1 Project Description

This project incorporates highly innovative advances in display hardware and software design to provide a unique environment for displaying digital media, 3D graphics, video, computer aided design, real-time applications and animation.

Funds for this project will be used to set up an environment for 3D interactive immersive visualization and simulation. The proposed environment is somewhat akin to virtual reality environments. It can be used either for pre-rendered computer-generated 3D images or for rendering real time live action productions.

The proposed virtual reality environment is built around a Vision Station driven by a high performance graphics workstation described in Section 1.1.

1.1 Vision Station

The Vision Station sensory encounter grows out of graphic content projected onto a hemispherical screen. Its hemispherical projection and display system integrates optics, software, and screen design to envelop the user in 3D graphics. The hemispherical screen is positioned so as to fill the field-of-view (FOV), creating a sense of immersion, for the user. The user loses the normal depth cues, such as edges, and perceives 3D objects beyond the surface of the screen as he enters a simulated version of his model in a virtual three-dimensional world. A picture of display screen of the Vision Station is shown as an annexure at the end of the proposal.

1.1.1 Vision Station Hardware

The Vision Station contains three main hardware components:

(i) a video projector mounted with a fisheye lens (budget item-1 section 4.1),

(ii) a hemispherical projection screen (budget item-1 section 4.2), and

(iii) a graphics workstation (budget item-2).

Mounted with a fisheye lens that provides a full 180-degree field of view (FOV), the projection source completely fills the hemispherical screen with imagery. The lens uses linear

angular distortion to evenly distribute the projection over the entire viewing area. The lens also provides an infinite depth of field, so images remain in focus on screens from half meter away to theoretical infinity at all points on the projection surface. Because of its wide immersive display, the Vision Station can properly present a larger portion of a visual environment than a conventional flat-screen display. Furthermore, by mimicking the natural human visual perception system, the Vision Station provides a compelling first-person experience.

Real-time performance of software, necessary for a virtual reality environment such as this, is achieved by a Wildcat graphic accelerator card residing within the workstation. The graphic accelerator card is designed to run openGL functions in hardware, as opposed to running it in software, and therefore provides the necessary performance for real-time rendering.

1.1.2 Vision Station Software

One of the key features of the software is its ability to create spherical images that project pixels equally across the hemispherical screen surface. Working in conjunction with the lens and screen to provide a non-distorted 180-degree FOV, the Vision Station software supports rendering of:

(i) computer generated 3D images in real-time and

(ii) video images from standard digital media in real-time.

To support creation of the computer generated 3D images suitable for projection on hemispherical screen surface, the software suite contains Spherical Projection Image (SPI) libraries (budget item-1 section 4.3). Running on graphics workstation, the SPI library functions work in conjunction with common software API (application programming interface) libraries. In this respect, 3D graphics generated from programs using functions from the common API libraries such as: openGL [1] from Silicon Graphics, and DirectX

[1] openGL is used for instruction in computer graphics course within CS program

from Microsoft, can be easily rendered by Vision Station display system. For example, a function call within a program to a openGL library function is indeed made transparently from within a SPI library call.

This aspect of the project will strengthen the existing program in computer science through advanced instruction in computer graphics and animation. Since openGL is already used in Computer Science program for instruction in computer graphics course additional instruction in SPI use is a natural extension of training for students interested in virtual reality.

To support rendering of digital video and digital images from a live digital stream or from a media onto hemispherical screen surface, software suite provides three tools: (a) TrueMotion, (b) TrueView, and (c) TrueFrame.

TruMotion tools (budget item-1 section 4.3) enables developers to compress and play back their high-resolution .AVI files containing animated, or live capture video without the need for dedicated hardware. Running on workstation, TruMotion-compressed movies can play back at resolutions up to 1280x1024 at 30 progressive frames a second with virtually no compression artifacts. This set of software tools will make Vision Station an attractive platform for other department (e.g., Film Studies) for creating high resolution digital video.

TruView tools (budget item-1 section 4.3) allow users to view existing content built with VRML (virtual reality markup language) standards. This set of software tools can be used for example, by the Art & Theatre Department for experimenting with different scene designs.

Also, the animation software package Maya[2] can use TruFrame tools (budget item-1 section 4.3) to transform their .JPEG or .TGA frames into hemispherical animations in Microsoft .AVI format.

