Navigation and Interaction with People in a 3D Virtual Environment

Diana Forrest

Advisor: Dr. Badler

University of Pennsylvania

ABSTRACT

The purpose of this project is to implement the ability to navigate and interact with computer-generated crowds from a first-person point of view through use of an immersive three-dimensional virtual environment. Leading up to this outcome is the implementation and possible improvement of current methods that are used to explore a virtual space whose boundaries are larger than those of the real-world location.

Project Blog: http://dforresteas499.blogspot.com/

1. INTRODUCTION

With the help of modern-day technology, anthropologists are able to represent sites and findings via 3D computer modeling and animation techniques. It is even possible to populate these environments, showing how people from a particular time period may have lived and interacted with each other and their surroundings. There are several ways these scenes can then be presented to an audience – for example, one method is to have a camera fly over the scene, circling everything from a distance. Another approach is to navigate the virtual environment from a first-person point of view, as though looking through the eyes of a person who is a participant in the scene. Using this latter approach, a user would be able to come closer to feeling like he or she were really there.

A three-dimensional virtual environment that uses a head-mounted display (HMD) and real-world walking as a means of navigation is a highly immersive way to explore a computer-generated space, enabling a user's real actions to correspond to similar actions in the virtual world. An inherent problem with this technology, however, is that the virtual environment can be larger than the real-world physical space that the user actually moves around in. Due to this limitation, re-orientation techniques have been developed that use audio or visual cues to change the user's real-world direction in order to allow continued exploration in the virtual direction.

When non-static elements such as virtual people are added to the environment, a new challenge is presented in terms of both navigation and interaction. Using CAROSA, a crowd simulator, groups of people can be placed in the virtual environment and given particular behaviors and activities that would enable them to interact with the user, and the user, in turn, would be able to move around and interact with the computer-generated population.

1.1 Design Goals

The target audience of this project includes (but is not limited to) anthropologists who wish to create a more immersive setting and experience in which sites and peoples can be represented via modern-day technology. The ability to navigate and interact with people in a virtual environment is designed as a means of presenting a populated past, and to show how peoples lived and interacted with each other and their environment. The target audience can also be expanded to include anyone who is interested in first-person navigation and interaction with computer-generated crowds.

1.2 Projects Features and Functionality

Using an HMD and a real-walking means of locomotion, users will be able to navigate a virtual environment larger than the boundaries of their real-world location, as well as navigate and interact with large groups of computer-generated people in the virtual scenario.

2. RELATED WORK

Peck, T., H. Fuchs, M. Whitton, "Evaluation of Reorientation Techniques for Walking in Large Virtual Environments." *IEEE Virtual Reality 2008*, pp.121-127, 2008.

Pelechano, N., J. Allbeck, N. Badler, *Virtual Crowds: Methods, Simulation, and Control*. Morgan & Claypool Publishers, 2008.

Razzaque, S., Z. Kohn, M. Whitton, "Redirected Walking." *EUROGRAPHICS 2001*, 2001.

Slater, J. Frederick, and P. Brooks, "Walking > Walking-in-Place > Flying, in Virtual Environments," *Proc. ACM SIGGRAPH '99*, pp.359-364, 1999.

Williams, B., G. Narasimham, T. McNamara, T. Carr, J. Rieser, B. Bodenheimer, "Updating orientation in large

virtual environments using scaled translational gain." *ACM International Conference Proceeding Series*, Vol. 153, pp.21-28, 2006.

Williams, B., G. Narasimham, B. Rump, T. McNamara, T. Carr, J. Rieser, B. Bodenheimer. "Exploring Large Virtual Environments with an HMD when Physical Space is

Limited." *Applied Perception in Graphics and Visualization*, Vol. 253, pp.41-48, 2007.

3. PROJECT PROPOSAL

The goal of this project is to use CAROSA with HMD technology in order to enable a user to navigate and interact with computer-generated groups of people in a virtual environment. Ideally this would enable a user to explore areas such as representations of populated archaeological sites in order to learn more about peoples of the past.

3.1 Anticipated Approach

Since the area of the virtual environment is expected to be larger than that of the real-life space, a method of being able to navigate the virtual world despite real-life boundaries is required. The implementation of reorientation techniques to redirect the user's walking will be used to address the space issue. Afterwards, computer-generated crowds will be incorporated into the virtual environment via CAROSA. The people will be programmed to recognize and respond to certain actions, which, when performed by the user, would enable him or her to interact with the virtual population.

3.2 Target Platforms

CAROSA (Crowds with Aleatoric, Reactive, Opportunistic, and Scheduled Actions) system; Ogre Game Engine; eMagin Z800 HMD.

