Role of Game Programmers for Serious Games in Academia: Colleague, Collaborator AND Client

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This is a story of four university faculty, two men and two women, and the research team they formed based on an NSF grant opportunity. There is also a cadre of university students that are learning real-world lessons on group roles in a research endeavor. Our story begins with the role of **Colleague**.

A typical situation at institutions of higher learning is that faculty in different colleges (or departments) are unlikely to find common ground to collaborate. But the assumed Colleague-role will easily allow a faculty with a need (computer enhanced education in Mechanical Engineering) to reach out to another by email in April 2008. In our situation, Dr. Khaled Morsi knew that undergraduate students in the College of Engineering were each required to take a lecture course in Materials Science. Due to the possible danger and as well as expense of having a lab experience in this topic, only students in the Mechanical Engineering (ME) major received the hands-on experience of working with the impact testing and tensile testing machines in the engineering college lab. Dr. Morsi contacted the first author due to her SDSU Undergraduate Catalog listing teaching CS 583 3D Game Programming [1]. His goal was to apply to the National Science Foundation (NSF) for funding to create a computer simulation of the Materials Science laboratory experience that students in the lecture-only course could use to gain some level of insight to the field. Stewart was interested to provide students who enrolled in her CS583 course the experience of working outside their discipline with a Client from ME.

Having taught Game Programming at SDSU since 2005, Dr. Stewart knew that most CS programmers do not have the training in art to allow them to effectively create the 3D objects that would be needed to simulate the actual engineering laboratory. She had collaborated over the years with Dr. Mark Siprut in Art and realized he needed to be part of the team to ensure authentic art objects would be incorporated into our online game simulation. The NSF program CCLI also required assessment of the effort. Luckily SDSU has a strong College of Education and Dr. Marilee Bresciani agreed to join our team, which was funded in January 2009 [2].

Then the **Collaboration** began. The four co-PIs discussed the software to use for the game simulation and Stewart suggested Microsoft XNA [3] based on the software capability to simulate the engineering lab in 3D, strong education support from the online community, advantageous licensing fees (free) for non-commercial use and this was the software currently used in the CS 583 course. Dr. Morsi is our Principal Investigator (PI), and content expert in the topic of the game, and the three Co-PIs would guide and supervise the work of graduate students in our own disciplines to create the art models for the game software, write the game code in XNA and evaluate the learning experience.

The artists' first choice of development tool was Maya [4] from Autodesk, due to its capability and availability in the Art Labs through cite-license with SDSU. This software is covered in various courses that Dr. Siprut teaches, so he would be able to find art students to join the team.

Stewart was part of the NSF's OCI "EPIC - Engaging People in Cyberinfrastructure" [5], where she studied the Torque Game Engine [6] which led to establishing the SDSU course in 2006. Stewart has studied how game programming can be used as service-learning for computer science students [7] and always incorporates this consideration in the course . She feels that channeling CS programming student interest towards the Serious Games [8] field will add depth to student programming experience. Over time much additional evidence tracks the growing use of game technology in a variety of applications [9]. There are applications in military training [10] and NASA (National Aeronautics and Space Administration) [11] as well as Science and Engineering Visualization [12].

Within the game programming side of development, Stewart was able to engage a sequence of students, after completing the upper-division CS elective class CS 583, to join our team. The first student was Mark Thompson, Jr., in January 2009. Mark worked closely with the students from ME who used Pro/Engineer [13] to create fine-grained prototypes of the devices in the Materials Science laboratory. Mark was key to the project in finding the way to smooth the process of taking prototypes from Pro/Engineer, which were refined by the art lab students using Maya and eventually recast using 3D Studio Max, now also available from Autodesk [14]. The compromise between the realistic detail from the engineering CAD models, then made believable as 3D models on the screen by artists using Maya, then simplified to allow effective representation within the 3D world of the game environment without losing any needed detail for an efficient game was essential to the development and is a continual tradeoff.

