An Internet-Based Framework For Streaming, Stereo Video And Multimedia Content For Use In Medical Education

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The observation of surgical procedures is a fundamental cornerstone of surgical education. However, often the training surgeon is limited in their experience by the cases that are present at their institution. Furthermore, in some parts of the developing world, travel to the developed world is prohibitive for cost or political reasons, which further limits the training opportunities for surgeons in these countries. Finally, some procedures, such as cadaveric dissection, are also limited for religious or other reasons and their exclusion from medical training can not be construed as a benefit.

While videotaped surgeries have been available for some time, the restrictions imposed by this medium limit its utility. The monoscopic and small field of view image provided from videotaped viewing serves to provide an experience much more like television than surgery. In addition, the exclusion of other, supplemental, but important information to the procedure (such as vital signs and other data), produces a learning environment that restricts the potential of the user. Finally, since the procedure has long since taken place, the ability to ask questions and have interaction during the procedure is also lost.

Clearly, a system which removed these restrictions would be more valuable toward surgical education. Moreover, such a system that provided for stereoscopic display, presentation of relevant supplemental data, and interaction would be useful not only for observation, but also for remote mentoring (where the training surgeon is performing the procedure and the expert is providing oversight). If such a system worked over the Internet, then it would provide for worldwide, relatively inexpensive and ubiquitous access to this valuable content.

We have developed a system to begin to address these issues. Our system consists of a PC-based videoserver, with two, inexpensive, attached FireWire-based cameras. This system encodes the stereo stream of video data in real time (15 fps per camera) and compresses it to a roughly 5 Mbps stream. Either the same, or a different PC can also acquire vital signs data from a number of wireless physiological monitoring devices that are integrated with the system.

These streams of data are sent to a server over the Internet known as the *switchboard*. This application handles multiple connections from both data suppliers and clients. As a connection from a data supplier is received, the switchboard updates a web page for the channels of data, and a remote user that wishes to view a channel need only click on a hyperlink for the desired channel. The relevant information is encoded using an efficient, custom protocol and sent from the suppliers to the switchboard, which then relays the data to all the clients of that particular channel. This data includes traditional physiological parameters (ECG, SpO2…) as well as multimedia information (audio, video, text, …). Once received by the client these data are decoded in real time and displayed. In this way, multiple users can view the same channel of multimedia information in real time and interact despite great distance. In addition, the switchboard implements a novel adaptive bandwidth algorithm to ensure that all clients are receiving data at their maximum rate, unhindered by the throughput of others.

The technology for the system is currently being refined and the network performance and scalability characterized. Once these technical issues are completed in the near future, the utility of this system will be in its daily use and integration into medical education.

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