Op3D-Grid

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Building a Grid-enabled surgical visualization system for use in the operating theatre

Although 3D visualization has been available for some time it has not proliferated into working environments as well as might have been hoped. There are several reasons for this:

- Large data sets need specialist software/hardware to produce images in real-time.
- Manipulating and interacting with the data is difficult and requires practise.
- Integrating the use of a visualization system with other working practises is not always easy.

These problems have all been solved by the Op3D software so that a surgeon can view and interact with 3D images of medical scans in the operating theatre while performing an operation.

Figure 1: Surgeon works at light box in operating theatre.

Figure 2: Surgeon now works with 3D images in operating theatre.

Background

Op3D is a remote visualization system that was developed in collaboration between Manchester Visualization Centre (MVC) and Manchester Royal Infirmary and has been used on many patients throughout 2002 and 2003. MVC was a finalist in the 2003 Computer World Honours 21st Century Achievement Awards for this work.

Figure 3: Medal of Achievement.

The original Op3D project was innately a grid application that relied on the use of SGI's visual area networking technology. More recently a further collaboration, this time including SGI and funded by the ESNW, has resulted in a truly grid enabled version of Op3D.

Technique

The medical data is placed on a high end SGI Onyx system. The Op3D software uses OpenGL Volumizer and OpenGL Performer to produce high quality 3D renderings of the data in real time. OpenGL Vizserver compresses and transfers images to a laptop in the operating theatre across a 100BaseT connection. A projector is used to display the images from the laptop onto the wall. The surgeon interacts with the 3D rendered images throughout the surgery with a joystick that is coated in a sterile plastic bag. Op3D uses a specially defined class of interactions that make its use as intuitive as possible.

Op3D-Grid uses patient specific data, which is stored in DICOM format on a hospital database. Secure access to this data is important so a java based User Interface has been developed that uses globus in the form of the java based cog kit to securely transfer the data to the

Onyx machine. Here the data is anonymised and converted into the appropriate format using the dctk (dicom tool kit) and various scripts. A run script is also produced that sets the Op3D application to run with this data and preferences of the surgeon.

Op3D uses a profile of user interactions. The surgeon can manipulate the data and a cut plane through a series of single button interactions, icons are used to show which interaction is current. The new set of interactions include book marking which allows the surgeon to mark and go to important scenes at the push of a button. More importantly a new type of interaction has been developed which uses "physically" accurate interactions to move the camera and alter the surgeon's view. This type of interaction is still being tested but it is hoped that this will increase the usability of the system and make it easier to locate features in the data.

The graphics hardware on an SGI Onyx is being used extensively to provide real time volume rendering of patient data. Currently the server provides rendering capabilities and little processing. However, Op3D-Grid will provide the infrastructure for more functionality to be delivered to the Operating Room e.g. physiology simulation.

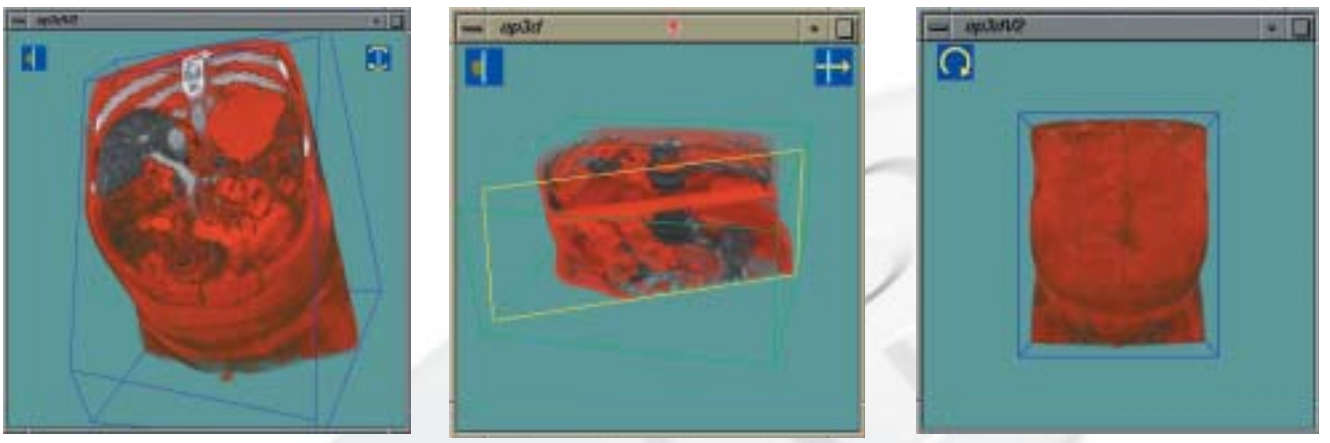

Figure 4: Slices showing 3D views of patient data.