Our second game programmer, Abhishek Sood, took on the task of providing much of the text-manipulation needed in the lab to explain the requirements of the lab and the materials being explored. As a preliminary presentation on campus, both Thomspon and Sood participated in the SDSU Student Research Symposium, 2010, with their poster [15] created by Claudia Fault in the Art Lab. Abhishek Sood defended his Masters Thesis [16] at SDSU Spring 2012. A co-game-programmer with Sood, Sathyanarayan Chandrashekar, also successfully defended his CS Masters thesis in Fall 2011, on a topic distinct from MatsISLE, "3D Visualization of Conic Sections in XNA Game Programming Framework" [17].

We are now happy to share preliminary assessment results [18] for the learning outcomes of the students from engineering who have used the software game, now titled MatsISLE (Materials Science Interactive Simulated Laboratory Experience) [19]. Our current game programmer, Megha Shaseendran, has entered the Microsoft Imagine Cup with her programming of the 3D Lattice Voyage [20].

Our game programming students and art students have been working side by side through the development process for several years now and though the individuals have changed, the project is now demonstrating believable detail and effect game-play. The students have also had the opportunity, in our weekly team meetings with Morsi, Siprut and Stewart, to observe some discipline-specific attitudes expressed by the faculty. Talking with the game programmers afterwards, they have uniformly told Stewart that the experience was unique and useful. Programming to deadlines was challenging. Being the **Client** for the artists who were charged with creating the 3d models was illuminating. The game programmers have been client, collaborator and colleague with an outcome of three separate Material Sciences Labs that allow 3D simulation of the lab. The engineering students have expressed they value of the interactive labs and further formal assessment results are expected soon.

We have a first person point of view game that runs on Windows platforms that provides an interactive, non-linear and dynamic education experience, as suggested by Jackson [9]. Please stay tuned for access to the final software which will be distributed through the Multimedia Educational Resource for Learning and Online Teaching (MERLOT) [21]

We wish to acknowledge the artists who have contributed to this project: Christina Bertrang, Claudia Faulk, Julius Santos, Jessica Knight and more.

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[11] NASA Ames Simulation Laboratories, http://www.simlabs.arc.nasa.gov/

[12] Science Magazine's Science and Engineering Visualization Challenge http://www.sciencemag.org/feature/data/vis2003/ssintro.html

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[19] Web Page of artifacts from our Game Development project can be viewed at http://www-rohan.sdsu.edu/~stewart/MatsISLE

[20] Imagine Cup http://www.imaginecup.com/CompetitionsContent/GetStarted.aspx

[21] http://www.merlot.org/merlot/index.htm MERLOT is a free and open online community of resources designed primarily for faculty, staff and students of higher education from around the world to share their learning materials and pedagogy.

Samples of images from game-play. A live demonstration of the running game will be presented at the conference.

Fig 1: Start Screen with our logo

Tensile-Testing Lab:

