DATE: August 6, 2001

FROM: Ronald D. Kriz

TO: A. Habayeb

CC: Lance Arsenault, John Kelso, and Fernando das Neves

SUBJECT: NAVCIITI Quarterly Report

RE: - Project 2.0 Visualization HCI and Collaboration
- Task 2.1a: Command and Control Visualization: Development of CONRAY C&C acoustic simulation model based on API developed in Task 2.1b
SOW 2.1a.4, Evaluate and modify CAVE display interfaces for NUWC acoustic model, July 01

Background: Our objective is to provide a distributed collaborative network of graphical and device independent tools in a shared virtual environment, which can be used by Command and Control (C&C) personnel to gain a strategic advantage. Specifically we focus on the mission critical C&C interpretation of acoustic undersea data from towed arrays for the Naval Undersea Weapons Center (NUWC) using the CONRAY simulation models. These simulation models can be extended to "real-time" data acquisition systems. Under the direction of personnel from NUWC and the Naval Research Laboratory (NRL) we have identified a working prototype which we have successfully incorporated into our Device Independent Virtual Environment Reconfigurable-Scalable-Extensible (DIVERSE) tool that works in stereo in the (C)AVE Automated Virtual Environment (CAVE), Immersive Work Bench (IWB), Immersive Desk (I-Desk), desktop workstation simulator, and Head Mounted Display (HMD) systems at the Virginia Tech Center for Virtual Environments and Visualization (CVEV). Hence the idea of "DIVE" (Device Independent Virtual Environment). The DIVE in DIVERSE provides the basis for collaborative C&C.

Activities redefined during previous quarter: On February 5, 2001 NUWC, NRL and VT agreed to coordinate efforts the following task break down.

NUWC: (POCs Ken Lima, Ann Silva, Lauren Mathews, Richard Shell)
- Develop a geometric method for determining points of intersection for complex conical angles.
- Develop 3-D Eigenray Manifold 'ray trace' algorithms that employ 3-D reflection, sound-velocity profiles and propagation loss models.
- Create multiple scenarios that will test operator effectiveness.
- Make 3-D displays equivalent to Mark II block 1C combat system displays for 2-D vs. 3-D comparison testing:
  - Determine what combat system information should be displayed on the 3-D canvas
  - Update and finalize the form of the information bezel
- Set up software to read in common navy databases.
- Coordinate NUWC and NRL efforts and interact with VT as required.

NRL: (POCs: Larry Rosenblum, Robert King)
- Integrate the information bezel with the DRAGON software - bezel should turn on and off from keyboard or I/O device.
- Ensure control devices operate properly with all software and scenarios - adjust control device parameters as required.
- Integration of NUWC code into the DRAGON software.
- Documentation of DRAGON software
  - Diagram of DRAGON component interaction.
  - Quick guide to code modification of elements pertinent to visualization
  - Organized copy of source code
  - Dragon presentation at NUWC

VT: (POCs: Ron Kriz, Lance Arsenault, John Kelso, Fernando das Neves)

- Explore optimization techniques to permit the code to run faster
- Explore optional enhancements to the current code for incorporation into the DRAGON software such as:
  - Create a bathymetry contour following grid that maps to the bottom
  - Create bottom following vessel tracks.
  - Create the ability to lay generic texture maps of information such as navigational charts, bottom type, gravity maps, etc. on bathymetry.
- Explore alternative devices and interaction techniques to improve selection and analysis of data subsets.

Discoveries, Accomplishments, Test Results:

- Adaptation of the general code to work with Open Inventor, after solving the differences between the Open Inventor's data types , scene graph philosophy and field+value memory model, and Performer's scene graph and shared memory, reference-counted model.

- Modification of the construction bathymetry graphical model for bathymetry data. This stage is in an advanced state, momentarily suspended after NRL raised questions about the use of Open Inventor for the translation of SubVE code to the TAC-4 HP/UX+OpenGL platform. Development will continue after meeting with NRL and NUWC personnel on August 20.

- Rewriting of SubVE bezel User Interface using FLTK (Fast-Light toolkit), a freely available widget set for X-Windows with capabilities similar to XForms (originally used to write the bezel), and the added advantage of having full source-code available, simplifying the port to other platforms like TAC-4.

Plans for Next Quarter:

- *SOW 2.1a.6, Evaluate and modify CAVE display interfaces for NUWC acoustic model, July 01.*

NUWC will coordinate NUWC and NRL efforts and interact with VT as required. VT will maintain regular communications with NUWC regarding the development of these new subtasks.

Outstanding Issues: SOW 2.1.5*: Design Digital Ship CAVE interface (DCSI) for simulation of ship under fire, June 01.* The software integration of MIX with the Digital Ship requires not only the existence of a Digital Ship Lab (DSL) Application Programming Interface (API), but DSL-API documentation as well. At this point an API does not exist. Year Three Task 2.1 was redefined as Task 2.1(a) and a new Task 2.1(b) was created to rewrite the DIVERSE API in OpenGL. Task 2.1(a) will use the OpenGL API to create an OpenGL CONRAY/MIX simulation that will work on-board a submarine HP workstation running the HP-UX operating system. When a DSL API becomes available we can integrate CONRAY/MIX at that time. This is still an "outstanding issue" and was reported in the previous quarterly report May 1, 2001.

Successful development of a working Command & Control (C&C) model, "MIX", between NUWC, NRL and VT has resulted in raising new questions in the development of C&C models that scale across heterogeneous VE systems. There have been several meetings to resolve these issues between NUWC and NRL. On August 20, 2001 there will be a technical meeting between NRL, NUWC, and Virginia Tech to resolve technical issues. Results of this meeting will be reported in the next quarterly report.