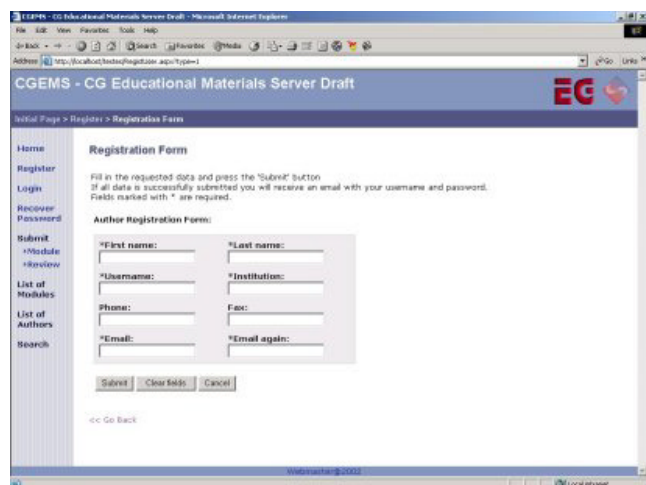


Figure 4 - CGEMS Authors Registration Form

In order to submit and resubmit modules *authors* must fill in a *module submission form* including the author's contacts, title of the submission, abstract, keywords, authors, and their submission as a compressed file. After the first submission the modules are sent to the *EIC* who checks the modules against formal grounds as seen above and is able to reject or accept the modules for review. Modules thus accepted are assigned to reviewers. After all the reviews have been submitted, the EIC can either accept the module without the need for major changes, send back the module for revision based on the comments made by the reviewers for a later reformulation and resubmission, or reject the module. In either case the author is notified via email of the EIC decision.

During the reviewing process, *authors* can check the status of their submissions in order to follow the review process. A submitted module can be in one of several states: a) submitted; b) accepted for reviewing; b) sent to reviewers; d) rejected; e) sent back for revision; f) resubmitted; g) accepted for publication and h) published.

Authors of educational modules accepted for publication are notified by the EIC. They can still review the module for a final submission and check the anonymous comments made by the reviewers and the feedback made by the EIC. If the reviewers and the EIC feel that substantial changes need to be made, another review cycle is started after the revised module is resubmitted.

5.2 Reviewers

Reviewers can be registered on the system by the EIC or they can volunteer to join CGEMS by filling in a *reviewer volunteer form* indicating their personal data and their review preferences, which are based on a collection of computer graphics and education keywords. The EIC can accept or reject the reviewer registration based on the registration information or through emails exchanged between them. After successful registration on the system, reviewers can login to their own personal web pages (see Figure 5) using the username they chose and a password that was sent automatically by email during the registration process. They are then able to: change their review preferences, change the password, change personal details and preferences, check and download the assigned modules for review, check the modules for the reviews they have

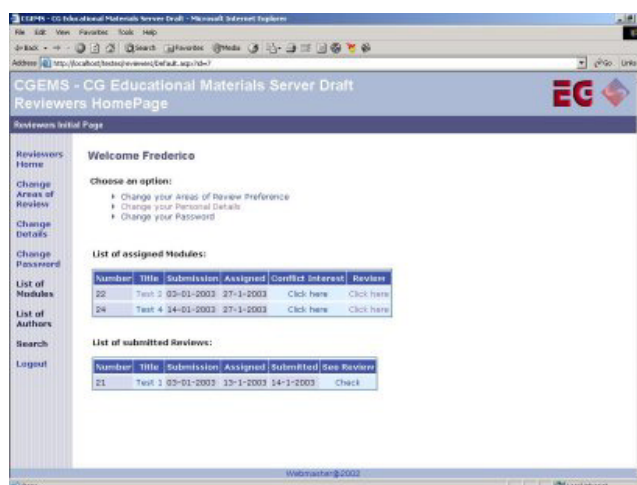


Figure 5 - CGEMS Reviewers Initial Page

already submitted, submit reviews, check submitted reviews, consult the comments made by other reviewers (after they have submitted their own review), and submit a conflict of interest to the EIC on their assigned modules.