Fig 2: The samples on the lab table, along with Task List for this last

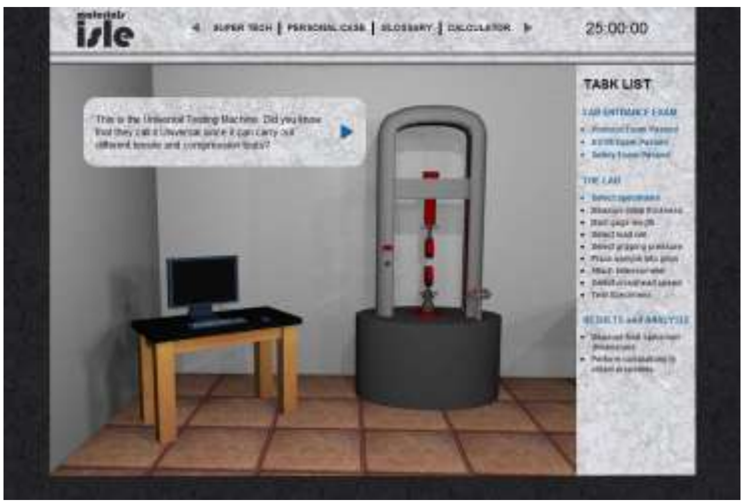

Fig 3: The Virtual Tensile Testing Machine

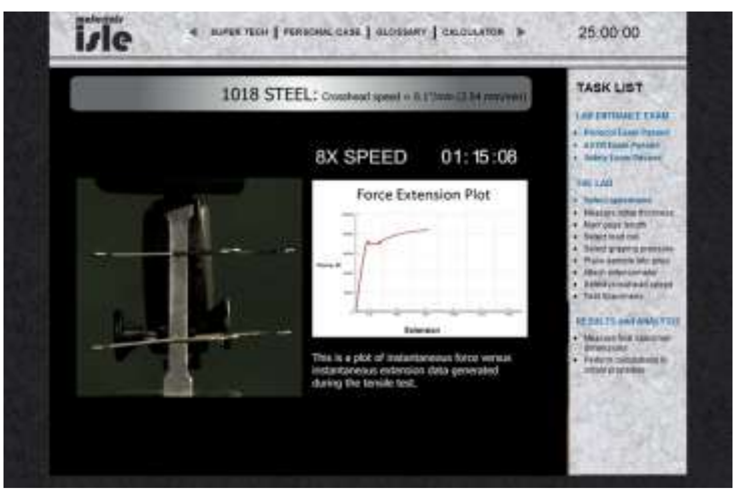

Fig 4: The high-speed video of actual tensile-test lab experiment, incorporated in MatsISLE Game

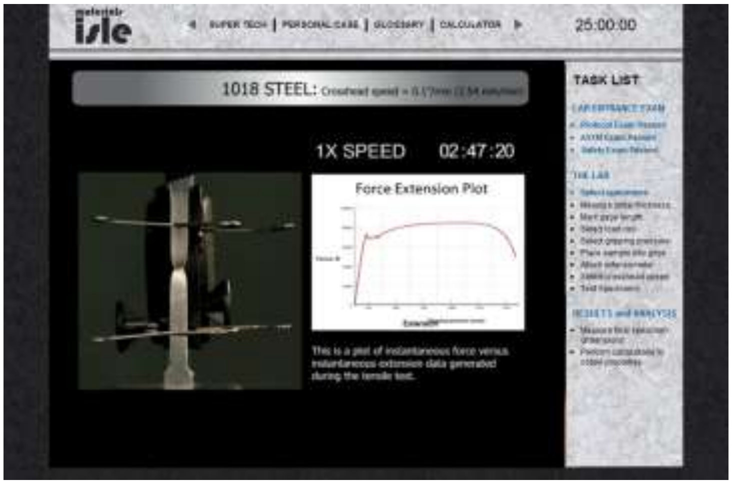

Fig 5: Critical frame of "necking" of the material before actually pulled apart

Impact Testing Lab:

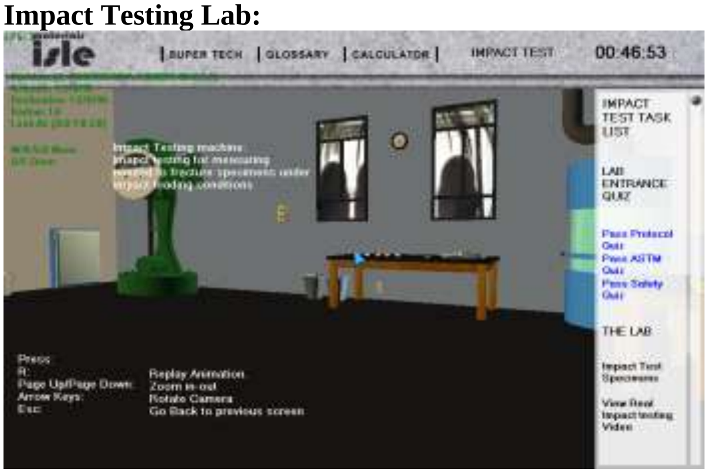

Fig 6: The Lab room with the Virtual Impact Test Machine on left; Sample table on right

