# Wireless And Portable EOG Based Interface For Controlling Wheelchair

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***Abstract*— In this paper, we proposed an eye-movement tracking system. Based on Electro-Oculography (E.O.G) technology we detected the signal with different directions in eye-movements and then analyzed to understand what they represented about (e.g. horizontal direction or vertical direction). This enables people to control applications using bio-electric signals recorded from the body. In an Electrooculogram (EOG) based, signals during various eye (cornea) movements are employed to generate control signals. Electrooculography is a technique for measuring the resting potential of the retina. The resulting signal is called the electrooculogram. Moreover, it is simpler to complete the feature extraction and analysis of EOG signals. So, it will achieve more success to design of wheelchair guidance by EOG.**

*INDEX TERMS*— ATMEGA16, ELECTROOCULOGRAM, EYE MOVEMENTS, EYE GESTURE RECOGNITION, ELECTRODES.

## I. INTRODUCTION

Wheelchairs are important mobile aids for elders and disabled patients. Electrooculography is a technique for measuring the resting potential of the retina. The resulting signal is called the electrooculogram. This paper has investigated that different EOG signals obtained from four different places around eye; (right, left, up, and down) have led to different level of distance and rotation of wheelchair. Those four signals are correspond to different levels of right and left steer, forward and backward motion. EOG controlled device are gaining popularity in recent times. Therefore, this new type HCI interface based on biopentials can help people, especially the disabilities, interact with the surroundings, and has wonderful application prospects. This technology has the potential to enable severely disabled people to drive wheelchair directly by brain activity rather than by physical means. The ultimate importance of BCI technology hinges on its clinical applications, that is, to what degree it can provide to people with motor disabilities useful communication and control capacities. One of its main applications is especially in rehabilitation. It may have many potential applications, not only in the control of wheelchair, but also in other devices like computer cursor.robotic arms or neuroprostheses.

## II. ELECTROOCULOGRAPHIC PHYSIOLOGY

Medical studies proved that the potential difference, which is commonly called the resting potential, arose from hyperpolarisations and dehyperpolarisations existing between the cornea and theretina.In1849,DuBios-Reymond found there was a certain relationship between eye movements and electrode potentials from the skin surface. The resting current flows continuously from the retina side to the corner side, so that an electrical field comes into being with a negative pole at the retina and a positive pole at the corner.The EOG value varies from 0.4 to 10 (mV) with a frequency ranging from 0 to DC 100 (Hz). When the eyeball moves, the potential difference between the retina and the corner changes continuously according to the eyeball movement. It can thus be estimated by measuring the voltage induced across a system of electrodes placed around the eyes as the eyegaze direction changes. Furthermore, these potential changes with time are recorded on the time axis, thus obtaining the EOG .When eyes move to left or right, the horizontal EOG signals are obtained. Similarly, when eyes move to up or down, the vertical EOG signals are given. Also, the voluntary blinks and nonvoluntary blinks are represented in the vertical EOG. The signal potential remains the same even with the eyes closed. EOG signal has pulse duration of approximately 200ms on average. The signal shows a particular pulse shape for eye ball movement in either direction. Signal magnitudes changes from 5-20 micro volts for a degree of eye ball movement typically. The main disadvantage of EOG signal is that head or body movement alters the DC level of the signal. From the characteristics of EOG signal it is known that the frequency range of the signal is 0.1 to 20 HZ and the amplitude lies between 100-3500 micro volts. Hence a voltage gain of minimum 2000 is needed to further use the raw signal. The collected signal from the electrodes is fed to instrumentation amplifier having high input impedance and CMRR followed by a second order low pass filter with a cut off of 20HZ and a high pass filter of 0.1Hz cut off to eliminate unwanted data.

## III. SYSTEM ARCHITECTURE

This paper presents an electrooculography based wheelchair control systems . To achieve the desired functions, the system architecture is designed as two major parts: EOG signal collection and wheelchair command generation. EOG signal collection and wheelchair command



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generation, this part is responsible of collecting electrooculography of users. Due to small and noisy biopotential signals, the analog EOG signal is amplified and filtered to extract the horizontal eye-gaze direction. In addition, the calibration procedure is done to eliminate individual variations. The EOG stores the movement of the eye by measuring activity, through electrodes, and therefore the difference of potential between the cornea and the retina. A motorized vehicle is a part of control parameter in proposed system where user can control the vehicle in multiple direction using facial motions near eye area.