The reviewer's preferences are used by the EIC to appropriately assign and distribute modules accepted for reviewing. This process is called *binding*. Reviewers can also indicate their preferences regarding which modules they would like to review. In order to support both the EIC and reviewers on the binding process the system provides them with web pages containing overviews of submitted modules.

Modules assigned for reviewing can be downloaded from the reviewers' web page. After reviewers have formulated their reviews they can submit them through a submit review form where they evaluate the modules on the following optional areas: portability and technical review; pedagogical content; scientific content and quality of exposition. In each of these categories the reviewer assigns an evaluation and writes his or her comments, which will help the EIC make a final decision about the module. The reviewers then make a final module evaluation based on the following classification: a) out of scope/ inappropriate; b) strongly reject; c) weak reject; d) weak accept and e) strongly accept; and fill in comments to both authors and EIC.

5.3 Editor-in-Chief

The *editor-in-chief* (EIC) is responsible for managing the submission and reviewing process.

The EIC is able to check modules against a set of minimal requirements (as described earlier) and can reject modules that fail on formal grounds and terminate the review process. Modules thus accepted are assigned to at least three reviewers according to their expertise and preferences.

Besides assigning modules to reviewers, the main task of the EIC is to monitor the review process by checking the reviews pipeline. The "check review pipeline" page is shown in Figure 6. Checking the status on all reviews enables the EIC to send reminders to reviewers who are late in submitting their evaluations. In extreme cases the EIC can assign the selected module to other reviewers.

After all reviewers have produced their reviews for a selected module, the EIC checks and resolves any existing conflicts and decides whether a submission is: (a) accepted;

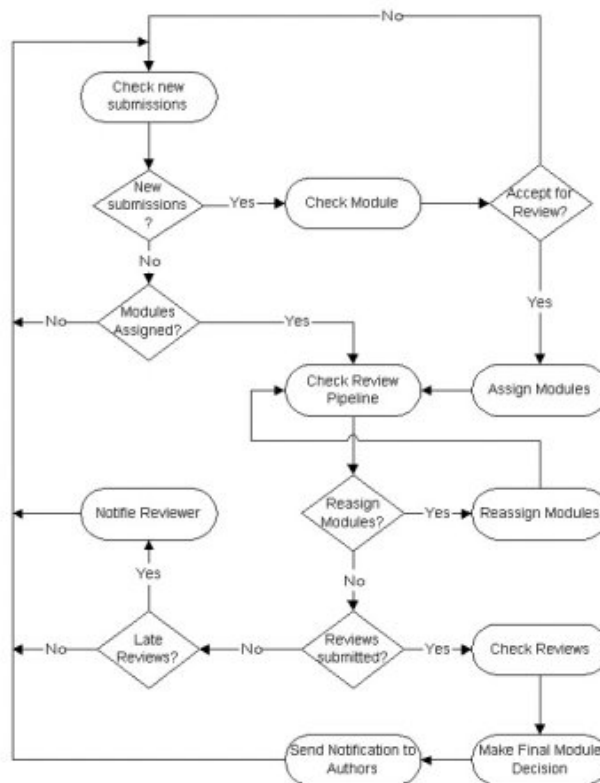


Figure 7 - EIC Workflow

(b) must be revised according to the comments from reviewers; or whether it will (c) not be accepted. In any case the authors receive an email with the final decision and feedback from the EIC concerning the module in question. The described editor-in-chief workflow is shown in Figure 6.

In addition to these main operations, the EIC can also: register reviewers; decide on reviewer's registrations; check all submitted modules and their status; check authors and send notifications; check reviewers and send notifications; manage the existing keywords on the system and manage CGEMS configurations details.

5.4 Maintainer

The maintainer, who could be the same person as the EIC, receives the final version of the modules that were accepted for publishing submitted by the authors. His or her role is to then prepare the accepted contribution for publishing. This may involve some extra formalisms, but more importantly, requires formatting, cataloging, and classifying accepted contributions so that they can be retrieved at a later time.