Fig 7: Safety glass comes up to simulate sheltering user from flying fragment

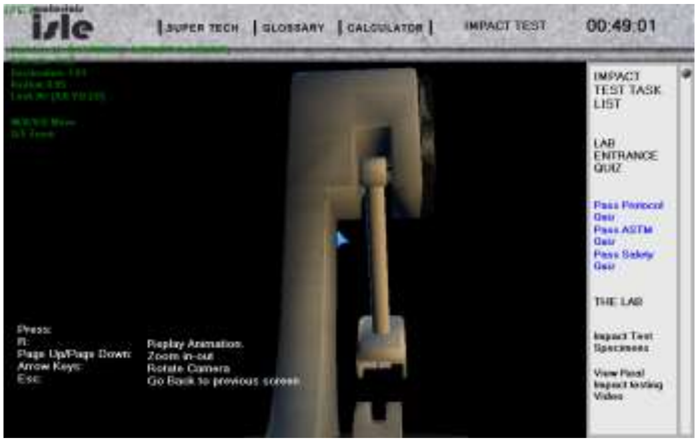

Fig 8: Simulated swing of Impact Test Machine through the sample

Fig 9: Actual high-speed video of actual Impact Test Machine, included in MatsISLE game

Lattice Voyage:

Fig 10: Virtual image of Caliporter in the virtual lab environment

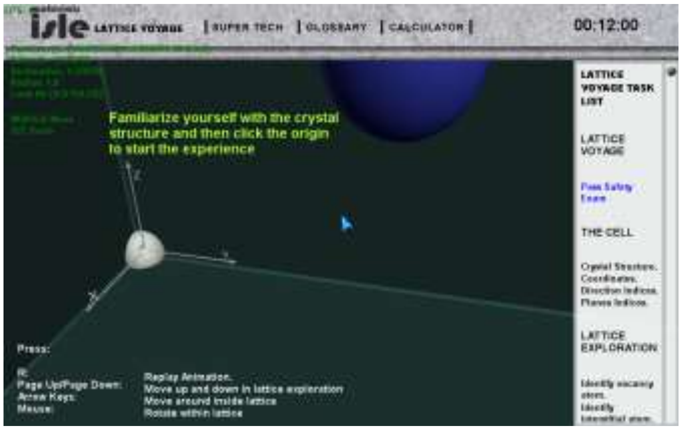

Fig 11: Students asked to familiarize themselves with crystal structure (by moving about), then click origin to start the virtual experience

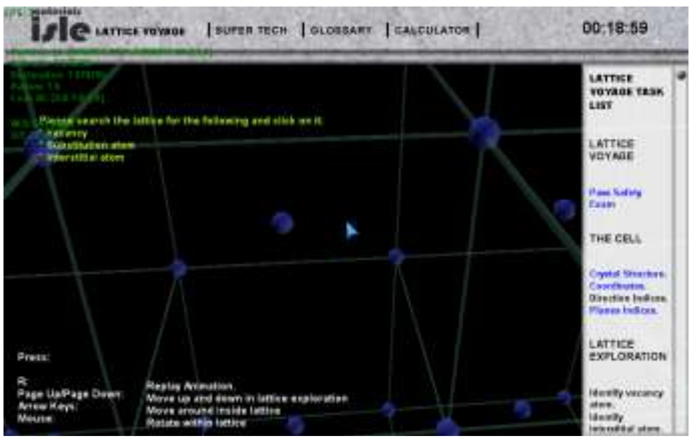

Fig 12: Student sill search the virtual 3D space to identity a vacancy, a substitution atom and a interstitial atom

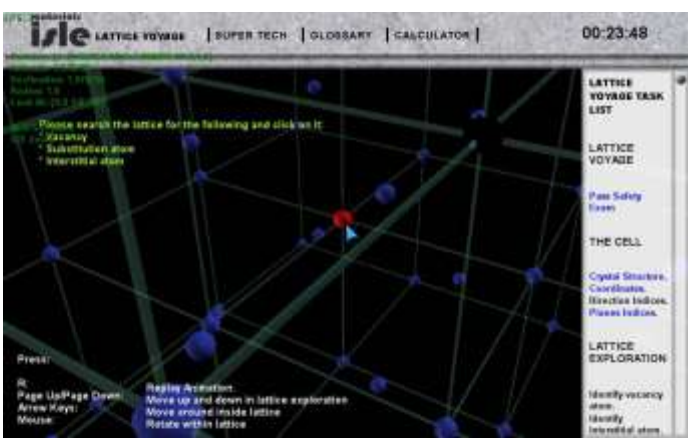

Fig 13: The red item is identified as a substitution atom