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Assistance for Disabled Through EOG

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Abstract: The purpose of the paper is to guide the disabled with the help of EOG signals. It is a viable replacement for the currently available bio control systems. The Electrooculogram (EOG) signal is acquired through an acquisition system and processed for its use in biomedical instrumentation. This paper discusses the applications of EOG signal processing and emphasizes the possibility of building a circuit for controlling various operations to be performed by extremely paralyzed patients. This paper also discusses the application of EOG signal processing to activate an hospital alarm. EOG based bio-control is found to be a suitable alternative to current control schemes, especially for quadriplegics and severely paralyzed patients.

Key words: Electrooculogram · EOG signal

INTRODUCTION

Electrooculography (EOG) is a test to measure the electrical response of the light sensitive cells (rods and cones) and motor nerve components of the eye [1]. This involves placing of electrodes on the the skin near the eye. Its main applications are in ophthalmology and detection of eye disorders. In this paper, we focus on disorders. In this paper, we focus on exploiting these electrical signals in assisting severely paralyzed patients to operate equipments [2]. The basis of this paper is the generation of a potential difference between the electrodes in correspondence with the motion of the eye ball. These potentials are very low magnitude bipolar signals, which are amplified by suitable biopotential amplifiers after eliminating the shifting resting potential since these values vary continuously. The resulting output is a four channel discrete amplitude signal, which can be transmitted to a control unit using suitable techniques. It can also be used as a supplemental assistant to help in guiding the patients.

Outline

Electrodes: Ag-Ag Cl electrodes placed in the fore head region pick up the EOG signal based on the eyeball movement.The electrodes are fixed on an elastic headband,which provides ease in wearing / removing the electrodes.Two active electrodes and one reference electrode is used for acquiring the signal.

Amplifier: The acquired EOG signal is of less amplitude which cannot drive the system. Hence the signal is amplified using a dual OP amp instrumentation amplifier which is the basic amplifier used in biomedical equipments.Again the signal is further amplified using a differential amplifier which generates a threshold value of the potential difference between the electrodes [3].

Microcontroller: The microcontroller controls the entire operation of the system.PIC 16F877A is used in this system [4].

Relay: The output of microcontroller is in the form of impulses and cannot drive loads such as motors which has been used in this case. Hence relay acts as a switching device between the microcontroller and the reset button.Relay switches on and off the LED based on the output from the microcontroller.

Filter: Filter circuits which usually capacitor is acting as a surge arrester always follow the rectifier unit.Low pass filter is used with cut off frequency 15 Hz, i.e. it passes only low frequency signals and bypasses high frequency signals.The load resistor should be 1% to 2.5% of the load.

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Power Supply: Power supply is needed to run the entire system.A regulated supply of +5 V supply is provided for the microcontroller.We have used a 230 V / 50 Hz step down transformer as the power source.The regulated supply of 5 V drives the microcontroller.

Application of Eog Processing-Dual Stage Hospital Alarm System: There are over 4 million disabled people in India according to the 2000 census, most of whom live below the poverty line. Indian hospitals, both rural and urban, usually have no facility for a convenient switch that can be operated by disabled people as an alarm. Patients who are admitted to hospitals often have problems in operating devices manually. This may be due to immobility caused by accidents and amputation, or body ailments such as paralysis and polio. As a result, these patients require an easy to operate and completely secure switching system for the devices in their immediate environment like the lights, fans, bed pillow rise and alarms. A few of the presently existing, popular control 'schemes for hospital alarm systems are Electromyogram (EMG) based switching, contact based switching by limited body movement and speech based switching. The EMG is the biosignal associated with the muscles of our body. Flexing and relaxing of the muscles results in an increase or decrease in the amplitude of the EMG signal and this is processed to work as a switch. Contact based switching involves the use of body parts such as the neck Of head, which can be moved relatively freely. A set of push button contact switches are placed around the head or neck and the user operates them by the limited movements which are available to him. Numerous hospital alarm systems based on user voice commands exist in the commercial market today, owing to the ease of operation of the system as well as the relatively noise free environment of hospitals, which drastically improves the reliability. Such systems have to be customized for individual patients based on the various traitsof speech such as pitch, tone, volume and frequency.

Switches based on the EOG signal offer a safe, reliable and cost effective solution, since evenpatients with extreme paralysis generally have control over the movement of their eyes. This section deals with one such hospital alarm system, which is to be activated in two stages Extensive analysis of the V and H channel EOG signals has shown that the reliability of the V Channel signal is inferior to that of the H Channel, owing to its sensitivity to eye blinks, neck motion artifact and offset drift. Hence, the H channel EOG signal was chosen to operate the hospital alarm system.

A digital monitoring circuit detects if the correct sequence of eye movements is performed for the correct durations. The sequence of eye movements is chosen such that it minimizes the probability of accidental triggering. A beeper is used to warn the patient about the start of the second stage of the alarm activation procedure. In case the patient has accidentally triggered the beeper, he may subsequently cancel the activation process. Hence, this beeper provides audio feedback to the patient. If the patient has intentionally started the alarm activation procedure, a buzzer positioned in the vicinity of the attendant's room IS enabled. This buzzer now remains on, until it is manually switched off by the attendant or nurse.

RESULTS AND DISCUSSIONS

It is observed that the V channel is more prone to interface, artifacts and drifts than the H channel. Hence, the H channel is more suited to operate hospital alarm systems. The typical EOG amplitude was observed to range from 10 micro V to 100 Micro V and the frequency between DC and 10 Hz. Eye blink, neck movement and head motion were observed to be a major sources of artifacts and these have been recorded and studied for possible minimization. lnter-channel interference was also observed and it was found that this can be significantly reduced by precise positioning of the electrodes and careful selection of the threshold voltage levels. Effective filtering of the acquired EOG signal has yielded us around 60 dB attenuation of the 50Hz power line interference [5-9].

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