Project Title:

Creation of an Interactive Software Program for the Study of Human Anatomy

Applicant(s):

<table>
<thead>
<tr>
<th>Name</th>
<th>Telephone</th>
<th>Dept.</th>
<th>College</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paul Craig</td>
<td>5-6145</td>
<td>Chemistry</td>
<td>Science</td>
</tr>
<tr>
<td>Richard Doolittle</td>
<td>5-5972</td>
<td>Medical Sciences</td>
<td>Science</td>
</tr>
<tr>
<td>Andrew Phelps</td>
<td>5-6758</td>
<td>Information Technology</td>
<td>GCCIS</td>
</tr>
</tbody>
</table>

Project Summary:

Previous Work

To-date, there are no educational software programs that allow the user an opportunity to move from the gross to the cellular to the molecular environment of the human body in a virtual 3D or 2D world. Much of this past summer and current academic year have been spent investigating ways in which students could learn more about structural design through the use of 3D graphical systems, possibly coupled with real-time interaction. With the aid of student employees, new 3D graphics animations were created in pilot molecular, cellular, and whole organ system models as a means of proving that 3D reconstructions and visualization tools could help enhance the learning process. Many of the graphics produced over the year will be utilized within Powerpoint presentations and specialized demonstrations offered to students in a number of classes, particularly this coming spring.

Proposed Work

The graphic assets generated last summer are in the form of digital images and short Quicktime movie clips that will be shown as demonstrations to students in Human Gross Anatomy and Histology and will be made available for unlimited student use within the MyCourses system. Information will be gathered with regard to overall student use and student perception of this
product’s impact on their learning process.

However, these forms of display are somewhat limited by their static nature. Students can view the images or play the movies, but they can’t explore or interact with the content. The goal of the proposed project is to create new software that will allow students the opportunity to learn from a virtual environment utilizing a fully interactive tool. Specifically, with the aid of students from information technology and/or computer science, under the mentorship of Professor Andrew Phelps, an interactive world will be constructed to allow students full maneuverability through a virtual representation of the pancreas and liver. Users will be able to view all parts of these organs through a wide range of magnifications all the way down to the molecular level. Additionally, students hired from the Medical Illustration program will be part of the team to continue to create new assets, while working with the students from GCCIS to make modifications in existing ones for use in the proposed interactive environment. The ultimate goal is the creation of a virtual human, a digital library of body organ systems that students may access at any time to improve their understanding of structures and functions of the human organism.

It must be noted that the creation of such a system is decidedly non-trivial, particularly under the performance constraints of real-time interactivity. Researchers the world over are struggling with issues of medical visualization, trying to best understand how the performance benefits and real-time nature of game environments can be appropriately applied to the study of serious visualization topics. We hope to build upon existing success in visualization, computer graphics, and games technology such as the M.U.P.P.E.T.S. engine, our work in Multi-User Media Spaces coursework, and other synergistic projects within the Entertainment Technology Laboratory. Our goal is to combine these technologies to create a real-time interactive display for virtual medical media. A distinctive advantage of such a system is that it allows for per-student customization of the interface, and instructor customization of the content such that specific elements can be queried, highlighted, and discussed. Finally since the delivery of such a tool can be problematic, every effort must be made to appropriately interface with the existing tools for student interaction and course material dissemination, which in this case implies a careful integration with the MyCourses system.

**Targeted learners**

A fully interactive software tool for understanding body structure and function will prove valuable to a wide audience of student learners. Two different groups of students will be affected: users and developers. Materials developed in the course of this project will provide users with the ability to maneuver through an interactive program to investigate structure and function within a 3D and/or 2D environment. In particular, courses in Human Anatomy and Physiology (COS/CIAS/COE students), General Biology (COS students), Human Biology (general education course for any major), Human Gross Anatomy (COS), Medical Pathophysiology (COS), and Histology (COS) would make the greatest use of the software product.

