A GESTURE-BASED TOOL FOR STERILE BROWSING OF RADIOLOGY IMAGES

LITERATURE SURVEY

ABSTRACT

The use of doctor-computer interaction devices in the operation room (OR) requires new modalities that support medical imaging manipulation while allowing doctors' hands to remain sterile, supporting their focus of attention, and providing fast response times. This paper presents "*Gestix*," a vision-based hand gesture capture and recognition system that interprets in real-time the user's gestures for navigation and manipulation of images in an electronic medical record (EMR) database. Navigation and other gestures are translated to commands based on their temporal trajectories, through video capture. "*Gestix*" was tested during a brain biopsy procedure. In the in vivo experiment, this interface prevented the surgeon's focus shift and change of location while achieving a rapid intuitive reaction and easy interaction. Data from two usability tests provide insights and implications regarding human-computer interaction based on nonverbal conversational modalities.

INTRODUCTION

Computer information technology is increasingly penetrating into the hospital domain. A major challenge involved in this process is to provide doctors with efficient, intuitive, accurate, and safe means of interaction without affecting the quality of their work. Keyboards and pointing devices, such as a mouse, are today's principal method of human—computer interaction. However, the use of computer keyboards and mice by doctors and nurses in intensive care units (ICUs) is a common method for spreading infections.[1] In this paper, we suggest the use of hand gestures as an alternative to existing interface techniques, offering the major advantage of sterility. Even though voice control also provides sterility, the noise level in the operating room (OR) deems it problematic.

In this work we refer to gestures as a basic form of non-verbal communication made with the hands. Psychological studies showed that young children use gestures to communicate before they learn to talk. Manipulation, as a form of gesticulation, is often used when people speak to each other about some object. Naturalness of expression, non-encumbered interaction, intuitiveness, and high sterility are all good reasons to replace the current interface technology (e.g., keyboard, mouse, and joystick) with more natural interfaces.

This paper presents a video-based hand gesture capture and recognition system used to manipulate magnetic resonance images (MRI) within a graphical user interface. A hand gesture vocabulary of commands was selected as being natural in the sense that each gesture is cognitively associated with the notion or command that is meant to represent it. For example, moving the hand left represents a “turn left” command.

The operation of the gesture interface was tested at the Washington Hospital Center in Washington, DC. Two operations were observed in the hospital's neurosurgery department and insights regarding the suitability of a hand gesture system was obtained. To our knowledge, this is the first time that a hand gesture recognition system was successfully implemented in an “in vivo” neurosurgical biopsy. A sterile human—machine interface is of supreme importance because it is the means by which the surgeon controls medical information avoiding contamination of the patient, the OR and the surgeon.

MEDICAL GESTURE INTERFACES

By the early 1990's scientists, surgeons and other experts were beginning to draw together state-of-the-art technologies to develop comprehensive image-guidance systems for surgery, such as the *Stealth Station.* This is a free-hand stereo-tactic pointing device, in which a position is converted into its corresponding location in the image space of a high-performance computer monitor. In a setting like the OR, touch screen displays are often used, and must be sealed to prevent the build-up of contaminants. They should also have smooth surfaces for easy cleaning with common cleaning solutions. These requirements are often overlooked in the busy OR environment.

