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Technology for the Convenience of Persons with Disabilities

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ABSTRACT

This paper explores trends in information and communication technology, highlights the potential opportunities and problems these trends present for people with disabilities. Specifically, this paper discusses technology that can have significant impact on quality of life for people with disabilities. The details of two emerging technologies which can do wonders for the physically disabled people namely: Silent Sound Technology and Eye Gaze Tracking System are discussed in detail highlighting their importance, applications and restrictions.

Keywords: — Silent sound technology, Eye Gaze Tracking System, Electromyography, Disability.

I. INTRODUCTION

Almost 10 percent of the world's population—650 million people—live with some type of disability. A disability is any physical, sensory, or cognitive impairment that makes daily activities more difficult. Many people are born with a disability. Others acquire a disability later in life, from an accident, an illness, or the aging process. Many older individuals are diagnosed with chronic conditions that lead to functional or cognitive disabilities.

Until a few years ago, being physically challenged was a curse that made life miserable for the individual by making him dependent on others. However, things have changed over the course of time, and a large part of the credit for this, goes to the gigantic strides we have taken in various sciences. A whole lot of innovative products, which are readily available in the market today, have helped physically challenged individuals to carve a niche for themselves and become independent against all odds.

If anything has become indispensable today, it is technology. Our world is largely dependent on computers, such that not being well-versed with this technological marvel is bound to make the person feel left out. That was the case for people with disabilities until some specially designed computer devices were introduced one after another over the last decade. Courtesy the innovative minds out there, specially designed computer devices have made life a lot easier for the physically challenged, helping them to face the world against all odds. What is surprising though is that most people are not aware of the fact that such devices exist.

If anyone in this world has proved how useful assistive technology can be, it's the renowned English theoretical physicist, Stephan Hawking [1]. His use of this technology to compensate for impaired mobility and speech has been nothing short of exceptional.

How do People with Disabilities Use Computer?

Physically challenged individuals require alternative input devices in order to use the computer. These devices, which range from voice recognition programs to alternative keyboards, provide them adaptive options in the form of computer hardware and software, thus helping them to eliminate the barriers of disability and use the computer [2]. With these devices at their disposal, people with disabilities can use various machines and not just the computer.

More recently, pointing devices that can be controlled by the movement of the eyes have also become popular among people with disabilities. In this case, the system tracks the user's eyes on the screen and presses a particular key when he looks at it for a specific period [1]. So the user can surf the net and even send emails simply by looking at the screen.

More recently, we have seen the advent of the SNP (Sip-and-Puff) technology, which enables users to control on-screen action by breathing [1]. In this case, the cursor can be controlled by inhaling or

exhaling in a specifically designed tube, which can be worn either on the head or chin. Sound cannot be seen, tasted, smelled, or felt and nothing other than sound can be directly heard. (Objects are heard indirectly by virtue of the sounds they produce.) All subsequent commentators agree, often characterizing the principle as an analytic truth.

For instance Geoffrey Warnock says 'sound' is the tautological accusative of the verb 'hear'. I shall argue there is a single exception. We hear silence, which is the absence of sounds. Silence cannot be seen, tasted, smelled, or felt but only heard [3].

How hearing silence differ from not hearing?

Hearing silence is successful perception of an absence of sound. It is not a failure to hear sound. A deaf man cannot hear silence but it is possible with Silent Sound Technology.

In the present era of continuous evolving strides in the communication technology, it is imperative to remain updated with the latest devices available or being developed which can significantly enhance the capabilities of persons with disabilities. The sections below elaborate the concept, working, applications and challenges for two most important technologies specifically aimed at persons with some hearing and speaking disabilities.

II. SILENT SOUND TECHNOLOGY

The Silent sound technology is a completely new technology which can prove to be a solution for those who have lost their voice but wish to speak over phone. This technology helps you to transmit information without using your vocal cords. Silent Sound technology was developed at the Karlsruhe Institute of Technology, Germany [4].