Developers will create the materials for this project A few of these will participate directly in the proposed work with Doolittle/Craig/Phelps, but many will also have the opportunity to create content and/or software tools as part of advanced courses in their major fields. This project will serve, therefore, as a model for projects similar in scope for students within upper division classes in Computer Science/Software Engineering/Information Technology (GCCIS), Biomedical Photography/Medical Illustration (CIAS), and Biology/Bioinformatics/Biochemistry (COS).
Number of Students Affected

These materials will be utilized within the courses listed below across a number of Colleges (student numbers listed in parentheses):

College of Science
General Biology (125 st)
Human Biology (100 st)
Human Gross Anatomy (65 st)
Histology (30 st)
Medical Pathophysiology (60 st)

College of Imaging Arts and Sciences
Advanced 3D:Bio and Organic Forms I and II (15 st)
Anatomical Studies (15 st)

College of Science
Biochemistry – Conformation & Dynamics (60 st)
Molecular Modeling & Proteomics (25 st)

Golisano College for Computer and Information Sciences
Computer Graphics I, II (60 st)
Foundations of 2D Graphic Production (40 st)

Anticipated Impact on Teaching and/or Learning

With the availability of a fully interactive software tool, students will be able to zoom in and out through wide ranges of organ, tissue, and molecular structural detail. Students will have the option to click into specific structures to access contextualized, annotated information. In this way, they can proceed at their own pace through ascending levels of organ complexity to learn about body structures and functions.

In addition, there are several areas for student growth within the Information Technology program, and the forthcoming Masters in Game Design & Development. The work that this project seeks to undertake will be done by students in these programs through the Entertainment Technology lab within GCCIS, and they provide a unique opportunity for students studying graphics, game technologies, and user interface design to apply those skills within a specific domain of scientific conceptualization and visualization. This cross-disciplinary experience has been successful in the past with the partnership of the M.U.P.P.E.T.S. project and the work of Paul Craig’s students at the Brookhaven National Laboratory, and we expect that there will be similar learning and growth that this project facilitates.

GCCIS further hopes to document this ‘melding’ experience between computer visualization and scientific study such that our development work here can be used as a case example to students studying computer graphics and entertainment technology in future years – a home-grown example of the type of cross-disciplinary approach that has sparked the Serious Games Movement within the International Game Developer’s Association, and one where the students can actually examine the source code to explore the similarities and differences between doing such work for educational software and purely entertainment domains.
**Anticipated Impact on Student Success/Retention**
As we speculated in our PLIG submission one year ago, the lives of last year’s student participants were changed dramatically.

“Creating near-limitless opportunities for students to engage in imaging research as part of an interdisciplinary team will add greatly to their professional development and scholarly achievements.”

We anticipate, based on the successes of this past academic year, the thrust of this next year’s team will achieve similar gains as we expand the group to include greater representation from computer science and information technology. At the same time, the software products developed through the proposed work will improve the learning potential for students who might otherwise struggle with their understanding of the connections between body tissue structure and function.

**Measure of Impact**
Consistent with the outcome from last year’s PLIG-supported project, we intend to submit an abstract and request to present at the 2007 Slice of Life international conference on medical education as a means of highlighting students’ achievements and contributions to new multimedia tools. We will also plan to submit a manuscript for publication, co-authored by students, within an established journal for medical education i.e., Journal of Audiovisual Media in Medicine, BMC Medical Education, or Teaching and Learning in Medicine.

This project and its product outcome will help bridge the gap between faculty and students across several Colleges at RIT and thereby provide a working model in support of interdisciplinary initiatives within the university. We will track the number and variety of faculty and students who become involved in this project as a measure of its degree of impact. Faculty who participate individually or by using these materials in their courses will be asked to prepare a summary statement at the end of the project and student use will be tracked through mechanics available within myCourses.

**Project Rationale**
In the past year, we have worked with students to generate new virtual reality images and animations of tissue architecture that have never been seen before. In and of themselves, while these new products have wide appeal, students’ capacity to learn from them is limited by the absence of an interactive interface. Students will become more effective learners if they have the ability to maneuver freely through a virtual environment while having access to full annotation associated with each of the structures.

Within the real world workforce, new software educational tools are developed each day from interdisciplinary teams of technical and content experts. Through the proposed study, we plan to create a team of faculty and students in a continuing effort to connect RIT’s technology base to content areas of the disciplines within the sciences and graphic arts to generate new educational materials that will change the way in which students learn about the life sciences.

**Project Development Timetable**
During the spring quarter we will identify student participants, select target organ systems and disease states, and select a programming approach and environment. During the months of June,
July, and August, the proposed work will be conducted under the guidance of the faculty advisors. In particular, the team will meet weekly to discuss progress and plan future directions.

Week 1  Time line project responsibilities
Week 2  Define project scope
Week 5  Reassess breadth and depth
Week 8  Finish content/software
Week 9  Documentation and integration
Week 10  Presentation at Open House and at Summer Undergraduate Research Symposium

We will continue the work during the 2006-2007 academic year by (a) continuing to supervise student research, (b) presenting and publishing our results, and (c) involving more faculty and students campus-wide in the project.