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An Overview of "Electrooculography"

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Abstract: This paper brings out a new technology of placing electrodes on user's forehead around the eyes to record eye movements which is called as Electrooculography (EOG. This technology is based on the principle of recording the polarization potential or corneal-retinal potential (CRP), which is the resting potential between the cornea and the retina. This potential is commonly known as electrooculogram. is a very small electrical potential that can be detected using electrodes which is linearly proportional to eye displacement. EOG serves as a means of control for allowing the handicapped, especially those with only eye-motor coordination, to live more independent lives. This is a low cost assistive system for disabled people. The total command control based on EOG permits users to guide it with a enough degree of comfort ability.

Keywords:AnalogDigitalConverter(ADC),Electroencefalogram(EEG),Electromyalgy(EMG),Electrooculography (EOG), Rapid Eye Movement(REM),Slow eye movement(SEM).

I. INTRODUCTION

Electrooculography is a technique for measuring the resting potential of the retina. The resulting signal is called the electrooculogram. An electrooculograph is a device that measures the voltage between two electrodes placed on the face of a subject so it can detect eye movement. Today the use of computers is extended to every field. Many sophisticated devices like touch screen, track ball, digitizers etc made interaction with computer ease from novice to professional. Assistive robotics can improve the quality of life for disable people.

Nowadays, there are many help systems to control and guide autonomous mobile robots. All this systems allow their users to travel more efficiently and with greater ease. In the last years, the applications for developing help systems to people with several disabilities are increased, and therefore the traditional systems are not valid. In this new systems, we can see: videooculography systems (VOG) or infrared oculography (IROG) based on detect the eye position using a camera; there are several techniques based in voice recognition for detecting basic commands to control some instruments or robots; the joystick is the most popular technique used to control different applications by people with limited upper body mobility but it requires fine control that the person may be have difficulty to accomplish. All this techniques can be applied to different people according to their disability degree, using always the technique or techniques more efficiently for each person [1].

EOG is a measurement technique that is inexpensive, easy to use, reliable, and relatively unobtrusive when compared to head-worn cameras used in video-based mobile robots.

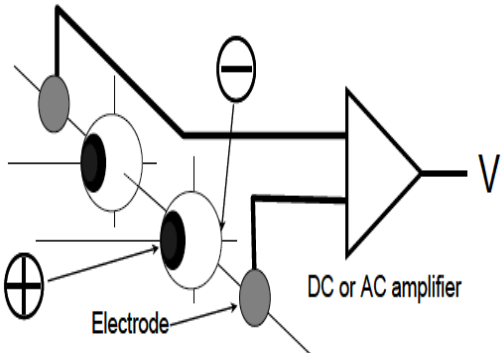

Fig 1. Principle of Electrooculography (EOG)

All this systems allow their users to travel more efficiently and with greater ease.Electrooculography (EOG) is a new technology of placing electrodes on user's forehead around the eyes to record eye movements. This technology is based on the principle of recording the polarization potential or corneal-retinal potential (CRP), which is the resting potential between the cornea and the retina. This potential is commonly known as electrooculogram[2].

II. LITERATURE SURVEY

Several research groups have been developing various eye gaze interfaces since 1980's, using different eye movement
recording methods, such as infrared oculography(IROG), the limbus tracker, and videooculography (VOG) [1].

In 1849,it was found there was a certain relationship between eye movements and electrode potentials from the skin surface [6].

In 1879 in Paris, it was observed that reading does not involve a smooth sweeping of the eyes along the

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text, as previously assumed, but a series of short stops (called fixations) and quick saccades.

During the 1900s, an early eye tracker, using a sort of contact lens with a hole for the pupil was built. The lens was connected to an aluminium pointer that moved in response to the movement of the eye.
The fact that electrical activity could be recorded by placing electrodes on the surface of the skin in the eye region was discovered in the 1920's.

In the 1950s in an important research on eye tracking.It is showed conclusively that the character of the eye movement is either completely independent of or only very slightly dependent on the material of the picture and how it was made, provided that it is flat or nearly flat." The cyclical pattern in the examination of pictures"is dependent not only on what is shown on the picture, but also on the problem facing the observer and the information that he hopes to gain from the picture"[2].

This study in (1967) is often referred to as evidence on how the task given to a person influences his or her eye movement."Records of eye movements show that the observer's attention is usually held only by certain elements of the picture.

The Stanford Sleepiness Scale (SSS) which was developed in 1973, put emphasis on the detection of increasing feelings of sleepiness.

According to several researchers (in 1975; SEM (sleep with slow eye movements) are characteristic indicators of the transition from wakefulness to sleep.

In 1980,it was formulated the influential Strong eye-mind Hypothesis, the hypothesis that "there is no appreciable lag between what is fixated and what is processed".

