International Journal of Modern Engineering Research (IJMER)
www.ijmer.com *Pp-84-86* *ISSN: 2249-6645*

Hands-free PC control for users with disabilities of their hands

Sampath Kumar[1], Mr. Dorairangaswamy[2],
[1]*Research Scholar*
Sathyabama University
[2]*Sr. Prof & Head CSE & IT / AVIT, VMU*

Abstract: *Physically disabled and mentally challenged people are an important part of our society that has not yet received the same opportunities as others in their inclusion in the Information Society. Therefore, it is necessary to develop easily accessible systems for computers to achieve their inclusion within the new technologies. This paper presents a project whose objective is to draw disabled people nearer to new technologies.*

In this paper the assistive multimodal system is presented, which is aimed for the disabled people, which need other kinds of interfaces than ordinary people. The group of users of this system is persons with hands disabilities. The interaction between a user and a machine is performed by voice and head movements. It gives the opportunity for disabled people to carry out a work with PC.

I. Introduction

Many people are unable to operate a standard computer mouse or keyboard because of disabilities of their hands or arms. One possible alternative for these persons is multimodal system, which allows controlling a computer without using standard mouse and keyboard, for example:

(1) Using head movements to control the cursor across the computer screen; (2) using the speech for giving the control commands.

Automatic speech recognition and head tracking in joint multimodal system are combined in the system. The multimodal system processes the input information and controls the PC devices. For output of information the standard means of PC are used: PC monitor for graphical output and sound card + speakers for audio output.

In the multimodal system we combine two modalities only: speech and head movements. It is concerned with specific application area for hand-disabled people, so such modalities as gestures, haptics, handwriting cannot be used. On the other side using emotion recognition, facial moves, eye detection, etc. the system can be enhanced in future. Speech and head-based control systems have a great potential for improving the life comfort of disabled people, their social protectability and independence from other people. Hands-free control devices such as hands-free mouse and keyboard for access to PC are effective applications of these technologies. Users who have difficulties using the standard PC control devices could manipulate cursor merely by moving their heads and giving the speech command instead of clicking the buttons.

Unfortunately, a person's disability may affect his neck and head movements along with hands and arms. For instance, a person may have reduced active neck range of motion and hence reduced ability to move the head in one or more directions. In many of such cases the gaze tracking system can be successfully used instead of head tracking system. Though, usage of the gaze tracking system is worse in such parameters as task performance, human's workload and comfort both for untrained user and for experienced user, than the head tracking system. Of course, speech input is only one acceptable alternative to the keyboard for motor-disabled users.

Another good application of hands-free cursor control allows users to change the "focus of window" in GUI without mouse movement. It is helpful because ordinary human at typing uses both hands and during this typing he cannot move the mouse. The usage of hands-free mouse cursor control is effective way to increase the speed of information input. Let's imagine that there are two GUI opened side-by-side on the desktop. Instead of having to laboriously switch the active window by moving and clicking on the mouse, the user could simply turn head towards desired window and say the speech command after that keyboard input will flow into the appropriate document. Also, there are applications of hands-free cursor control for entertainment such as: painting programs, games, designing systems, etc.

The Technology

Developments in hands-free access to computers could perhaps be split into two categories,

I. Mouse and keyboard alternatives
II. Speech recognition

II. Mouse and keyboard alternatives

Some alternatives to the standard mouse have been available for a number of years. For example trackballs, that do not necessarily have to be used by the hands. A sturdy trackball such as the Kensington Orbit can be used with the elbows or chin. The Crayola Kids PC trackball with an extra large, brightly coloured ball and widely spaced buttons is easily used with the feet. As with the trackball devices, it is not necessary to use a touch screen by hand. A headset with a prodder attachment could be used as an alternative to a finger to touch icons on the computer screen.Until recently, the hands-free alternative to using a mouse by head movements involved a complex headset and specialist software only available at great expense. These devices were aimed at those with a major disability such as cerebral palsy or Motor Neuron Disease. For those needing

complete hands-free access to the computer there are some sophisticated solutions. One of these systems is known as Lucy designed by the University of Delft. This system provides not only an alternative to the mouse but also an alternative keyboard and a range of other input options such as switches.

Improvements in infrared devices have allowed aspects of these complex systems to become more accessible. Recent devices that allow access to the computer by head movements include Headway and Smart-Nav. The introduction of USB and plug and play is making the addition of these extra devices to a computer easier to undertake. It is now possible to have more than one mouse or trackball attached to a single computer. This ability to have a range of input devices attached to the computer would allow a student to vary their means of data entry around their disability or impairment.

Some of these systems include devices where the student wears a small reflective dot on their forehead or glasses to pick up the infrared or optical signal. The rest of the equipment is attached to the computer and the student is free to move around without needing to detach themselves from a number of wires. These devices are less intrusive for the student and do not need to be set for each individual. Other students, not requiring hands-free access, can still use the computer with the standard mouse and keyboard. While these devices provide a method of moving the mouse pointer around the computer screen with head movements they still require some means of providing the 'button click'. Most systems can be used in combination with a dedicated switch, perhaps used by the elbow or foot. Others have software that assumes that a length of time on a particular icon should be taken as a'double click'. Many of these head activated devices can be combined with specialist on-screen keyboard software and predictive software providing a total hands-free alternative to the keyboard and mouse.

