Interactive Remote Visualization Hardware

Background

Supercomputing resources are expensive to build and maintain and should be utilized to the maximum. The distance between the supercomputer and the user often limits access to these resources. Since the best performance is achieved when the computation and rendering are co-located, the user needs access to the high-resolution image display. This is especially important when data sets are too large to transfer and store remotely, and also when shared data sets can not be synchronized if replicated and modified at multiple sites.

It is difficult to achieve both high resolution and acceptable display frame rate when attempting to move the rendered images to the user's location. The extent of a user's interaction with the rendered images is dependent not only on the image presentation rate but also on the delay between user input and subsequent image changes. Improved interactivity results in improved user productivity.

The solution lies in developing an apparatus to handle the transfer of this information at a speed acceptable for human interaction and retain images of a high quality. Equipment currently available delivers either low latency, low-resolution images such as video conferencing systems; or high latency, high-resolution images such as used by entertainment systems. The “Interactive Remote Visualization Hardware” allows for the transfer of such information while maintaining an acceptable frame rate and resolution, as well as interaction with the visual data from a remote location. Sandia National Laboratories, under the Department of Energy’s Advanced Simulation Computing Program (ASCI), is prototyping this technology and is seeking industrial partners to commercialize it.

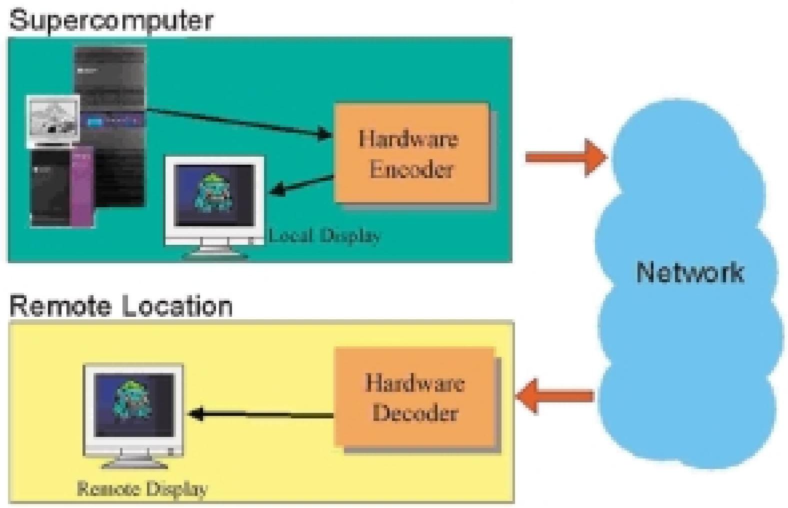

Figure 1

History and Evolution

The initial remote visualization system consisted of commercial equipment that converted a 640×480 low resolution image into NTSC video format and transferred this image in a compressed format over an ATM network at 8 Mbps. The project demonstrated the transfer of a 1280×1024 screen by using four of these devices. However, the setup was cumbersome and the equipment was expensive. Spatial reconstruction and color matching required careful and frequent adjustment. Switching from NTSC to PAL provided only slightly better image quality.

Recognizing that a better solution would be to avoid the scan conversion altogether, the project developed custom hardware to capture the video signal directly from a video card and then send it frame-by-frame across the network, conserving the spatial quality of the original image.

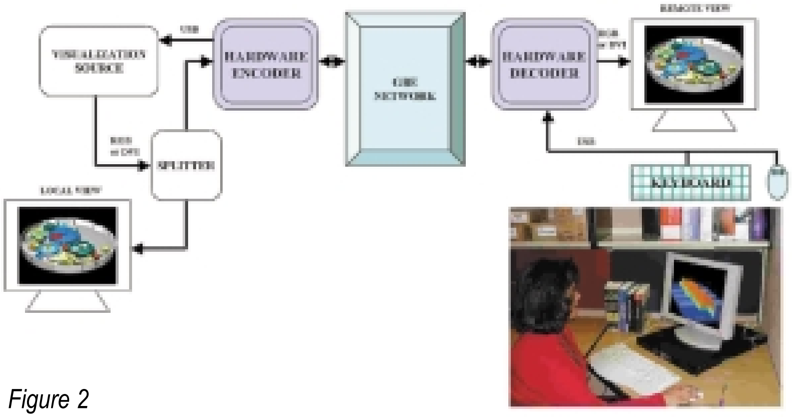

Figure 2

Interactive Remote Visualization Hardware

The Interactive Remote Visualization Hardware achieves a milestone in delivery of high quality video over standard networks. It captures video data from both RGB and DVI video sources, delivers captured graphics images across the network at a resolution of 1280×1024 pixels with frame update rates as high as 60 fps. The hardware consists of an encoder at the source and decoder at the remote end. It can achieve a maximum resolution of 1600×1200 pixels in DVI mode. This is the peak resolution on all but the most expensive digital monitors. The hardware design can handle even higher resolutions such as the popular 1920×1024 format as capable monitors become more common. Remote user keyboard and mouse inputs are conveyed back across the network to the image source computer. A conceptual diagram of the system is shown in Figure 1, and a more complete operational diagram of both the encoder and decoder is shown in Figure 2.

The Interactive Remote Visualization Hardware provides the remote visualization user unsurpassed ability to view and manipulate computer generated graphics from anywhere in the world. It allows for a "quick look" at in progress supercomputer calculations. It provides the remotely located scientist the ability to interactively explore a design space, which requires high resolution and low latency transfers, as well as the ability to adjust compression to assure fidelity of the simulation data.

This Interactive Remote Visualization Hardware operates with any standard graphics acceleration card and allows the user to take advantage of the latest graphics acceleration technologies. It is platform independent. It does not tie remote visualization to a specific graphics processing technology.

Finally, while providing a remote user input and display capability, it does not interfere with the local display and user input function.

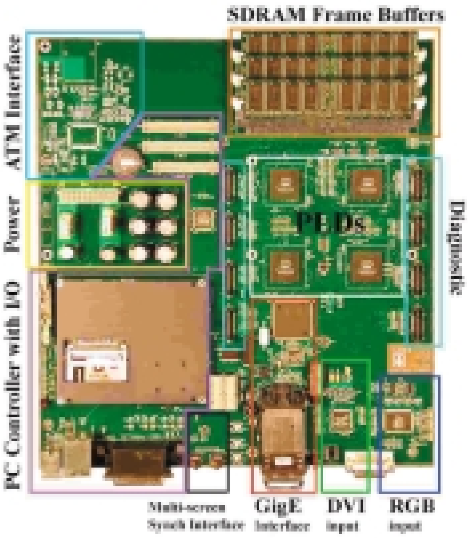

Figure 3 shows the hardware board and illustrates the major blocks of circuitry.

Conclusion

When visualization images are transferred from supercomputing locations to remote sites, there is often a loss of frame rate, resolution, or interactivity due to increased communication latency. Each of these attributes affects the usability of the transferred information. The Interactive Remote Visualization Hardware transmits graphics with low-latency, high interactivity, and with high-resolution.

This project is actively seeking industrial partners to commercialize this technology. For more information, contact Lyndon Pierson at (505) 845-8212 or lgpiers@sandia.gov; or Perry Robertson at (505) 844-2414 or pjrober@sandia.gov.

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under contract DE-AC04-94AL85000.