A GESTURE -BASED TOOL FOR STERILE BROWSING OF RADIOLOGY

TEAM MEMBER
K.PAVENDHAN (310519104085)
THAMIZHARASAN.S (310519104131)
VINGNESHWARAN S (310519104137)
THAMARAISELVAN M(310519104130)

INTRODUCTION

Computer information techn**The Tracking Algorithm**

After a short calibration process, where a probability color model of the doctor's hand is built, images of the surgeon's hand gesturing are acquired by video-camera and each image is back-projected using a color model. The hand is then tracked by an algorithm which segments it from the background using the color model back-projection and motion cues.[7] This is followed by black/white thresholding, and a sequence of opening and closing morphological operations resulting in a set of components (blobs) in the image. The location of the hand is represented by the 2D coordinates of the centroid of the biggest blob in the current image.

"Gibson" Image Browser

The "*Gibson*" image browser is a 3D visualization medical tool that enables examination of images, such as: MRIs, CT scans and X-rays. The images are arranged over a multiple layer 3D cylinder. The image of interest is found through rotating the cylinder in the four cardinal directions. To interface the gesture

recognition routines with the "*Gibson*" system, information such as the centroid of the hand, its size, and orientation are used to enable screen operations in the "*Gibson*" graphical user interface.

Hand Tracking and Operation Modes

Gesture operations are initiated by a calibration mode in which a skin color model of the user's hand or glove, under local lighting, is constructed. In a browse mode, superimposed over the image of the camera's scene is a rectangular frame called the "neutral area." Movements of the hand across its boundary constitute directional browser commands. When a doctor/surgeon wishes to browse the image database, the hand is moved rapidly out of the "neutral area" toward any of four directions, and then back again. When such a movement is detected, the displayed image is moved off the screen and replaced by a neighbor image. To evoke a zoom mode, the open palm of the hand is rotated within the "neutral area" clockwise/counterclockwise (zoom-in/zoom-out). To avoid the tracking of unintentional gestures, the user may enter a "sleep mode" by dropping the hand. To re-arouse the system the user waves the hand in front of the camera. The selection of these gestures was designed to be intuitive, expressing the "natural" feeling of the user. For example, the left/right/up/down gestures evoke the actions used to turn pages in a book left/right, or flip notepad pages up/down. The rotation gesture (zoom-in/zoom-out commands) reminds one of a radio knob to increase or decrease volume. Dropping the hand (stop-tracking command) is associated to the idea of 'stop-playing', while the waving gesture ("wake-up" command) is associated with 'greeting a new person'.

Experiments

"Gestix" Setup

Prior to the initiation of the surgery, the "*Gestix*" system was placed in front of the main surgeon, midway between the patient's bed and the main control wall. The VC-C4 camera was attached over a large flat screen. Before the use of "*Gestix*," a calibration process is conducted to capture a sample of the gamut of colors of the hand or surgical glove. The setup time for the whole "*Gestix*" system was approximately 20 minutes. Instead of a nurse assistant, the "*Gestix*" system was used for the biopsy planning procedure during the time that the biopsy results were being obtained in the lab.

Usability Tests

Three different types of usability tests were conducted with the "*Gestix*" system in the OR: (i) a contextual interview; (ii) an individual interview; and (iii) a subjective satisfaction questionnaire. The main result of the contextual interview which was based on watching and listening to the users while they work indicated that the main surgeon had to remain sterile, close to the patient, and avoid distractions (change in focus of attention), which could be life threatening. The main issues found in a 20 minute interview of the main surgeon were; (a) the need of replacing the plastic adhesive cover from the touch-screen monitor for every new surgery in order to keep it sterile; (b) the delay caused by frequent visits of the surgeon to the main control wall and to return to the patient's side; and (c) the surgeon preferred hand gesture control since it is based on interaction with hands, in which he/she is

most proficient. At the end of the entire operation procedure, the main surgeon filled in a questionnaire to measure overall satisfaction about usability. This questionnaire was designed to measure satisfaction on a five point scale, similar to the ASQ created by Lewis.8 This questionnaire included questions on task experience, ease of task, task completion time, and overall task satisfaction. The surgeons found the "*Gestix*" system easy to use, with fast response and quick training times. Subsequent tests, using students, resulted in gesture recognition accuracy of 96% (for the eight gestures used in the system). Learning tests when tested by students for the eight gestures used and the learning tests required only 10 trials to converge with an average task performance time of 22 seconds.7