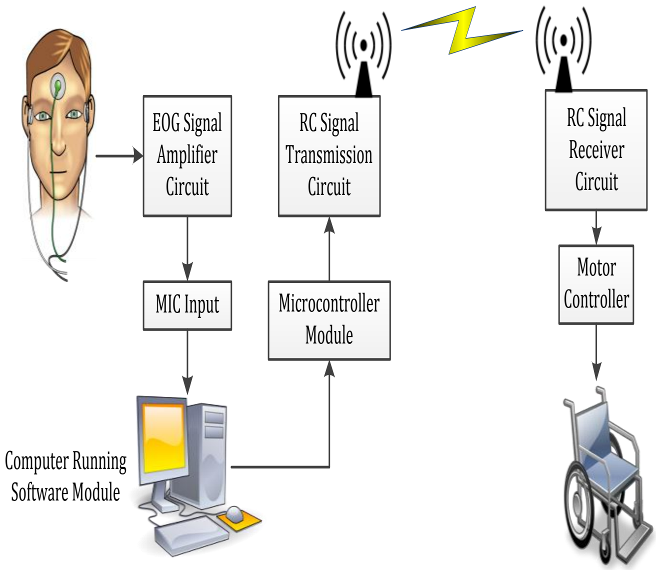


Figure 1: Block diagram of proposed system

## IV. Eye Gesture Recognition

Eye movements can be recorded in three ways: with magnetic coils, using video processing or using EOG. Video processing and EOG are most used techniques. Although video processing requirements are very easy to fulfill (just a quality camera), EOG tends to produce more accurate outputs in terms of speed and error. In the EOG approach, a simple low cost device can use two pairs of electrodes to measure the resting potential of the retina reflecting to the eye movements. So, we adopt EOG-based rather than video-based design scheme. Eye gesture recognition is to distinguish all kinds of eye movements such as blink, horizontal signal, vertical signal.The detection of consecutive saccades in horizontal and vertical direction is a key step of eye gesture recognition. The detected saccades are mapped to eye movements in basic directions. These basic directions are left, right, up and down. Then they are encoded into the basic commands for controlling the wheelchair.

## V. EOG BASED HUMAN-WHEELCHAIR INTERFACE

In this paper, the electrooculography (EOG) signal is used to generate the driving command of wheelchairs. The EOG is a very typical approach to measure eye movements, and it is measured based on the steady corneal-retinal potential. In general, this steady dipole is used to measure eye position in terms of placing surface electrodes to the positions around volunteer's eyes. If the steady dipole is symmetrically placed between the left and right electrodes and the eye-gaze is straight ahead, the EOG output will be zero.The EOG output depends on the relative positions of the cornea and electrodes.

For example, the EOG output will be more positive when the eye-gaze shifts to the right. However, the EOG output value is still dependent on the individual properties of users, surface
electrodes, and electrode placements. It is noted that the EOG may also be affected by the activations from the EEG of the brain as well as the electromyography (EMG) of facial expressions and head movements.

## VI. ATMEGA16 Microcontroller

Microcontroller can be termed as a single on chip computer which includes number of peripherals like RAM, EEPROM, Timers etc., required to perform some predefined task. For experimental setup, we are using Atmega16.In RISC architecture the instruction set of the computer are not only fewer in number but also simpler and faster in operation.For precise and optimize control ATMEGA microcontroller is chosen.The acquired EOG signal using the disposable electrodes is level shifted and then sent to the microcontroller. From microcontroller the outputs are connected to the dc motors attached in the wheelchair via a motor driving circuit. The amplified analog EOG signal is fed to a level shifter circuit. Level shifting is essential because EOG signal amplitude can be negative but microcontroller cannot work with negative voltage. The level shifted signal is given to the
16 bit ATMEGA microcontroller (ATMEGA16).The user can move his/her eye balls voluntarily e.g. in case of reading or general observation. These eye movements which are not intended as control commands can cause undesirable motion of the motors. To prevent such problem, there is a condition for initializing on or off the control system which is mentioned as the START/STOP condition.

## VII. Conclusion

In this paper we propose human machine interaction technique using EOG signal obtain near eye area by using this signal we can control any real time machine like computer system , robot , vehicle , wheelchair etc. In this paper, we proposed a multi-purposes eye-movement tracking system. Integrating Electro-Oculography (E.O.G) installations we detected the signal with different directions in eye-movements and then analyzed to understand what they represented about (e.g. horizontal direction or vertical direction). We converted the analog signal to digital signal and then used as the control signals. The system adapted the direction-sensor interface design, and the system would be active according to the indicated direction. Users could easily use this system and the precision of the system after adjustment could get more than 90%. Thus, this EOG-based


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system designed to detect eight directions of eye movement, will be useful in real-life applications.

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