3.3 Evaluation Criteria

Evaluation criteria would include comparisons to current methods of reorientation techniques, as well as comparisons of how virtual scenarios (i.e. interaction with the groups of people) compare to expected outcomes for a given type of user action.

4. RESEARCH TIMELINE

Project Milestone Report (Alpha Version)

- Completed all background reading
- Proposed Software and Hardware tested and functioning
- Navigation of virtual space working
- Incorporation of crowd models
- Testing interactions

Project Final Deliverables

- Virtual Environment that a user can freely navigate while interacting with computer-generated crowds of people with pre-defined choices of actions

Project Future Tasks

- Use for representation of actual archaeological site

(See Figure 1 for Gantt Chart.)

(remove line)

You will fill these sections in as you complete your project for the alpha review and the final document, these sections give psedo-code, charts, images, examples etc to show what you've done over the course of the semester.

We are leaving this section open to creativity too, feel free to add whatever you feel is necessary to relate your

5. Method

6. RESULTS

7. CONCLUSIONS and FUTURE WORK

APPENDIX

A. Optional Appendix

Some text here. Some text here. Some text here.

(remove line)

References

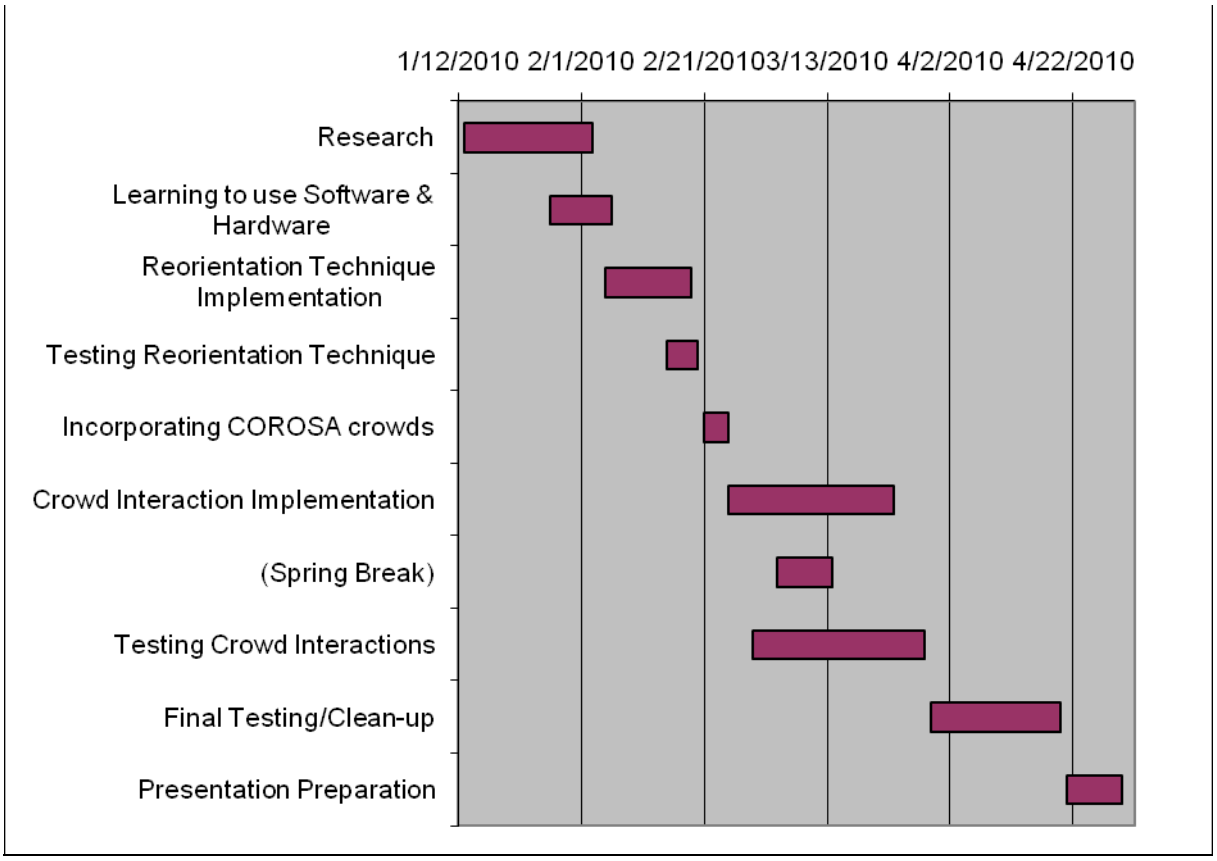

Figure 1: *Gantt chart outlining proposed schedule for project.*