Silent sound technology enables speech communication to take place when an audible acoustic sound is unavailable. By acquiring sensor data from elements of the human speech production process- from the articulators ,their neural pathways ,or the brain itself –it produces a digital representation of speech which can be synthesized directly, interpreted as data, or routed into a communication networks[4].

A. Types of Silent sound technology

Silent sound technology is processed in two ways [5].

1) Electromyography (EMG): Electromyography is a technique used in silent sound technology that monitors tiny muscular movements that occur when we speak and converting them into electrical pulses that can then be turned into speech, without a sound utter. Electromyography (EMG) is a technique for

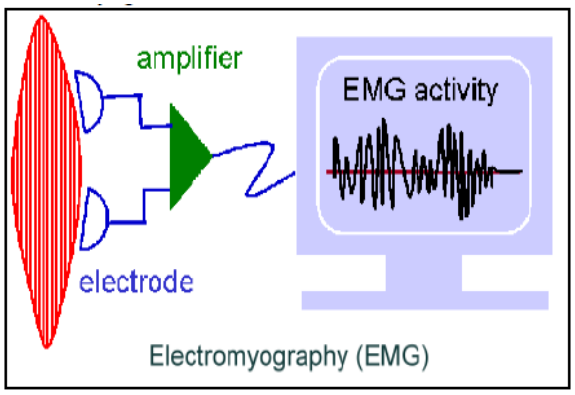

Fig. 1 Basic mechanism of Electromyography

evaluating and recording the electrical activity produced by skeletal muscles. EMG is performed using instrument called an electromyography, to produce a record called an Electromyogram. Fig 1 shows the basic mechanism of Electromyography where the muscle activity is analysed by the Electromyograph to generate an Electromyogram. An electromyograph detects the electrical potential generated by muscle cells when these cells are electrically or neurologically activate

2) Image Processing: The simplest form of digital image processing converts the digital data tape into a film image with minimal corrections and calibrations. Then large mainframe computers are employed for sophisticated interactive manipulation of the data. In the present context, overhead prospective are employed to analyze the picture. In electrical engineering and computer science, image processing is any form of signal processing for which the input is an image, such as a photograph

B. Applications of Silent Sound Technology

The Technology opens up a host of application such as mentioned below [6]:

• As we know in space there is no medium for sound to travel therefore this technology can be best utilized by astronauts.

• Helping people who have lost their voice due to illness or accident.

• We can make silent calls even if we are standing in a crowded place.

• Allow people to make silent calls without bothering others.

• Telling a trusted friend your PIN number over the phone without anyone eavesdropping -assuming no lip readers are around.

• Silent Sound Techniques is applied in Military for communicating secret/confidential matters to others.

• Since the electrical signals are universal they can be translated into any language. Native speakers can translate it before sending it to the other side. Hence it can be converted into any language of choice currently being German, English & French

Thus Silent Sound Technology, one of the recent trends in the field of Information technology implements 'Talking without Talking'. It will be one of the innovative and useful technologies and in near future this technology will be of use in day to day life.

C. Challenges in Implementation

Translation into majority of languages but for languages such as Chinese different tone holds different meaning, facial movements being the same. Hence this technology is difficult to apply in such situations [7].

- From security point of view recognizing who you are talking to gets complicated.
- Even differentiating between people and emotions cannot be done. This means you will always feel you are talking to a robot.
- This device presently needs nine leads to be attached to our face which is quite impractical to make it usable.

Silent sound technology is expected to be in the market in five to ten years. And there will be a time when the following phrase becomes prevalent – 'Silence is the best answer for all situations - even our mobile understands'.

D. Future of Silent sound technology

Developments in Silent sound technology gives way to a bright future to speech recognition technology from simple voice into commands to memorandum dictated over the phone all this is fairly possible in noisy public places. Without having electrodes hanging all around your face, these electrodes will be incorporated cell phones. Nano technology will be a mentionable step towards making the device handy.

