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Concept Paper on Future Use of Visualization and Virtual Environments in Research, Education, and Outreach at Virginia Tech

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D_Collabtools is a networked collaborative software tool that allows multiple users to participate as "avatars" who can arbitrarily move through VE space, communicate, and load objects into the shared space interactively much the same as current network games. D_Collabtools is DIVERSE based which allows multiple user to primarily work from their desktop computers but also link to a variety of other VE resources such as CAVEs and HMDs. Hence such a tool could be used for collaborative research, and distance learning. For example researchers or students could remotely control laboratory instruments interactively through their web browser using their Pocket PCs.

Data visualization software tools are now commonly used by faculty across many different disciplines for research and education. This is largely a result of affordable and easy to use software tools running on affordable and powerful desktop computers. However, researchers and educators are also interested in access to high-end Virtual Environments (VE) that allow them to analyze large multidimensional data sets generated by simulations running on High Performance Computers (HPC) or laboratory equipment such as MRI or CT systems. Virginia Tech is fortunate to have access to state-of-the-art HPC and VE resources: System-X and the CAVE. However at present no plan exists to support, link, or access these resources with faculty's desktop computers. The remainder of this report is an attempt to outline how HPC, VE, and desktop computers can be linked into a networked collaborative workplace. Philosophically this is problematic. Often jokes are made about getting faculty to work together is like herding cats. In spite of such insightful joking, there is an opportunity to do so within the scope of studying how the current generation computer users are using desktop networked collaborative resources, e.g. three-dimensional networked games. Although this may be dismissed as just "playing", it is fundamental to Jean Piaget's theory of intellectual development and learning in children. Of course faculty are not children, but we are still interested in intellectual development both for ourselves as well as our students. So within the context of networked collaborative three-dimensional game playing I propose there exists an opportunity to link HPC, VE, and desktop computing resources and create an environment that would promote intellectual development for faculty and their students. This model would also fit within our academic goals for outreach and distance learning.

In the last ten years we have all witnessed how the Web server and Web browser have revolutionized our world. I was fortunate to witness the development of the Mosaic Web server and browser first hand when I was working at NCSA's Software Development Tools Group in 1991. Consequently I created the first Web server in Virginia at Virginia Tech when Mosaic was released in 1993. I believe the success of Mosaic was largely due to keeping the development of web content simple from the users' point of view. Similarly networked collaborative software tools must be designed so that the end user

can link HPC, VE, and other computing resources openly and freely within a secure environment. This software must also be designed from a user-centered design viewpoint, which includes extensive and thorough evaluations throughout development. Frequently software is created where input from the user community is only solicited after software is released. To foster code development from a community viewpoint the software should be licensed GNU-GPL, which will promote open and free access.

I propose that Virginia Tech build on the momentum established at UVAG by future development of the Collaborative Toolkit for DIVERSE (D_Collabtools). http://www.sv.vt.edu/future/cave/software/D_collabtools/D_collabtools.html . D_Collabtools is a networked collaborative software tool that allows multiple users to participate as "avatars" who can arbitrarily move through VE space, communicate, and load objects into the shared space interactively much the same as current network games. D_Collabtools is DIVERSE based which allows multiple user to primarily work from their desktop computers but also link to a variety of other VE resources such as CAVEs and HMDs. Hence such a tool could be used for collaborative research, and distance learning. I propose that the development of this networked collaborative software for research and distance learning should be an interdisciplinary effort between UVAG, System X, IDDL, Educational Technologies and CHCI. Currently D_Collabtools runs only on the SGI Irix OS and Linux OS. It would be critical to include both Microsoft OS and Mac X OS for education and distance learning. The UVAG currently has Beta prototypes of DIVERSE running in Mac X OS, and DIVERSE Toolkit can currently run in Microsoft Windows OS. Recently DIVERSE has been used to create a computational steering link between System X and the CAVE, but lacks the ability to be easily installed or content easily created. To facilitate widespread use, D_Collabtools should be designed so that content can be created as simple as basic html. To promote development for outreach and distance learning D_Collabtools should be developed as a web browser plugin, where existing web based content can be used along with the interactive plugin.

Because the D_Collabtools is based on DIVERSE that uses Dynamic Shared Objects (DSO), experienced C++ coders can openly and freely develop new applications that run on a variety of VE systems, e.g. CAVEs, Immersive Work Benches, Immersive Desks, Head Mounted Displays, and desktop computers running the CAVE simulator. Since DIVERSE is based on a networked shared memory architecture, designing future networked collaborative applications facilitates inclusion of new Input/Output (I/O) devices such as Pocket PCs, Palm Pilots, desktop haptic devices, etc., which would facilitate networked collaboration. Each I/O device or VE systems can be loaded and unloaded into the networked collaborative space as a DSO in realtime. For example researchers or students could remotely control laboratory instruments interactively through their web browser using their Pocket PCs.

Developing and freely distributing new and exciting networked collaborative software tools for education and research projects would not only facilitate use of Virginia Tech's existing HPC and VE resources, but also establish Virginia Tech as an IT leader in the development of new and exciting software tools for research, education, and outreach.