Student Learning Project with 3-D Visualization and Virtual Reality

Elmer A. Grubbs
Department of Electronic Engineering Technology
The University of Southern Colorado

ABSTRACT

This paper presents work done in Three-D and Virtual Reality in the Department of Electronic Engineering Technology at the University of Southern Colorado during the 1996 - 1997 academic year. Two student projects, one using Three-D imaging and the other presenting a virtual reality representation of the campus of the University of Southern Colorado are described, along with a method of using Virtual Reality as a recruiting tool.

INTRODUCTION

Since the beginning of this decade, Virtual Reality has captured the imagination of many researchers and teachers in universities and industries in the United States and around the world. There were many early articles and books written on this topic describing the basic concepts and some of the ideas for applications. Events have moved somewhat slower than anticipated by many people, and in fact there are still a fairly limited number of research projects in universities or industrial products that have reached the marketplace. The largest application for the present seems to be in the Virtual Reality game arena. However, more and more attention is being paid to Three-D imaging and Virtual Reality and the future use of these technologies is still very promising.

Three-D imaging is defined by various people in one of two ways, either as a two dimensional image with three dimensional perspective, or for purposes of this paper as fully three dimensional imaging, where each eye sees a slightly different perspective, thus giving not only the illusion of depth, but depth so real, one is tempted to reach out and touch the images as they go by. These are not the old images of red and blue television movies from years ago, but represent pictures so real that they stun the viewer. These images represent the future of electronic image viewing in television as well as in computers and on the Internet.

When the first commercial products were produced, the cost of the viewing equipment was very high, around $50,000 for a head mounted display (HMD). Today reasonably high quality HMD's are available in the $400 to $600 range. Free software as well as inexpensive software is readily available, although much of it is just barely useful. More expensive programs are more readily available, but even on a budget, much can be done.

PROJECTS AT THE UNIVERSITY OF SOUTHERN COLORADO

Figure one is the block diagram of the system designed and built by Brian Conner as a senior project. It is a fairly complex system, consisting of a stereoscopic camera with remote convergence controls, a multiplexer, television and video recorder and a head mounted display. The camera system, which was built for a cost of about $1500, simulates a commercial stereo camera system which can cost over $5000. It includes the capability of focusing the cameras to different depths by changing the angle between the two cameras manually as the scene changes. This duplicates the eye's ability to focus in angle as an object moves closer or further from the viewer. The controls for this operation allow the focusing to be done remotely. Figure two shows the camera system including the convergence controls.

The heart of this system is the multiplexer circuitry. It takes the two images produced by the camera system and places them together so that they are interlaced in odd and even frames in the standard NTSC video format. These images may then be transmitted or recorded on standard video systems. They are viewed by Virtual Iglasses, an inexpensive Head Mounted Display. Annoying 30 Hz flicker, present on systems using LCD glasses, is eliminated by the Iglasses. This system allows viewing and recording for future use, of any scene that can be recorded by a normal video camera. The next step in this project is to build a similar system with miniature cameras that can be used on a robot to provide remote viewing. This system requires no software or computer systems.

This project was completed as a senior project for a cost to the student of about $185 and approximately 100 hours of labor. As mentioned before, it serves as a starting point for other projects which can be built using this technology.

The second project was also constructed by Bryan Conner in an independent projects class, and consisted of modeling the campus of the University of Southern Colorado, and the interior of the technology building in virtual reality. This was to allow the user to fly through the campus looking at the various buildings and structures, and also to tour the technology building and the electronics laboratory. It could be expanded in the future to allow the viewer to tour any of the buildings and labs or classrooms on the campus. This project also uses the Virtual Iglasses from the previous project, now connected to a Pentium processor equipped with Virtual Reality software.

The first part of the project was, in fact, a search for state of the art software to interface between the computer and the Iglasses. We were looking for free or very inexpensive software, and at first glance much seemed to be available. As the project continued, however, Bryan found that promised deliveries were not met, or that free software in hand did not work as advertised, presumably since companies were rushing to provide programs that worked with the Iglasses. Software researched included VRCreator, SuperScope, RenderWare, 3D-Ware, Avril, Reanimation and Mindrender.