Though not an immediate goal of this project, we expect as the interest in virtual reality grows contents for Vision Station can be developed by faculty in many other departments (e.g., Nursing faculty could support the training needs of students by allowing them to

[2]Department of CSC is in the process of acquiring Maya for instruction in computer animation.

pre-determine surgical tactics by simulating the procedure beforehand).

2 Qualification of Applicant(s):

Dr. Adhar received a PhD in Computer Science from the University of Maryland and is currently an Associate Professor of Computer Science at UNCW. He has considerable expertise in the area of digital signal processing, computer aided design, and real-time applications and animation. Dr. Adhar has recently completed a Cahill Awarded project titled:
"A design and development platform for Real-Time Digital Signal Processing". This project involved the rapid prototyping of hardware and software resources for design and implementation of real-time signal processing applications. More information on this project can be found on:
http://www.uncwil.edu/people/adharg/DSP/dsp.html
Several other faculty in the Computer Science Department also have a strong interest in this project. The unique, 3D, interactive, and immersive environment created by this hardware and software will have many potential uses. These are new and energetic faculty who have recently joined UNCW. It is expected that they will find uses for this equipment that is not yet conceivable.

3 Expected Outcome:

1. The procurement and installation of the system will be completed before June 2002. The Department of Computer Science will provide support for training and maintenance of the equipment.

2. During the Fall 2002 semester Dr. Adhar plans to offer a course in computer graphics and visualization within Computer Science Department based on openGL standards.

3. Vision Station will be available to faculty and students in Computer Science, Art & Theatre, and Film Studies departments for creating and previewing high resolution digital animation and live productions. These three department have re-

cently received approval for two exciting new courses: CSC/ART/FST 220 - Using Graphics Tools and CSC/ART/FST 320 - Computer Animation courses. As a partnership effort between, UNCW, Screen Gems Studio and Planet 3 Animations (http://www.planet3animation.com/), these new courses offer a unique university/industry collaboration for both teaching and research. This partnership provides potential for future support and funding.

4. Since Vision Station provides an attractive platform to visualize scientific information, we expect that this project will strengthen existing partnerships between Computer Science and the departments of Chemistry, Biology, Geography, Marine Sciences, among others. Accordingly, we plan to give several demonstrations and lectures on the capabilities of new virtual reality environment to UNCW faculty and students in these departments and the university community at-large. The potential for grant opportunities will be explored as well.

4 Budget:

ITEM 1:

4.1 VisionStation 800 Projector

1. Projector with trutheta Lens
2. Display Technology: LCD Poly-Silicon TFT; active matrix
3. Display Resolution: SVGS 800 x 600 (480,000 pixels)
4. Input Resolution(s): SXGA, XGA, SVGA, VGA
5. Color Reproduction:16.7 million colors (24 bit)
6. Contrast Ratio:400:1
7. Brightness:1100 ANSI lumens
8. Vertical Frequency:50-85 Hz
9. Power:AC 100 to 240V 50/60Hz;350W
10. Lamp:150 W (user replaceable estimated 1000 hrs)
11. Inputs:HD15,S-Video,Video,Audio (R/L)
12. Remote Control:Keystone,Source select,Image settings

4.2 VisionStation 800 Equipment

1. 1.5 Meter Hemispherical Screen
2. Storage Desk for Projector and User Guide
3. Power Cables

4. HD15 Monitor Cable Extension

5. Mouse Cable Extension

4.3 VisionStation 800 Software

1. Image Stitch/.AVI Out:TruFrame Spherical Correction Utility

2. TruView tools

3. Open-GL:SPIclops API 1.0 for Win NT/2000 & IRIX

4. Performer: SPI Performer for IRIX

5. DirectX 7&8:SPI-API 1.0 for Windows 2000

6. Video Codec:TruMotion for Win 98/2000 by On2

Manufacturer:

Elumens Corporation

Retailer and Contact number:

Elumens Corporation

1100 Crescent Green, Suite 211

Cary, NC 27511, USA

+1 919 816 8787

+1 800 842 1687

http://www.eluments.com

Cost (ITEM 1) including shipping and handling:

$10,000

ITEM 2:

4.4 Graphic Workstation

IBM IntelliStation M Pro Series minitower workstation
with Intense 3D Wildcat 4110 video card.

Manufacturer:

IBM Corporation

Retailer and Contact number:

CDW Computer Centers

http://www.cdw.com

Cost (ITEM 2) including shipping and handling:

$4,778