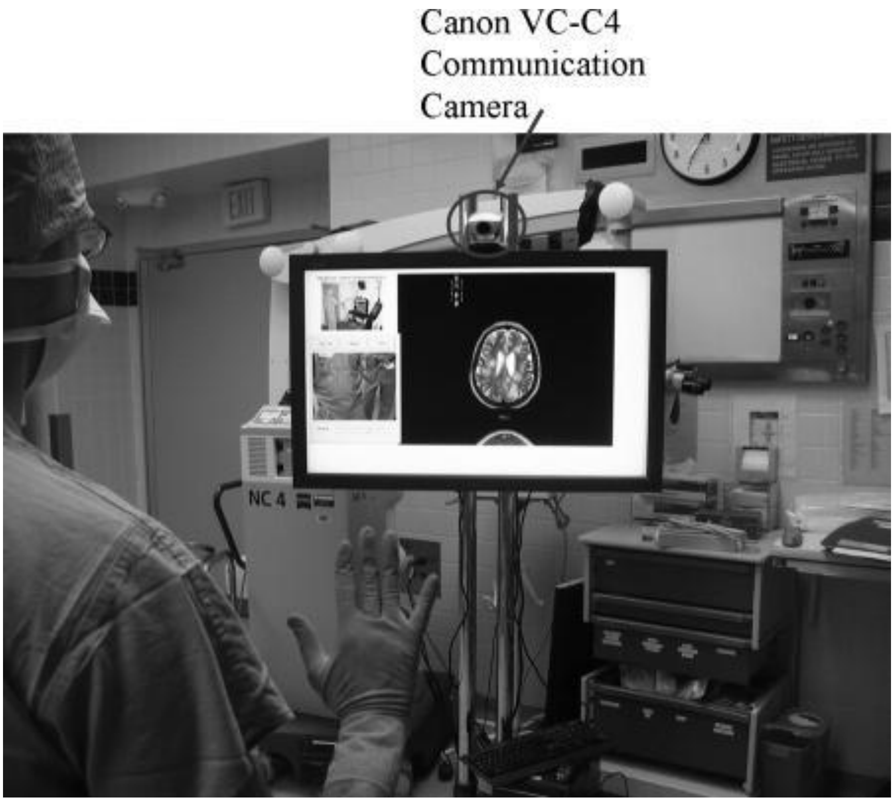
OVERVIEW

In two brain surgeries at the Neurosurgery OR at the Washington Hospital Center, procedures were observed by the authors to gain insights about the use of current technologies and how they affect the quality of the surgeon's performance. We found that: (a) surgeons kept their focus of attention between the patient and the surgical point of interest on the touch-screen navigation system; (b) a short distance between the surgeon and the patient was maintained during most of the surgery; (c) the surgeon had to move close to the main control wall to discuss and browse through the patient's MRI images.

The hand gesture control system “*Gestix*” developed by the authors helped the doctor to remain in place during the entire operation, without any need to move to the main control wall since all the commands were performed using hand gestures.

ARCHITECTURE

The sterile gesture interface consists of a Canon VC-C4 camera, whose pan/tilt/zoom can be initially set using an infrared (IR) remote. This camera is placed just over a large flat screen monitor (▶). Additionally, an Intel Pentium IV, (600MHz, OS: Windows XP) with a Matrox Standard II video-capturing device is used.



A two-layer architecture is used: In the lower level “*Gestix*” provides tracking and recognition functions, while at the higher level a graphical user interface called “*Gibson*” manages imaging visualization.

CONCLUSION

In this project they have developed a tool which recognises hand gestures and enables doctors to browse through radiology images using these gestures. This enables doctors and surgeons to maintain the sterility as they would not have to touch any mouse or keyboard to go through the images. This tool is also easy to use and is quicker than the regular method of using mouse/keyboard. It can be used regardless of the user's location since they do not have to be in contact with any device. It also does not require the user to have any device on them to use it. Further this technology can be extended to other industries like it can be used by presenters, by teachers for show images in the classroom, etc.

REFERENCES

1. Schultz M, Gill J, Zubairi S, Huber R, Gordin F. "Bacterial contamination of computer keyboards in a teaching hospital," *Infect Control Hosp. Epidemiol* 2003;4(24):302-303.

2. Nishikawa A, Hosoi T, Koara K, Negoro D, Hikita A, Asano S, Kakutani H, Miyazaki F, Sekimoto M, Yasui M, Miyake Y, Takiguchi S, Monden M. "Face MOUSe: A Novel Human-Machine Interface for Controlling the Position of a Laparoscope," *IEEE Trans. on Robotics and Automation* 2003;19(5):825-841. [

3. Smith KR, Frank KJ, Bucholz RD. "The NeuroStation- a highly accurate, minimally invasive solution to frameless stereotatic neurosurgery," *Comput Med Imaging Graph* 1994;18:247-256.

4. Graetzel C, Fong TW, Grange S, Baur C. "A non-contact mouse for surgeon-computer interaction," *Technol Health Care* 2004;12(3):245-257.

5. Kuno Y, Murashima T, Shimada N, Shirai Y. "Intelligent Wheelchair Remotely Controlled by Interactive Gestures." *Proceedings of 15th International Conference on Pattern Recognition* 2000;4:672-675.

6. Starner T, Auxier J, Ashbrook D, Gandy M. "The Gesture Pendant: A Self-illuminating, Wearable, Infrared Computer Vision System for Home Automation Control and Medical Monitoring" *Fourth Intl. Symp Wearable Comp* 2000:87-94.