

Chapter 3

An EOG Signal based Framework to Control a Wheel Chair

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ABSTRACT

Electrooculogram (EOG) signal extraction is critical in the working of any electrooculography aided system based upon the tracking of the ocular movement of the eye dipole. In this chapter the signals captured using sensors (electrodes), are first amplified, then the noise is removed and then digitized, before being transferred to controller for movement of the wheelchair. Finally, from the muscle sensor, the output is directly being given to the controller to reach the target and complete the control of the movement of the wheelchair. Initially, a potentiometer is used instead of the Ag-AgCl electrodes to test the strength of signal obtained due to the movement of the eyes. Using this wheelchair is quite an advantage because this chair helps a physically handicapped person to move freely without being dependent on anyone else. The research provides a new method for human-machine interface system.

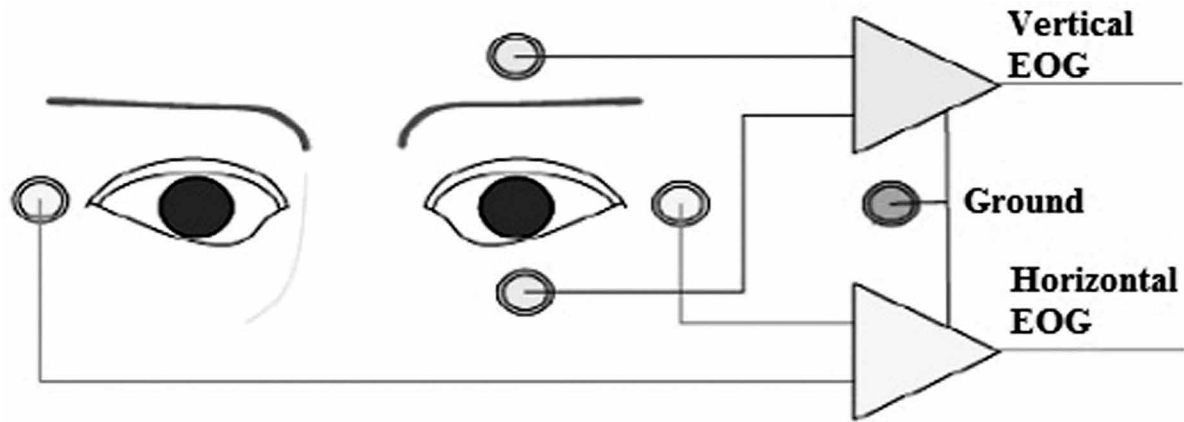
INTRODUCTION

Recently, various bio-signals are used to control the physical devices such as mouse, joysticks, key-board etc. In medical science, numerous assistive technologies are providing to help the handicapped persons. Bio-signals are generally detected from the excitable tissues of the human body that is, nerve and muscle cells. Electrooculography (EOG), electromyography (EMG), etc. are the examples of such signals. In this work the EOG signal has been used to control a wheelchair (Wissel & Palaniappan, 2011).

However, the first step of acquiring signals starts with positioning of electrodes followed by filtering and amplifying units respectively. The actual placement of electrode is required to determine electrical activity caused by eye movements. The placement of Ag/AgCl electrodes is important for acquiring a good signal from the eyes. The overall placement of the electrodes can be represented as shown in Figure 1.

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Figure 1. Electrodes placement for EOG signal



The generation of the electro-oculogram (EOG) signal is due to the hyperpolarization and depolarization of retinal cells. The measurement of horizontal eye movements is done by the placement of a pair of electrodes at the outside of the left and right eye. Horizontal EOG is measured as a voltage by means of electrodes strategically placed as close as possible to the canthus of each eye. Similarly, vertical EOG is measured as a voltage by means of electrodes placed just above the eye (Choudhury, Venkataramanan, Nemade & Sahambi, 2005). The entire idea of the approach is to design a system for the paralysed persons and the use of wheelchair proves to be a very important factor for mobility among disabled as well as the quadriplegic, which may cause by road accident, falling from the high position or severe diseases. The initial purpose of the wheelchair is actually aimed to give more freedom for these people to do basic things on their own, such as carrying items from one place to another and manoeuvre (Rokonuzzaman. et al., 2012). The mobility of the wheelchair users can be aided according to the level of injuries of a user has, or depending on the capability of the user to handle the wheelchair. It is very crucial in translating the eye movement into a correct motion input. Any wrong judgment of eye movement input classification will lead to a fault motion instruction of the wheelchair (Borea, Boquete, Maza, Lopez & Lledo, 2013).

OBJECTIVE OF THE WORK

A system consists of a DC motor with wheel and coupled with a servo motor. The speed reversal and the left-right direction control is the main scope this work. By the resulting signal of the potential difference caused by eye movements a voltage difference is measured between the cornea and the retina. The resting potential ranges from 0.4mV to 1mV and a pair of electrodes are commonly used to detect this signal, but the voltage difference when there's an eye movement can be as small as just some micro volts. Depending on the eye's position, an electrode is more positive or negative with respect to the ground electrode. Therefore, the recorded signal is either negative or positive as per the movement of eyes (Pradeep, Govada & Swamy, 2013). A manual switch operation, the servo mechanism and the DC motor speed reversal can be done respectively.

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