DATE: May 30, 2002

FROM: Ronald D. Kriz

TO: A. Habayeb

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

SUBJECT: NAVCIITI Annual Report April 1, 2001 – March 31, 2002

RE: - Project 2.0 Visualization HCI and Collaboration
- Task 2.1: Command and Control Visualization
- Task 2.1a Development of CONRAY C&C acoustic simulation model based on API developed in Task 2.1b

Statement of Work for Task 2.1a:
2.1a.4: Evaluate and modify CAVE display interfaces for NUWC acoustic model, July 01
2.1a.5: Work with NAVCIITI usability group to address usability issues in future SOWs, June 01
2.1a.6: Design NUWC CONRAY model on OpenGL API, October 01
2.1a.7: Demonstrate NUWC CONRAY model, February 02
2.1a.8: Evaluate and modify NUWC CONRAY model, March 02
2.1a.9: Through out development create collaborative interfaces to work with HMDs, IWBs, and flat panels, across heterogeneous operating systems, April 02
2.1a.10: Final report on NUWC CONRAY, April 02

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). This effort has evolved and become part of the 3D Visualization Project called TALOSS, which was originally referred to as SubVE or SUBV.

Third Year: In our third year we want to generalize the development of a software Application Programming Interface (API) for C&C visualization that can be used for a variety of tactical systems. For example a variety of other C&C activities of interest to the NUWC and the Virtual Reality (VR) Lab at the Naval Research Lab (NRL) requires that reality be augmented with simulation model results. Researchers at the NRL-VR Lab are also rethinking how software and hardware technical issues will influence their future development of software APIs that can be effectively used to build applications such as the Interoperable Virtual Reality System (IVRS). IVRS developed at NRL requires a fusion of a variety of external systems to give a common tactical picture across multiple levels of the network-centric battle-space. The complexity of such systems requires usability evaluations based on formal evaluation methodology. Our second year CONRAY project has required collaboration between NUWC, NRL and VT to develop C&C tactical simulations in immersive environments which where based on NRL's DRAGON and VT's DIVERSE APIs.

Results: Details of SOWs are discussed in detail in Quarterly Reports which are listed and referenced below.

- Report #16: August 6, 2001 http://www.sv.vt.edu/future/cave/resprj/navciiti/nuwc_task2.1/navciiti_rpt16_task2.1a_kriz.pdf
- Report #17: November 6, 2001 http://www.sv.vt.edu/future/cave/resprj/navciiti/nuwc_task2.1/navciiti_rpt17_task2.1a_kriz.pdf
- Report #18: February 13, 2002 http://www.sv.vt.edu/future/cave/resprj/navciiti/nuwc_task2.1/navciiti_rpt18_task2.1a_kriz.pdf
- Report #19: May 17, 2002 http://www.sv.vt.edu/future/cave/resprj/navciiti/nuwc_task2.1/navciiti_rpt19_task2.1a_kriz.pdf

Discussion of Significant Results:

On February 5, 2001 NUWC, NRL, and Virginia Tech agreed to coordinate efforts by breaking down tasks to redefine CONRAY as the SubVE (Submarine Virtual Environment) project. These task modifications reflected NUWC interest in using project results as a FNC to enhance an existing submarine tactical command and control interface bezel. The break down of tasks was outlined in the Quarterly Report #16. NUWC was assigned as the coordinating POC. To assist in coordinating this activity it was agreed that we would have regularly scheduled conference phone calls every two weeks, and every quarter (3 months) each group would host a meeting to discuss SubVE project issues.

During the first quarter each site built a TAC-4 as it exists on board submarines and experimented with OpenGL and Open Inventor for the translation of SubVE code to the TAC-4 systems. Virginia Tech's TAC-4 system was hostnamed "Anchor" due to it's size and weight. Results of this study reported in Quarterly Report #17 clearly showed that the existing TAC-4 system was not adequate to run the SubVE code in Open Inventor. The newer TAC-5 system was still a possibility but NUWC decided development the SubVE project should continue on a Linux OS with Open Inventor. The project was renamed SUBV to reflect these modifications.

Parallel to this effort was the development of the OpenGL DIVERSE API, Taks 2.1b, which would accept the Open Inventor SUBV code. Other OpenGL scene graphs such as OpenSG was evaluated and discussed but the final decision was to go with Open Inventor at the end of the second quarter with a deadline of January 31, 2002 to demonstrate code rewritten in Open Inventor. With this decision NUWC required that the SUBV code include a feature that would allow SUBV code to work with existing real-time data acquisition system called ICE. With ICE the SUBV code would benefit the NUWC FNC project.

