“Collaborative Animation Rendering System”

Student Faculty Research Collaboration Grant Proposal

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Project goals and objectives

In academia and industry, there is a growing demand for increasingly complex digital 3D modeling and animation. As the complexity and detail of these digital models and animations increase, the time and computational power required to render these images and videos have risen dramatically. Historically, large distributed computer systems called **render farms** have been implemented to spread the extreme workload of the rendering process among several processors such that the digital rendering is performed in parallel for massive speedup and throughput improvements. Having access to such a render farm not only provides quicker turnaround time (i.e. getting the final output sooner), but also enables the use of more detailed and sophisticated materials and techniques.

As part of the ongoing collaboration between the departments of Computer Science and Art, ***we propose constructing a collaborative animation rendering system*** that will be used by both Computer Science and Art majors to render and produce highly detailed and advanced digital models and animation. To accomplish this goal, we will utilize existing computational hardware resources from both departments[1] and develop the software system that combines these individual systems into a larger distributed rendering system for generating Blender 3D models and animations.

An example of constructing a low-cost animation rendering system is provided by Patoli et al., who utilized the Condor grid platform to combined the resources of 5-10 commodity desktop machines to form a modest render farm that generated animations for the Blender 3D modeling and animation application. Pooling these machines together enabled them to achieve significant speedups in terms of animation time. Moreover, Patoli et al. simplified the use of their system by integrating their rendering mechanism into the Blender application.

For our project, students will work with faculty to construct a similar animation rendering system that operates at a slightly larger scale (10-40 machines) and utilizes an heterogeneous computing environment. That is, unlike Patoli et al.’s system, our project will utilize a variety of

[1] For instance, we will use computational resources from Dr. Bui’s Condor Pool (http://dpl.cs.uwec.edu/operations) and possible some of the Macs from the Art student cluster.

machines running Linux, Windows, and Mac OS X and with varying hardware configurations. Additionally, we plan on supporting the ability for students to temporarily contribute their own computational resources (e.g. laptops) to the rendering system to form an ad hoc virtual cloud system. To facilitate these goals, we plan on using the WorkQueue distributed framework[2] to provide the software infrastructure for the project. To simplify the use of our rendering system, we will also attempt to integrate into the Blender application via its plugin system.

In addition to developing the collaborative rendering system, students will work closely with the faculty to develop a short film or animation that takes advantage of these additional computational resources. Usually, animators are limited by their hardware, and this has been especially true in art departments that are beginning to offer courses and curriculum in 3D animation and modeling. In this case, the students will be encouraged to create high level-of-detail (LOD) models and environments (i.e., they may use high polygon counts in the models, high-resolution material images and textures). Polygons are

Once this system is available and capable of rendering advanced models and animations, students will collaborate with faculty to produce a set of curriculum materials that can be used by both an animation program in Art & Design and in distributed and parallel programming courses in Computer Science.

In summary, our project goals and objects are:

1. Develop a software application that utilizes various computer hardware systems to implement a collaborative animation rendering system.
2. Produce a short film or animation that takes advantage of the capabilities of this render farm.
3. Compare the performance of this render farm to that of a single machine.
4. Present the developed system and the produced animations at various research venues.

Collaborative plan for students

1. Students and faculty will meet at regular intervals.
2. Based on the SCRUM software development model, students will propose a set of goals at each meeting, and will be accountable for reaching them.
3. Students write blog entries about their progress to provide a digital journal of their research experience.
4. Faculty will monitor student progress and provide feedback and mentoring.
5. Celebration of Excellence in Research in Creative Activity (CERCA) event will be held May 1-2, 2013.

Nature and extent of student and faculty activities and involvement

Students will meet with at regular intervals with Professors McMann and Bui to discuss goals, plans, and execution details. They will be the ‘boots-on-the-ground’ and will be able to offer valuable design and computational insights. The students will have a deep involvement in the process, which includes writing scripts and presentations, art direction, asset development, 3D modeling, environmental design, motion scripting, and application development.

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[2] Dr. Bui was one of the primary authors of the WorkQueue framework at the University of Notre Dame and has extensive experience with it.

While the high-level design of the software system will be provided by the faculty, the students will be responsible for the most of the implementation. This means that although faculty will contribute parts of the software and will perform system administration, the students will perform most of the programming. In particular, the students will be responsible for integrating components, testing, and interfacing with users.

Altogether, this project will provide students with an opportunity to work with faculty in exploring advanced research issues in distributed computing and digital animation, developing a production animation rendering system, and producing a sophisticated short animation film. Furthermore, students will learn how to work with parties from other disciplines in a collaborative and integrative project.

Plan for disseminating results

The results of our research project will be presented at the Celebration of Excellence in Research in Creative Activity (CERCA) event will be held May 1-2, 2013. Additionally, students will blog about their research experience and will create an online gallery where they will post finished projects, along with process material. The software system will also be released online under an open source license to the general public.

Depending on the success of our project, we may also pursue presenting our work at Condor Week 2013 in Madison, WI.

History of prior funding from ORSP for this project

No history of prior funding.

References

Patoli, M. Z. et al. “An Open Source Grid Based Render Farm for Blender 3D.” *2009 IEEE/ PES Power Systems Conference and Exposition* (2009): 1–6.