Video Oculography Based Device Control

Rachana R Bademi, Shilpa S, Suman N M

Department of Electrical and Electronics, Sai Vidya Institute of Technology , Bangalore, India

Praveen B R

Asst.Prof. Department of Electrical and Electronics, Sai Vidya Institute of Technology , Bangalore, India.

Abstract: Eye movements are tracked mainly using Electro-oculography (EOG), video-oculography (VOG) and electronystagmography (ENG) for detection of eye gaze. Here is a method to detect eye movements from Video-oculography. The study was started considering ALS patients. The images obtained were processed and a simple aspect is built to trace the eye movements whether it is center gaze, right gaze or left gaze.

Keywords: Video-Oculography; Eye gaze detection; Image processing.

I. INTRODUCTION

The Amyotrophic lateral sclerosis (ALS), also known as motor neuron disease (MND) and Lou Gehrig's disease, is a specific disease that causes the death of neurons which control voluntary muscles. ALS is characterized by stiff muscles, muscle twitching, and gradually worsening weakness due to muscles decreasing in size. This results in difficulty speaking, swallowing, and eventually breathing.

The disorder causes muscle weakness and atrophy throughout the body due to the degeneration of the upper and lower motor neurons. Individuals affected by the disorder may ultimately lose the ability to initiate and control all voluntary movement, although bladder and bowel function and the muscles responsible for eye movement are usually spared until the final stages of the disorder. [3]

One of the best examples is Dr Stephen Hawking.

Stephen Hawking was diagnosed with amyotrophic lateral sclerosis (ALS) when he was 21. Most sufferers die within five years, but fortunately for physics, and for Professor Hawking himself, his disease has progressed extremely slowly. Even so, at the age of 73, Hawking has just a small amount of motor function left, mainly in the muscles of his face. His link to the world is provided by the computer technology built into his wheelchair. As Hacking's physical was condition gradually deteriorates, his typing speed has dropped to just one or two words per minute. [4]

Since his cheek muscles and thumb muscles were gradually deteriorating, we can use the one organ which is still in function that being his Eye.

Videooculography is a method of recording eye movements through camera. By using video oculography we can detect eye gaze movement and use it to commute or/and operate appliances.

II. LITERATURE SURVEY

A. Electro-oculography

Electronystagmography is a test used to record involuntary eye movements caused by nystagmus.

Human eye acts as a dipole, where cornea acts as the positive pole and retina acts as the negative pole. Normally there will be at least 1mV potential difference between the two poles. An electrical field is created because of the corneoretinal potential in front of the head that changes its appropriate position to track the eye movements based on the electric changes. The mid-position of the eyes is the center gaze which serves as resting voltage between the electrodes and also serves as the baseline. Electrodes are placed such that it tracks horizontal and vertical eye movements in ENG and EEG recording. A similarity was observed between the EEG and ENG waveform, so single channel EEG recording was used for the processing of data. The signal processing was done and using the first derivative the position of the peaks and total number of peaks due to eye movement were obtained. This method can also be used to track eye movements during sleep.[1]
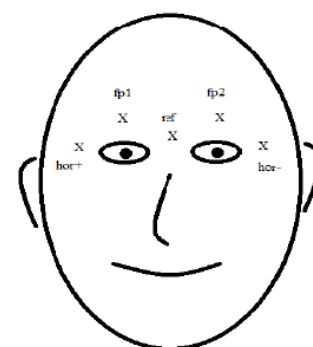

Fig 1.   Electrode Placement

This project uses Electro Oculography. Unlike video oculography here they place electrodes all around the face of the patient. In case the person moves his eyes or blinks a potential difference is created across the electrodes. Though easy to use, this is highly uncomfortable for patient.

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B. *Human Computer Interface*

Several researches have been carried out in recent years for developing Human Computer Interface (HCI). Human Computer Interface as an assistive technology helps the people with motor disabilities and who can't move their arms.

Eye tracking techniques can be used for the communication of these people. In this paper, image based eye tracking technique is used for interaction. The aim of this paper is to help the disabled people to use the computer efficiently. It is based on controlling cursor movements on the screen using only the eyes.[2]

This paper uses Camera for eye detection. But uses a very complicated method called - Hough Transform. This is highly time consuming and also complicated. We plan to use an easier methodology.
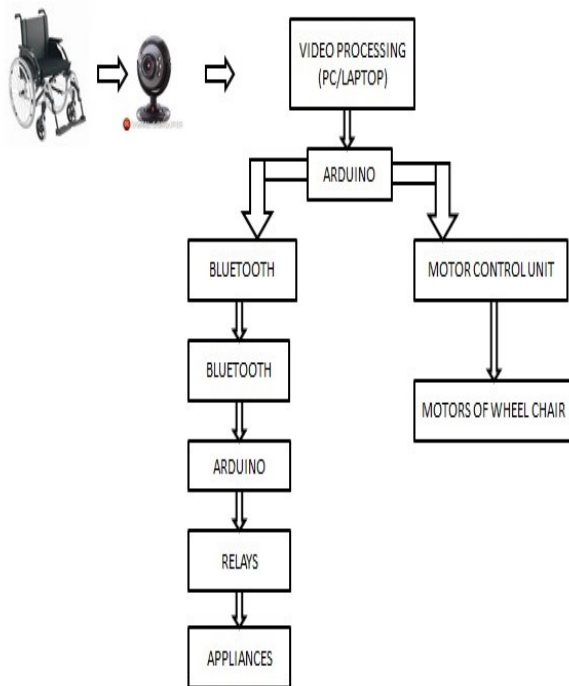
III. PROPOSED ARCHITECTURE

Fig 2.   Setup

A camera is placed in front of the wheel chair, which in turn is connected to a video processor which identifies the eye gaze moments of the disabled person. This video processor is connected to an Arduino Microcontroller which will send signal through Transmitter and Receiver to appliances to work. Another microcontroller is used to control the relays and the appliances. EX: - ON and OFF function of a bulb.   Arduino Microcontroller is also connected to motor control unit which gives signals to the motors of wheelchair to move in a desired direction.

IV. IMAGE PROCESSING

A. *Image acquisition*

It is a process of capturing of the image from the camera and loading it to the software or reading of an image.

B. *Pre-Processing*

It is the function to extract the feature of an image like cropping and zooming.

C. *Segmentation*

The goal of segmentation is to simply or change the representation of an image into something more easier to analyze.

D. *Noise removal*

Is the process of removing random variations of brightness in the image. It contains two steps namely, Erosion and Dilation.

a) *Erosion*

Is the process of making the central pixel black if the if the surrounding pixels are black.

b) *Dilation*

Is the process of making the central pixel white if the if the surrounding pixels are white.

V. CONCLUSION

A working model which will use eye gaze of a physically challenged person to commute will be designed. To control the operation of basic home appliances. Can send emergency message.

This type of direct eye interface would increase an individual independence and dramatically improve the quality of life of such people.

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