This task is very important and directly affects the usefulness of the refereed server. Thus we decided to isolate and assign this role to a distinct entity who may or may not be same person as the EIC

5.5 Automatic Notifications

A submission and review system should support sending notifications to the participants in the review process (authors, reviewers and the EIC). One of the main features of CGEMS is an automated notification mechanism. Our

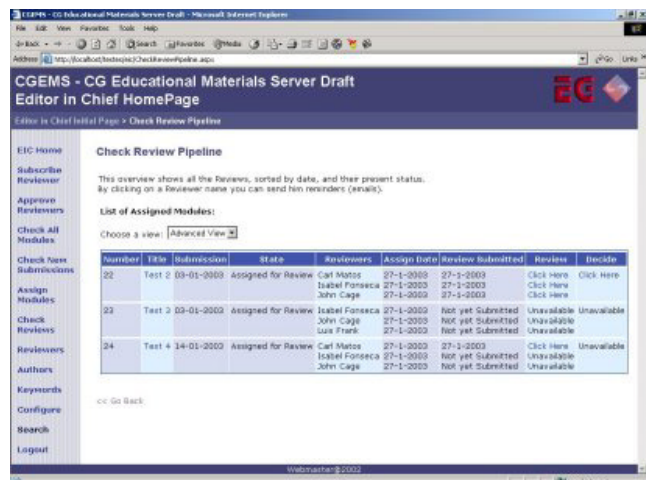


Figure 6 - CGEMS EIC Check Review Pipeline Page

goal is to minimize the number of times the users must access the system.

CGEMS sends automatic email notifications to the users to notify them of the activity that is happening in the server. This way we are able to reduce the user's need to logon to the system, yet at the same time keep tabs on refereeing activity. For example, the authors do not have to access CGEMS frequently to check whether their submission has been accepted or rejected because this information is sent to them by email.

Email is sent in a number of situations, including the following:

- authors receive a notification every time the module status changes;
- reviewers are notified when they have been assigned a module to review and when they are late in delivering their reviews;
- the EIC receives notifications when authors register; when reviewers volunteer; when an author submits a module; and when a reviewer submits his module review.

5.6 Current Implementation

From an earlier prototype developed in August 2002, CGEMS is currently available and hosted in an independent server installed at INESC. The current efforts are the outcome of a project in digital publishing partially supported by the European Commission, Eurographics and the SIGGRAPH Education Committee. A team of two developers, Frederico Figueiredo and Sónia Assunção, coded the initial application, web design and layout of CGEMS pages. Their design and layout definition were based on previous studies made on how to design web pages with good usability levels. Rhonda Schauer helped with the current design, layout and wrote the stylesheets for CGEMS. The current version works as a collection of ASP modules, although the server is in the process of being recoded in Java to ensure server platform neutrality.

5.7 Browser Compatibility

A major goal during the design and development of the web applications for CGEMS was to make the user pages browser independent in terms of both the interface design and interactive functionality. We have accomplished this for a large set of commonly used browsers. The current implementation works with Internet Explorer 5.0 (or higher), Netscape 7.0 (or higher), Mozilla 1.1 (or higher), Opera 6.04 (or higher) and Netscape 4 browsers. At the time of this writing we are presently working on some layout problems with Netscape 4.

It is possible to experiment with the current implementation of the CGEMS server and test it's functionality by visiting <http://cgems.inesc.pt>. At the time of this writing we are finalizing the server and performing integration and portability tests. By the time of SIGGRAPH'03 we expect the first call for contributions to be complete the first accepted submissions to be coming out of the reviewing pipeline. Our major aim is to make the server available to the community of CG educators worldwide by Fall 2003.

6 Discussion

In this section we discuss the current implementation, chief advantages, and perceived shortcomings. Among CGEMS main features are online registration for both

authors and reviewers and the ability to submit educational modules, reviews and other information online. Moreover the current version supports online management of all reviewing workflow. This includes awareness management for all aspects and events that arise out of a journal operation. Our system also provides automatic email notifications to CGEMS users whenever new modules are published. To foster interactions within the community of CG educators, authors and reviewers alike are able to access the system with only one username and password for a given user. Subject to EIC approval, users can volunteer online to review submissions. The EIC is also able to assign modules based on stated preferences and interest in particular modules expressed by reviewers. The system has been tested for portability with a large number of different browsers, spanning more than 80% of current Internet users' configurations.