Byran finally settled on 3D-Ware, which was software bundled with the Iglasses that provided usable 3-D, but inoperable headtracking. This meant that the users had to navigate using the mouse or keyboard arrows, instead of just looking in the direction that he or she desired to move.

Due to the large amount of time spent researching software, only a limited VR world was

created, but it is expected that the work can be continued in the future. Bryan spent 165 hours on this project; no funds were expended. Figure three shows part of the campus, as represented by the simulation.

The intention of the VR campus tour was to use it as a recruiting tool when groups of students came to the campus to visit, or when representatives from the department went out into the community. We have been using the Iglasses in this fashion since their purchase two years ago. They came bundled with a computer game called <u>Descent,</u> which in its two dimensional form is popular with many middle and high school (mostly) boys. As groups of five to eight students came into the lab, they were given the opportunity to play part of a game in true 3-D, while using the head tracking capability of the Iglasses to maneuver through the game world, a series of mine shafts on the moon. The potential students were almost universally excited by the use of the VR equipment. Additionally, we took the set up to the State Fair grounds for an educational fair that occurs every year. Figure four shows the local newspaper's front page picture on the day after the fair. We were one of hundreds of booths and felt very fortunate to receive the reward of a front page picture.

We have also used the Iglasses in a project for the Air Force, where we model the computer systems for an aircraft. This is also still at a primitive level, and the funding has not been renewed, but there are many research projects which are possible.

CONCLUSION

Virtual Reality and 3-D imaging has a very promising future, but much can be done, especially at the university level, in this exciting field now. An inexpensive investment of about $500 and some interest by a faculty member is all it takes.

