Inexpensive High Resolution Tiled Displays for Scientific Visualization of Data

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As scientific data increases in size and complexity, the need for new ways of displaying and analyzing the data are required. Traditional monitors fail in this task because they cannot show data to a scale that can be appreciated. Projectors fail because they simply take what a traditional monitor shows, and makes it larger without giving any new insight or detail. What is needed is a large, high resolution display that can show large volumes of data at once without loss of detail.

One such technology that accomplishes this is high resolution display walls based on tiled displays. They allow very large datasets to be visualized at high resolutions that a simple monitor display or printout cannot accomplish. Current solutions, such as VisWall™, cost in the $20,000 to $100,000+ range. With increasingly more supercomputing power becoming inexpensive and available to decreasingly smaller entities such as small business and K-12 schools, these solutions need to mirror the supercomputing power not only in terms of performance but also in price. These commercial solutions then fail to meet the price requirements of many possible customers. Many of these solutions use special code libraries, such as OpenMPI, which requires recompilation of client software in order to use the large display, making it prohibitively complicated to many users. By leveraging open source technologies with the current high performance low cost consumer computer hardware, it is possible to build a solution that costs significantly less while still performing considerably well.

The solution we propose is very inexpensive (relative to other solutions), can scale to the needs of the project, is simple to set up, and is simple to use. It consists of a single high performance consumer level computer that serves a large desktop over a network using a Virtual Network Client (VNC) server. Lower powered (and therefore less expensive) computers then connect to this networked desktop and display it locally using a VNC client. 3D Applications are served using another piece of software called VirtualGL. This is done transparently on the VNC server so that no additional software is required on the VNC clients. There is very little learning curve for users because the software serves a common desktop environment which presents the user with traditional computer interaction paradigms.

Our test setup consists of a 5120x4096 (over 20 Million pixels) over 16 monitors. One computer serves a desktop to two VNC clients which then drive 8 monitors each. They are connected via gigabit Ethernet. They run a Linux environment and use TightVNC to serve and receive the desktop. VirtualGL is used to access 3D acceleration. All of this

software is open source, freely available, and easily configurable.

This results in an approximately 20 mega-pixel display wall that can run multiple frames per second with full screen motion. Performance increases as more of the display becomes static. This display has the ability to run most traditional software that can run in a Linux environment and requires no recompilation or new configuration for existing programs and data to be used.

Successful tests have been performed using software such as full screen GoogleEarth (running custom weather and glacier simulations), Vis5D (a powerful open source scientific data visualization project), and MATLAB (among others). All were installable using no code modifications and no running configuration changes. All ran at frame rates fast enough to perceive motion, were stable within the testing times (hours to days), and allowed for the display of much more data then on a traditional screen.

Including the monitors for the display itself, an entire 20 mega-pixel system can be purchased for under $5000 (priced July 6th 2009). We believe this puts display walls well within the price point of many entities that could not previously afford them but could benefit greatly from their use.