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Devices that Assist MND Patients

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Abstract: Several researches have been carried out over the past years to assist the patients suffering from Motor Neuron Disease (MND) to communicate effectively. Though many interpretations exist, they are extremely outrageous and torpid in user response. This survey paper presents designing a wireless handheld device to assist the MND patients to communicate using series of blink.

Keywords: Motor Neuron Disease; Video-oculography; Video processing; Wireless handheld device; Electro oculography

I. INTRODUCTION

Effective communication is key to the existence and survival of persons. It is a mode which assists to send messages. This is embedded in every human being to bring proof of his existence in the form of language. In the contemporary world, the growth of telecommunications and information technology, as well as the increasing competition and difficulty in development, have made communication very important.

Patients suffering from MND experience an early symptom - difficulty in speaking. A MOTOR NEURON DISEASE is a set of problems that cause the nerves in brain and spinal cord to diminish functionality over time, in turn affecting the muscle. The slurred, unclear, faint speech is caused due to weakness in tongue, lips, vocal cord and chest. As per the survey MND patients include around 8%-20% of global population. In India 3 out of 100,000 people suffer from Motor Neuron Disease (MND). So approximately 40,176 (as per 2017) gets affected by this disease per year.

The motivation within the proposed project is from Stephen Hawking's wheelchair. Hawking was diagnosed with amyotrophic lateral sclerosis (ALS) when he was 21. ALS may be a sort of motor neuron disease, which ends up within the progressive death of the nerves that control the muscles. Many sufferers die within five years but thankfully, his illness has developed very slowly for physics and for Professor Hawking himself. At the age of 73, Hawking was left except for minimal selection of motor function, mainly in his face muscles. The PC technology built into its wheelchair offers its link to the planet. Professor Hawking was completely in charge of all the activities. Special interface such as EZ keys were used by Professor Hawking that scans one at a time through each letter of the on-screen keyboard. As Hawking is moving his face, the movement is detected by a sensor and the machine stops the scanner and picks the message. He could also use this method to search his email system (Eudora), Web browser (Firefox) or probably the following from one button or menu item to the next.

But, the cost of this wheelchair is about 2 to 3 lakhs which cannot be affordable and there were electrodes inserted on face; this method is called Electro-oculography. This was performed by measuring the voltage changes across the electrodes, which lead to irritation, discomfort and some side effects to the patient. In order to overcome these issues another technique called Video-oculography has come into existence.

Video-oculography is a non-intrusive, video-based method of measuring various movements of both eyes by employing a mask which contains small cameras. VOG is typically employed for medical purposes.

II. LITERATURE SURVEY

A. *Paper title: Eye controlled Electric wheelchair*

Authors: Neena Mani, Aby Sebastian, Alex Mathews Paul, Alex Chacko, Anupa Ranganath.

This paper delivers a way to move the wheelchair for disabled people based on the movement of eyes. The intention of this research is to implement a wheelchair functioned by the eyes of the person resting in the wheelchair. It might give people without full use of their

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limbs the liberty to move around and provide a degree of autonomy. The project involves three stages: image detection, image processing and sending of the controlled signals. Head mounted camera is used for detection of eye movements. Processing of the images is later handled by python software. The motor driving circuit will then receive the corresponding output signals. This controls the motors. The most drawback of the above project is the head mounted camera which may cause stress and uneasiness to the user [1].

B. Paper title: Augmentative and alternative communication device based on eye blink detection and conversion to Morse-code

Authors: Kingshuk Mukherjee, Debdatta Chatterjee

An extremely low-priced device that reads and convert eye-blinks from the patients to a universally accepted communication code-Morse code. In this system an IR-LED module is focused on the eye with the help of eyeglass. The LED focuses the light on the eye which is reflected back and is detected by the sensor. The amount of reflected light is used to indicated whether eyes are opened or closed. During a blink, more light is reflected back for a duration and the sensor gives a higher output than for a normal open eye. Likewise, eye blinks are recorded, analyzed and converted to a regular English alphabets using Morse-code. The drawback of the above project is the use of IR-sensors, which may get irradiated by other sources resulting in false eye blinks [2].

C. Paper title: Automatic motion control of powered wheelchair by the movements of the eye blink

Authors: Manoj Challakundla, K Yogeshwar Reddy, N. Harsha Vardhan

This paper proposes a new technique to use Infrared Radiation (IR) to monitor the motorized wheel chair. An attempt to transmit low-intensity infrared rays to the eyes has been made. The level of analog voltage in the infrared receiver varies according to the movement of the hand. This methodology allows the user to automatically navigate to the preferred target object with the possibility of preventing collisions omnidirectionally, so that a rigorous interaction with the wheelchair is possible by the user. The main aim is to reduce the human inconvenience and that the wheelchair can perform to achieve self-independence in everyday activities at least and to provide the services to disable society by increasing their range of mobility. The drawback of this project is that it requires the user to wear the optical glasses which may cause discomfort to the user [3].