III. Speech recognition

Speech recognition requires the computer to accept spoken words as input and interpret what has been spoken. To make the job of understanding speech easier for the computer, a method of speech input called command and control is used. Speech Recognition is technology that allows a computer to identify the words that a person speaks into a microphone. We used Microsoft Agent version 2.0 that provides a library for more natural ways for people to communicate with their computers. And also we used The Lernout & Hauspie True Voice Text-to-Speech (TTS) Engine that provides speech output capabilities for Microsoft Agent so we can hear what the characters are saying through your sound speakers. The commands available to the user are the following: "left click" (or just "click"), "double left click" (or just "double click"), "right click", "double right click".

The user can also keep a button pressed so as to highlight a group of objects. The command "down", "up" change the selection area of the mouse per example in the menu (File, Edit, Insert…) and we can select also the menu with the voice command. This set of available commands allows executing meaningful tasks on the computer since all the main mouse click operations are available.

One of the difficulties experienced by disabled students is that assignments and projects can take much longer to complete than for their fellow students. The latest version of Dragon Naturally Speaking has built on the macro facilities and script writing of the early Dragon dictate software. Dragon Naturally Speaking version 6 has four types of custom commands available within the professional solutions editions. These are:

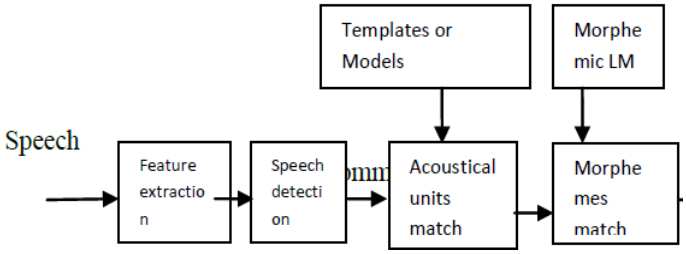
_ ⌋Text and Graphics commands |
_ ⌋Step |-by-Step commands
_ ⌋Macro Recorder |
_ ⌊Advanced Scripting |

These custom commands allow the user of the speech recognition software to automate areas of their computer work. In particular, the Macro Recorder and Advanced Scripting can be used to assist with access to computer systems requiring some mouse input.

Further we describe the developed multimodal system, which uses speeches and head movements for input of information into the Computer. The speech recognition and head tracking modules will be considered in detail. Then the process of information fusion and synchronization is described. Finally the structure of the complete assistive multimodal system and some examples of its using for hands-free PC control are presented.

SIRIUS speech recognition system

The main architecture of automatic system SIRIUS (Spiiras Interface for Recognition and Integral Understanding of Speech), developed in Speech Informatics Group of SPIIRAS is presented below. This architecture can be both speaker independent and speaker-dependent. The difference in these models consists in the acoustical-lexical level.



Structure of SIRIUS speech recognition system

For the speaker-dependent speech recognition system the acoustical templates of the whole words are used and for the speaker-independent recognition the stochastic acoustical models based on Hidden Markov Models (HMM) or Artificial Neutral Networks can be used. In order to apply this speech recognition system for Russian language several original methods on the all levels of speech processing were developed. Further the used methods for preliminary speech signal processing, continuous speech recognition and language modelling will be described consecutively.

Initial signal processing

For parametrical representation of the speech signal two methods are used (mel-frequency cepstral features and spectral-difference features). The second method was developed for more robust work in the conditions of variations of the signal amplification level. In this method the subset of pairs of spectral bands is chosen from discrete spectrum and the further processing consists in comparison of the energies of the chosen bands considering some weight coefficients. In this principle, this method allows describing any forms of speech spectrum with any required accuracy, but very high accuracy is not necessary since there is redundant variability of spectrum of natural speech.

At present there are many methods for speech endpoint detection based on calculation of short-time signal energy, spectral energy, number of zero-crossing of signal, adaptive threshold values and information about duration of speech fragments. However all these algorithms become less reliable in conditions of non-stationary noise as well as at appearance of diverse sound artifacts (aspiration, lip smacks, etc).

In order to detect the speech signal in conditions of non-stationary noise environments the method based on spectral entropy analysis was developed. The distinction between entropy for speech segments and entropy for background noise is used for speech endpoint detection. Such criterion is less sensitive to variations of signal amplitude. The experiments with the developed method have shown that speech fragments are successfully selected in sound signals, which have diverse kinds of intense noises and sound artifacts.

CONCLUSION AND FUTURE WORK

The multimodal system is aimed for the disabled people, which need other kinds of interfaces than ordinary people. In the developed system the interaction between a user and a computer is performed by voice and head movements. To process these data streams the modules of speech recognition and head tracking were developed. This system was applied for hands-free operations with Graphical User Interface in such tasks as Internet communications and lunching applications. We showed theoretically that this technology could be used to operate computers hands-free. Our prototype exhibits accuracy and speed, which are sufficient for many real time applications and which allow handicapped users to enjoy many computer activities. The experiments have shown that in spite of some decreasing of operation speed the multimodal system allows working with computer without using standard mouse and keyboard. Thus the developed assistive multimodal system can be successfully used for hands-free PC control for users with disabilities of their hands or arms.