The current implementation still falls short on several desirable services for community support such as user comments and ratings. However, we plan to add these in the near future.

The most relevant core services of the CGEMS proposal arising out of the CGE02 workshop are already implemented and in good working order. Both the core submission and review system functions are implemented and tested. We are looking to extend the core systems functionality through enlisting the cooperation of additional members from the computer graphics education community at large.

7 Conclusions and Future Work

While computer graphics has matured in regard to basic concepts, it is still experiencing rapid growth and phenomenal evolution in applications and research. This makes for an extremely dynamic environment and presents challenges to educators who have a need to keep abreast of latest developments while developing high-quality teaching materials. We have presented an overview and high-level description of CGEMS, a refereed content server for CG educational materials. CGEMS aims to provide basic services to the worldwide community of CG educators through refereed content. However this does not prevent using the server to also host non-refereed information.

We feel that the added value of such a server is directly related to the rigor of the refereeing process. Not only does a refereed system ensure premium materials, but it also supports recognition of those who publish on the server. To this end we have developed comprehensive support for online submissions and editorial workflow management. The prototype system is now online. In order to have initial publications of refereed content by SIGGRAPH 03, we plan to launch a call for volunteers and submissions shortly. Future versions will add extended community services and more sophisticated publication and redaction management services, as well as extended community services.

In the future we plan to implement services that further support the community, such as user comments and ratings for specific modules, mailing lists, advanced search mechanisms, and email notifications of server activity. Along with these added features, we will continue to evaluate the success of the functions and processes and make changes when necessary.

We hope to mirror the site in a number of locations, including highly visible sites such as the SIGGRAPH server. Our hope is for CGEMS to become the primary

centralized resource server for computer graphics educational materials. While much work remains to be done, we feel confident that CGEMS can serve as a cornerstone in supporting educators in spreading the gospel of computer graphics.

8 Acknowledgments

This work was supported in part by the European Commission grant Alfa II-0072A and by a Eurographics and SIGGRAPH Education Board special projects fund. The authors are especially indebted to Rhonda Schauer for her excellent contributions concerning stylesheets and browser independence. We are also grateful to Sónia Assunção who worked on the initial design. We would like to thank Steve Cunningham and Judy Brown for many comments and suggestions.

9 References

- [Bristol02] Proceedings, Eurographics/SIGGRAPH Workshop on Computer Graphics Education, Bristol UK, July 2002. <http://virtual.inesc.pt/cge02>
- [GVE99] Documentation of Workshop on Graphics and Visualization Education, Coimbra, Portugal, <http://www.eg.org/WorkingGroups/GVE/GVE99>
- [Lovejoy97] M. Lovejoy. *Postmodern Currents: Art and Artists in the Age of Electronic Media*. Upper Saddle River, NJ: Simon and Schuster.
- [Manovich01] L. Manovich. *The Language of New Media*. Cambridge, Mass: MIT Press. 2001
- [ACM98] R. Snodgrass. Summary of Conference Management Software, 1998
<http://www.acm.org/sigs/sgb/summary.html>
- [CYC96] Cyberchair homepage <http://www.cyberchair.org>
- [CR02] Conference Review at
<http://www.conferencereview.com>
- [SPARC02] Rich Johnson, Publishing Resources for Journals and Repositories, 2002
<http://www.arl.org/sparc/core/index.asp?page=h16>
- [BP01] Bench Press <http://benchpress.highwire.org/>
- [AT02] AllenTrack, at <http://benchpress.highwire.org/>
- [EK02] Berkley Electronic Press, EditKit available at
<http://www.bepress.com/services.html>
- [BMC] BioMed Central
<http://www.biomedcentral.com/info/authors/startajournal>
- [RR00] Rapid Review at
<http://cjs.cadmus.com/rapidreview/>
- [EM02] Editorial Manager,
<http://www.editorialmanager.com/homepage/home.htm>