D. Paper title: Real time drowsiness detection using eye blink monitoring

Authors: Amna Rahman, Mehreen Sirshar

The proposed project aims at reducing the increased rate of road accidents caused due to drowsy or a sleepy driver, by using an eye blink system that uses feature points of the eye to find out whether the eyes are opened or closed, an alarm is activated if the driver is drowsy. Detailed findings are also showcased to highlight the importance of technique used. A 94% accuracy was obtained for the proposed methodology. The tests used to diagnose drowsiness fall into three main categories: physiological, behavioral and vehicle based reforms. The algorithm proposed in the paper tracks the behavior of the driver and interprets the visuality of the driver. The main drawback of the above project is that it requires good illumination conditions and high-resolution camera for higher accuracy [4].

E. Paper title: Development of an EOG (Electro-Oculography) Based Human-Computer Interface

Authors: Qiuping Ding, Kaiyu Tong, and Guang

This paper provides a method for interacting with their caretakers, based on EOG(electro-oculography) signaling rather than very costly methods based on reflection. The aim of this project is to create an affordable user computer interface to help people with disabilities interact with their clinicians, based on EOG. EOG signals of different patterns os eye movements are analyzed with the self-constructed LOS guiding setting. An effective pattern of eye movement is found for the computer control [5].

F. Paper title: Emotion Recognition from Speech based on Relevant Feature and Majority Voting

Authors: Md. Kamruzzaman Sarker, Kazi Md. Rokibul Alam and Md. Arifuzzaman

This paper offers a framework for extracting emotions from human speech using technique of majority voting over many techniques of machine learning. The contribution of this work will be in two folds: firstly, it will select those speech characteristics that are most promising for classification and secondly, it will use the majority voting techniques that selects the specific emotional class. The use of majority voting technique has achieved a decent accuracy over other employed machine learning techniques. Just in case of emotion recognition from human speech as emotion from speech is not absolute i.e. same speech may represent multiple emotions; therefore, the accuracy obtained during this simulation is satisfactory [6].

G. Paper title: Brainwave Enabled Multifunctional, Communication, Controlling and Speech Signal Generating System

Authors: Kiran R. Trivedi and Dr. Rajesh A. Thakker

This paper delivers a method to a low cost hardware connected with mobile application which measures brainwave parameters and takes necessary actions based on the developed embedded algorithms. Mainly alpha, beta, gamma and delta brainwaves are available all the time with some important EEG power depending on the current human environment. The frequencies of brainwaves vary from 0 Hz to 30 Hz and more .Different state of minds based on measured frequency have been recognized by the researchers. The Delta Brain Waves ranges from 0.5 to

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4Hz, Theta Brain Waves ranges from 4 to 8 Hz, Alpha Brain Waves ranges from 8 to 13Hz and Beta Brain Waves ranges >13Hz [7].

H. Paper title: Recording eye movements with video-oculography and scleral search coils: a direct comparison of two methods

Authors: J.N. van der Geest and M.A. Frens

This paper provides a video-based 2D eye tracking system for its performance in recording eye movements and a comparison with the scleral finding technique. Positions of the eye were calculated irrespective of information from the two systems which simultaneously reported eye positions. Fixing positions were well compared between the coil output The values measured by the video system were fitted as linear function of the values measured by the coil system in reference to the saccadic analysis. Of all the saccadic parameters, strongly correlated linear fits were obtained with slopes one. These systems have had identical main sequence relationships. The comparatively noisier estimation of all parameters of small saccades may be due to the present low frequency of sampling [8].

III. PROPOSED WORK

As per the literature survey mentioned above the techniques used is Electro-oculography for eye blink detection. This methodology involves the user to be hooked to electrodes placed on the eyelids which in turn senses the movements during blinks. This led to many drawbacks such as, illumination conditions, training is needed to be given to the patients for the proper use of the device. The EOG are seldom deterministic, as the electrodes are hooked on the skin it made the patient uncomfortable and caused damages in the eye. Thus, in order to overcome the issues, Video oculography is proposed. In this proposed work, there are no electrodes nor contacts used, it is based on wireless real-time implementation. Easy to use and is affordable.

IV. CONCLUSION

The system consists of the eye tracking webcam, Arduino Microcontroller board and associated circuits. The system works by tracking the motion of eyeball, using a webcam image which is processed using MATLAB Software and corresponding movement is obtained. This setup is meant for MND patients and paralyzed patients. The hardware along with the software is a great tool which makes the life of MND people independent.

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