In(1997) designed an EOG based HCI system. The feasibility of eye movement related EEG signal to be used in HCI system.

In (2000) a new method to control and guide a mobile robot. To detect saccadic eye movements and fixations a neural network (RBF) is used. A Radial Basis Function Neural Network, which has only one hidden layer, is used in this work to detect where one person is looking as a function of detected EOG. The network inputs are the present EOG signal and the last nine delayed because a RBF tapped delay network is used and the network output is the angle of the gaze desired. Finally, the output of neural network is used to control an electric wheelchair by generating various EOG codes. It is necessary to eliminate the shifting resting potential (mean value) because this value changes with time.

In (2001) it is proposed that an ideal Velocity Shape signal processing algorithm to extract position data where the eyes are focusing on from the noisy and drift included EOG signals [6].

In (2002) the designed an eye-control method based on EOG to develop a system for assisted mobility. One of its most important features is its modularity, making it adaptable to the particular needs of each user according to the type and degree of handicap involved

In (2004) it was discussed that an improved method for measurement of Electrooculogram (EOG). The method measuring the relative potential between the inner canthus (nasal) and outer canthus (temporal) is described

In (2005) it was presented that instrumentation for EOG acquisition and signal processing [7].

In (2007) it was presented that a new time-frequency analysis of ocular artifacts found in the EOG. This provides a time-frequency analysis of blinks and eye movements (specifically large, rapid movements or "saccades") in an EOG signal measured at a very high sampling rate.

In (2008) the author designed an EOG based Human Computer Interface system. It composed of three parts: EOG acquisition and amplification, EOG pattern recognition, and control command output.

In (2010) it was discussed thatthe design and application of EOG measurement system. This system is microcontroller based, with CMRR of 88 dB, an electronic noise of 0.6 =V (p-p), and a sampling rate of 176 Hz[6].

III. BLOCK DIAGRAM

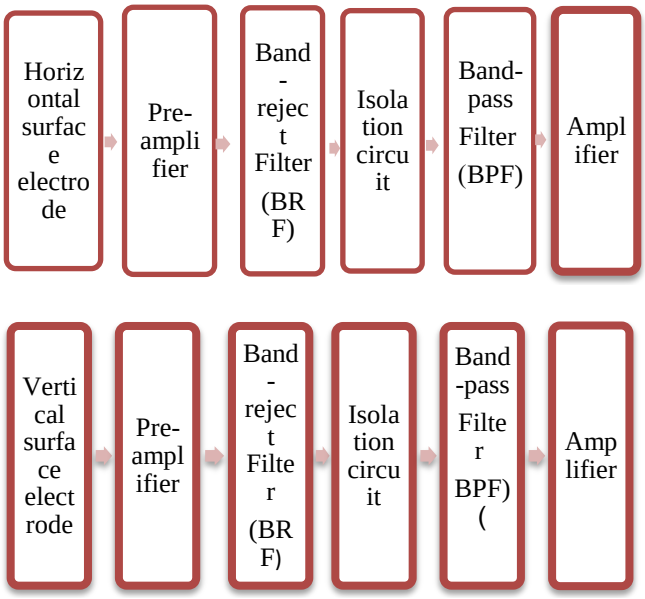

Figure 2 .Block diagram of EOG measurement circuit

With the arrangement, as the eye moves to right or left (upper or lower), the corresponding components of the muscular force will be obviously changed. Depending on that an instrumentation amplifier with a gain of 5 is applied as the preamplifier for picking up the unipolar component of the EOG signals. The band reject filter (BRF) used to reject the local frequency (50 Hz), The function of the isolation circuit is to isolate the signal and line power source, and be implemented by using either an optical or voltage-transformed method. The bandwidth of the band-pass filter is from 0.05 to 30 Hz (two active 2nd

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order HPF and two active 2nd order LPF), and the amplifier with an amplification factor of 50 can magnify the weak signal that has passed through the filter. Then, the amplified EOG signals can be directly sent to the control circuit**.**

IV. CONCLUSION

Compared with the electroencephalography (EEG), EOG signals have the amplitude of 15-200uV, the relationship between EOG and eye movements is linear, and the waveform is easy to detect. Additional eye movement characteristics that are potentially useful for activity recognition such as pupil dilation, micro saccades, vestibulo-ocular reflex, or smooth pursuit movements These characteristics are still worth investigating in the future as they may carry information that complements that available in the current work. Eye movements also reveal information on cognitive processes of visual perception, such as visual memory, learning, or attention. If it is possible to infer these processes from eye movements, this may lead to cognitive-aware systems that are able to sense and adapt to a person's cognitive state.An EOG interface has many advantages because of its simple configuration. EOG potential drift and eye blinking are major problems; however, it can be solved with the use of adequate signal processing, So EOG is a viable and inexpensive method for human-computer interaction.

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