ELMER A. GRUBBS is a former Assistant Professor and Department Head of the Electronic Engineering Technology Department at the University of Southern Colorado. He has over twenty years of industrial experience and fourteen years of teaching experience in Electrical Engineering and Technology. He is currently consulting to Raytheon Missile Systems Company in Tucson, Az.
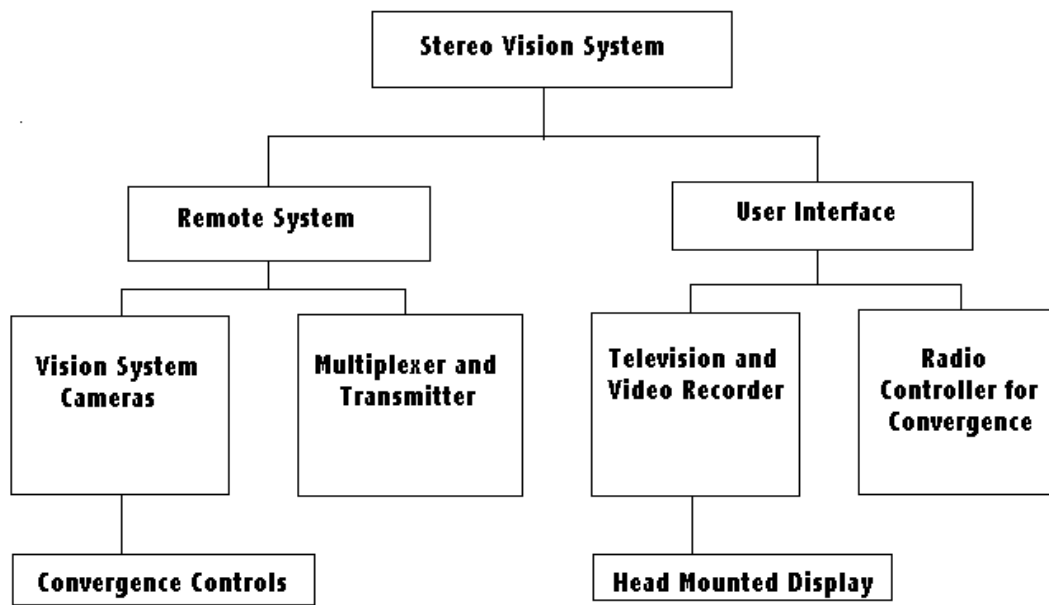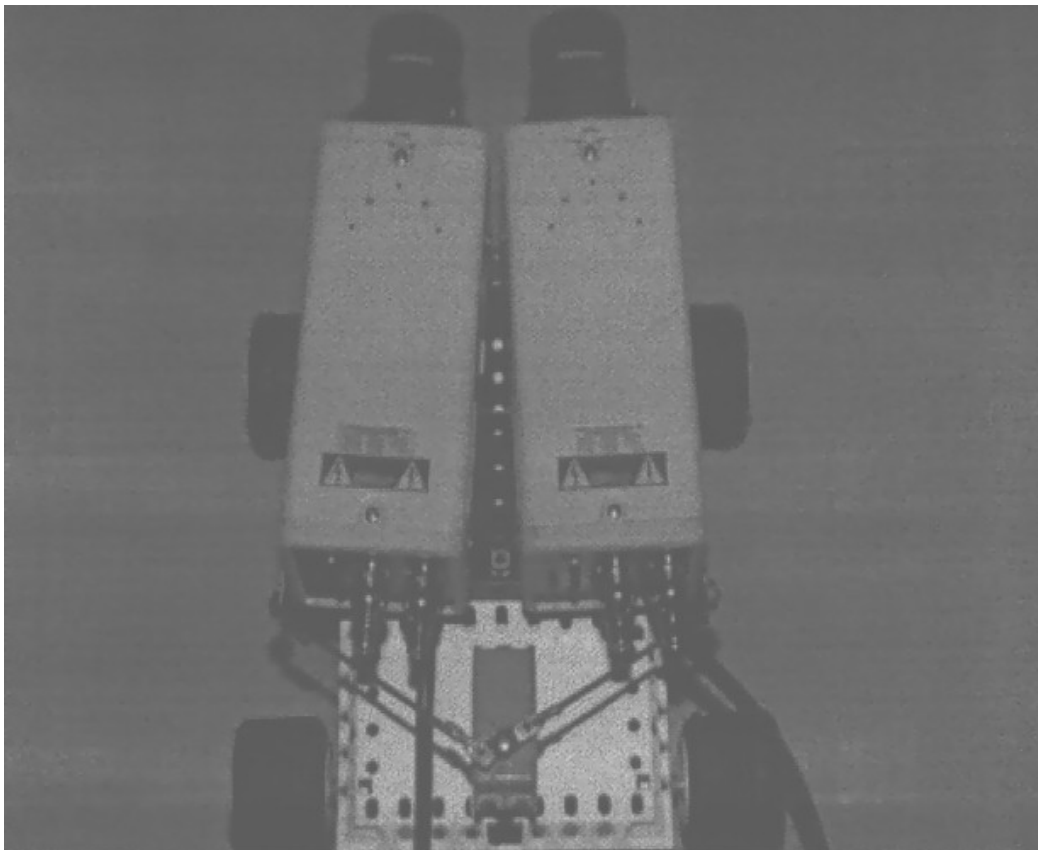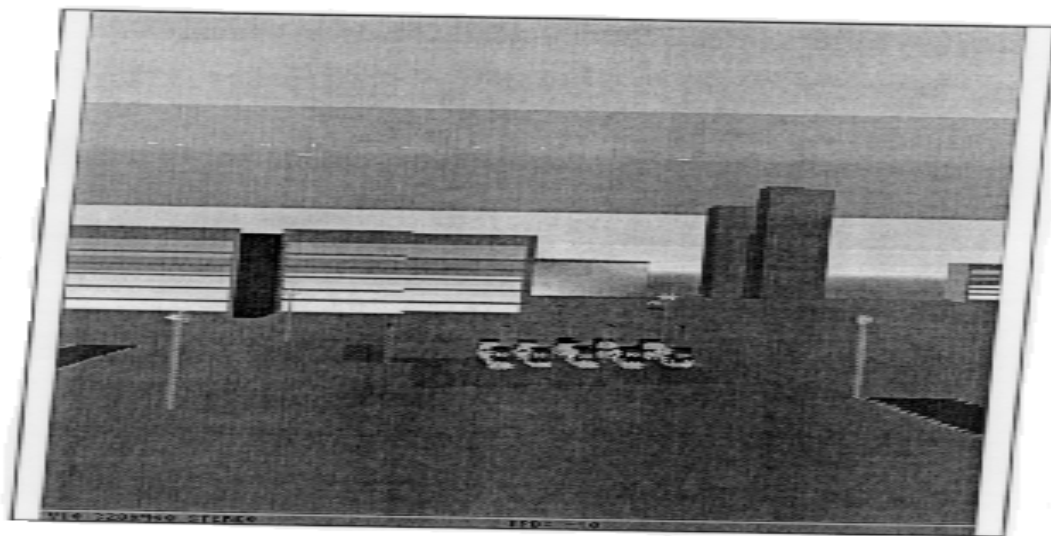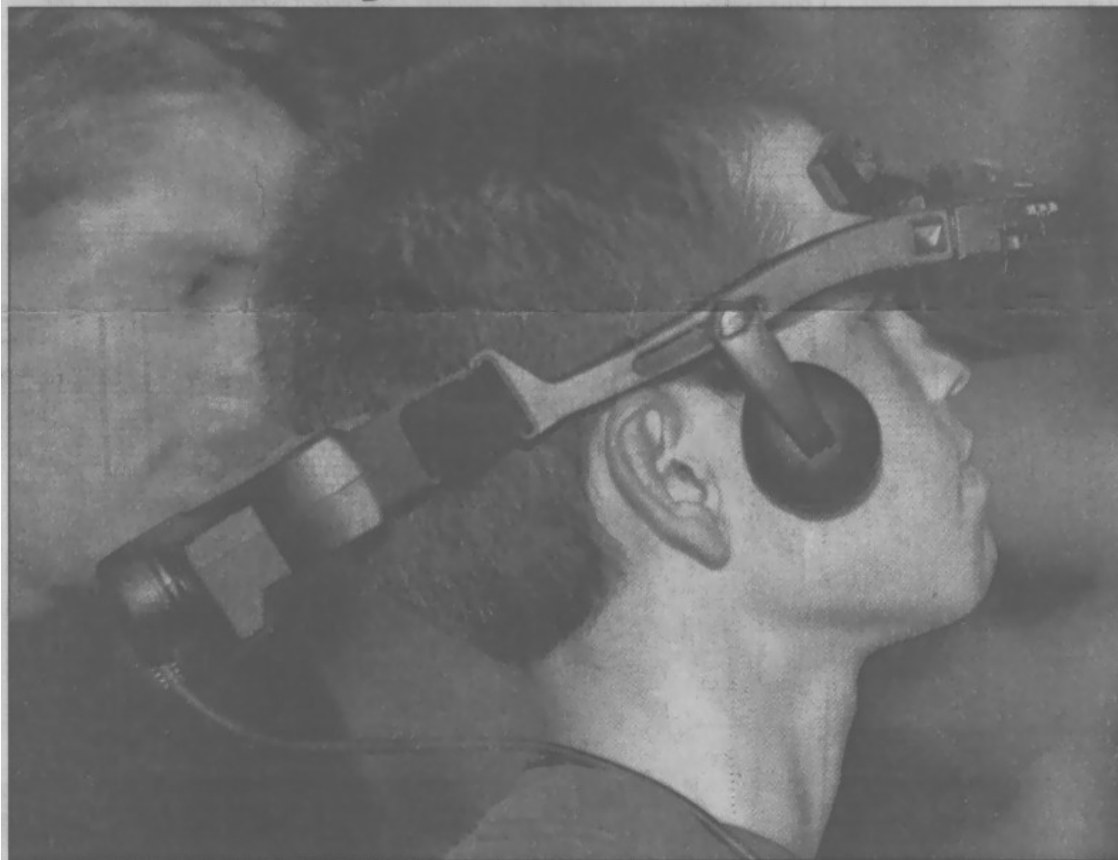
Figure one

Figure two

Figure three

Virtual reality

Chieftain photo by John Jaques

East High School student Mike Montoya works on a Virtual Reality computer sponsored by the University of Southern Colorado Department of Electronics Engineering Technology, during the Educational Extravaganza held Friday at the State Fair Events Center. The Extravaganza continues today from 10 a.m. until 3 p.m. Related story and photo on Page 12A.

Figure four