So we conclude that Silent Sound Technology, one of the recent trends in the field of information technology implements "Talking without Actually Talking". Engineers claim that the device is working with 99 percent efficiency. It is difficult to compare SSI technologies directly in a meaningful way. Since many of the systems are still preliminary, it would not make sense, for example, to compare speech recognition scores or synthesis quality at this stage.

III. EYE GAZE TRACKING SYSTEM

The eye gaze communication system [8] is a communication system which is very useful for the blind persons with the help which they can perform their daily activities by using such a communication system. In other words, the Eye tracking is the process of measuring either the point of gaze (where one is looking) or the motion of an eye relative to the head. An eye tracker is a device for measuring eye positions and eye movement. Eye trackers are used in research on the visual system, in psychology, in cognitive linguistics and in product design.

A. Eye-Tracking Technique

Eye tracking is a technique whereby an individual's eye movements are measured so that the researcher knows both where a person is looking at any given time and the sequence in which their eyes are shifting from one location to another. Tracking people's eye movements can help HCI researchers understand visual and display based information processing and the factors that may impact upon the usability of system interfaces. In this way, eye-movement recordings can provide an objective source of interface-evaluation data that can inform the design of improved interfaces. Eye movements

can also be captured and used as control signals to enable people to interact with interfaces directly without the need for mouse or keyboard input, which can be a major advantage for certain populations of users such as disabled individuals.

B. Types of eye trackers

Eye trackers can be classified as given below [9]:

- First generation: eye-in-head measurement of the eye consisting of techniques such as scleral contact lens/search coil, electro-oculography.
- Second generation: photo- and video-oculography.
- Third generation: analog video-based combined pupil/corneal reflection.
- Fourth generation: digital optics coupled with on-chip Digital Signal Processing.

C. Future Scope of Eye Tracking System

The developments in eye tracking should centre on standardizing what eye movement metrics are used, how they are referred to, and how they should be interpreted in the context of interface design. Eye-tracking technology also needs to be improved to increase the validity and reliability of the recorded data. The robustness and accuracy of data capture needs to be increased, so that point-of-regard measurement stays accurate without the need for frequent re-calibration [10]. Data collection, filtering and analysis software should be streamlined so that they can work together without user intervention. The intrusiveness of equipment should be decreased to make users feel more comfortable, perhaps through the development of smaller and lighter head mounted trackers. Finally, eye-tracking systems need to become cheaper in order to make them a viable usability tool for smaller commercial agencies and research labs. Once eye tracking achieves these improvements in technology, methodology, and cost, it can take its place as part of a standard HCI toolkit.

So we can conclude that eye-movement tracking represents an important, objective technique that can afford useful advantages for the in-depth analysis of interface usability. Eye-tracking studies in HCI are beginning to burgeon, and the technique seems set to become an established addition to the current battery of usability testing methods employed by commercial and academic HCI researchers. This continued growth in the use of the method in HCI studies looks likely to continue as the technology becomes increasingly more affordable, less invasive, and easier to use. The future seems rich for eye tracking and HCI. In mere future this technology will be used in our day to day life.

IV. CONCLUSION

The barriers of impractability and high cost are problematic—significantly inhibiting the use of technology.

Such technologies are making it easier for disabled persons to travel the digital world, interact with others and get the work done. Yet technical innovation is also generating remarkable new prospects for enhancing the capacities of affected people and optimizing their quality of life. Indeed, the nature of technical innovation are likely to set in motion profound changes in the meaning of disability for affected children and their families, particularly as the use of technology becomes more deeply integrated into the common tasks and routines of daily life for everyone. As technical capacity expands, so too does the burden on society to provide this capacity to all people in need While transforming human capability and disability, technical innovation also constantly reshapes our collective commitment to equality and social justice.

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