Discussion

A hand gesture system for MRI manipulation in an EMR image database called "*Gestix*" was tested during a brain biopsy surgery. This system is a real-time hand-tracking recognition technique based on color and motion fusion. In an in vivo experiment, this type of interface prevented surgeon's focus shift and change of location while achieving, rapid intuitive interaction with an EMR image database. In addition to allowing sterile interaction with EMRs, the "*Gestix*" hand gesture interface provides: (i) ease of use—the system allows the surgeon to use his/her hands, their natural work tool; (ii) rapid reaction—nonverbal instructions by hand gesture commands are intuitive and fast (In practice, the "Gestix" system can process images and track hands at a frame-rate of 150 Hz, thus, responding to the surgeon's gesture commands in real-time), (iii) an unencumbered interface—the proposed system does not require the surgeon to attach a microphone, use head-mounted (body-contact) sensing devices or to use foot pedals, and (iv) distance

control—the hand gestures can be performed up to 5 meters from the camera and still be recognized accurately. The results of two usability tests (contextual and individual interviews) and a satisfaction questionnaire indicated that the "*Gestix*" system provided a versatile method that can be used in the OR to manipulate medical images in real-time and in a sterile manner.

ology 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 pointingComputer devices, such as a mouse, are today's principal method of human—computer interaction. However, the use of keyboards and mice by doctors and nurseeading 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 s in intensive care units (ICUs) is a common method for sprprovides sterility, the noise level in the operating room (OR) deems it problematic

OVERVIEW

Gesture recognition is technology that uses sensors to read and interpret hand movement hand as commands.in the automotive industry

ABSTRACT

The use of doctor computer interaction devices in the operation room requires new modalities

manipulation of the project is to impelement the objectives.

navigation and other gesture are translated to common focus of attention

INTRODUCTION

Computer information technology is increasingly penetrating into the hospital domain. A major challenge involved in this process is to provide doctors with efficient,intutive,accurate

The basis of operation of the gesture interface was tested at the ashington hospital center

regarding the suitability of a hand gesture system recognition system was obtained

METHOD

In two brain surgeries at the use of current technologies and how they affect the quality of the surgeons s performance.

we found the hand gesture control system GESTIX development by the authors helped the doctors to remain in the place during the either operation without any need to move

All the commands were performed using hand

ABSTRACT

The use of doctor computer interaction devices in the operation room requires new modaities that support medical
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

The Tracking Algorithm

After a short calibration process, where a probability color model of the doctor's hand is built, images of the surgeon's hand gesturing are acquired by video-camera and each image is back-projected using a color model. The hand is then tracked by an algorithm which segments it from the background using the color model back-projection and motion cues.[7] This is followed by black/white thresholding, and a sequence of opening and closing

morphological operations resulting in a set of components (blobs) in the image. The location of the hand is represented by the 2D coordinates of the centroid of the biggest blob in the current image

"Gibson" Image Browser

The "*Gibson*" image browser is a 3D visualization medical tool that enables examination of images, such as: MRIs, CT scans and X-rays. The images are arranged over a multiple layer 3D cylinder. The image of interest is found through rotating the cylinder in the four cardinal directions. To interface the gesture recognition routines with the "*Gibson*"

system, information such as the centroid of the
hand, its size, and orientation are used to enable
screen operations in the "*Gibson*" graphical user
interface.