Results of the SUBV code shown in Figure 1 of the Quarterly Report #18 showed a working graphical bezel that worked with Open Inventor scene graph. This early prototype worked on Linux and SGI-Irix operating systems. This effort was developed as open-source to reduce cost, avoid license-locking, and enhance the ability to port the code to different hardware platforms.

In the final quarter extensive features were added to the SUBV code as reported in Quarterly Report #19. To reflect these changes the project was renamed TALOSS (Three-dimensional Advanced Localization-Observation Submarine System). Many user interface issues were resolved by close communication between NUWC, NRL and VT. The final TALOSS bezel is shown in Figure 1. Currently the code works with the existing real-time data acquisition system called ICE and can track multiple targets with firing solutions, track multiple weapons, and track multiple remotely piloted vehicles. Details of the current TALOSS project are summarized in an NUWC trip report where the TALOSS project was presented at the Submarine Technology Symposium, May 13-17, 2002, John's Hopkins University Applied Physics Laboratory in Laurel, Maryland. This trip report is attached as a reference on the current status of the TALOSS project.

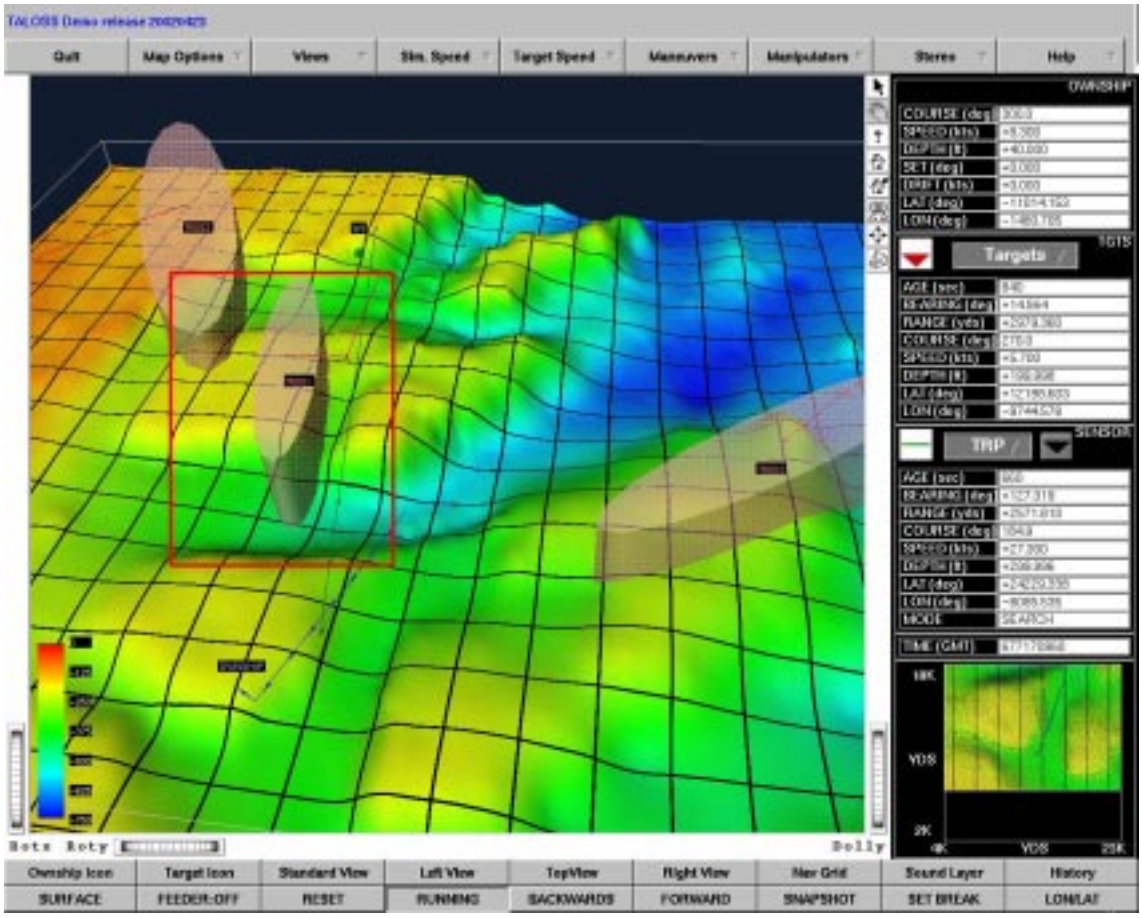

Figure 1. NRL, NUWC, and VT -- CONRAY / SUBV / TALOSS Interface, May 30, 2002