Hand Tracking and Operation Modes

Gesture operations are initiated by a calibration
mode in which a skin color model of the user's hand
or glove, under local lighting, is constructed. In a

browse mode, superimposed over the image of the camera's scene is a rectangular frame called the "neutral area." Movements of the hand across its boundary constitute directional browser commands. When a doctor/surgeon wishes to browse the image database, the hand is moved rapidly out of the "neutral area" toward any of four directions, and then back again. When such a movement is detected, the displayed image is moved off the screen and replaced by a neighbor image. To evoke a zoom mode, the open **"Gestix" Setup**

to the Priorinitiation of the surgery, the "*Gestix*" system was placed in front of the main surgeon, midway between the patient's bed and the main control wall. The VC–C4 camera was attached over a large flat screen. Before the use of "*Gestix*," a calibration process is conducted to capture a sample of the gamut of colors of the hand or surgical glove. The setup time for the whole "*Gestix*" system was approximately 20 minutes. Instead of a nurse assistant, the "*Gestix*" system was used for the

biopsy planning procedure during the time that the biopsy results were being obtained in the lab.**Experiments**

"Gestix" Setup

Prior to the initiation of the surgery, the "*Gestix*" system was placed in front of the main surgeon, midway between the patient's bed and the main control wall. The VC-C4 camera was attached over a large flat screen. Before the use of "*Gestix*," a calibration process is conducted to capture a sample of the gamut of colors of the hand or surgical glove. The setup time for the whole "*Gestix*" system was approximately 20 minutes. Instead of a nurse assistant, the "*Gestix*" system was used for the biopsy planning procedure during the time that the biopsy results were being obtained in the lab.

Usability Tests

Three different types of usability tests were conducted with the "*Gestix*" system in the OR: (i) a contextual interview; (ii) an individual interview; and (iii) a subjective satisfaction questionnaire. The main result of the contextual interview which was based on watching and listening to the users while they work indicated that the main surgeon had to remain sterile, close to the patient, and avoid distractions (change in focus of attention), which could be life threatening. The main issues found in a 20 minute interview of the main surgeon were; (a) the need of replacing the plastic adhesive cover from the touch-screen monitor for every new surgery in order to keep it sterile; (b) the delay caused by frequent visits of the surgeon to the main control

wall and to return to the patient's side; and (c) the surgeon preferred hand gesture control since it is based on interaction with hands, in which he/she is most proficient. At the end of the entire operation procedure, the main surgeon filled in a questionnaire to measure overall satisfaction about usability. This questionnaire was designed to measure satisfaction on a five point scale, similar to the ASQ created by Lewis.[8] This questionnaire included questions on task experience, ease of task, task completion time, and overall task satisfaction. The surgeons found the "*Gestix*" system easy to use, with fast response and quick training times. Subsequent tests, using students, resulted in gesture recognition accuracy of 96% (for the eight gestures used in the system). Learning tests when tested by students for the eight gestures used and the learning

tests required only 10 trials to converge with an average task performance time of 22 seconds.[7]

Discussion

A hand gesture system for MRI manipulation in an EMR image database called "*Gestix*" was tested during a brain biopsy surgery. This system is a real–time hand-tracking recognition technique based on color and motion fusion. In an in vivo experiment, this type of interface prevented surgeon's focus shift and change of location while achieving, rapid intuitive interaction with an EMR image database. In addition to allowing sterile interaction with EMRs, the "*Gestix*" hand gesture interface provides: (i) ease of use—the system allows the surgeon to use his/her hands, their natural work tool; (ii) rapid reaction—nonverbal instructions by hand gesture

commands are intuitive and fast (In practice, the "Gestix" system can process images and track hands at a frame-rate of 150 Hz, thus, responding to the surgeon's gesture commands in real-time), (iii) an unencumbered interface—the proposed system does not require the surgeon to attach a microphone, use head-mounted (body-contact) sensing devices or to use foot pedals, and (iv) distance control—the hand gestures can be performed up to 5 meters from the camera and still be recognized accurately. The results of two usability tests (contextual and individual interviews) and a satisfaction questionnaire indicated that the "*Gestix*" system provided a versatile method that can be used in the OR to manipulate medical images in real-time and in a sterile manner.

We are now considering the addition of a body posture recognition system to increase the functionality of the system, as well as visual tracking of both hands to provide a richer set of gesture commands. For example, pinching the corners of a virtual image with both hands and stretching the arms would represent an image zoom-in action. In addition, we wish to assess whether a stereo camera will increase the gesture recognition accuracy of the system. A more exhaustive comparative experiment between our system and other human–machine interfaces, such as voice, is also left for future work.

Production Management, and by the Rabbi W. Gunther Plaut Chair in Manufacturing Engineering, Ben-Gurion University of the Negev.