Design and Implementation of Electroculogram using Brain Waves Electric Signals

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***Abstract*—** Humans academician mainly works on electric signals transmitting all over the physique to forward the advice in adjustment to accomplish the physique parts Even while the eye brawl of animal physique increases or decreases the attrition abreast eye area. This aberration in electric signals can be abstinent using electrodes or the myo-electric sensors. By implementing these signals processor one can interface altered accessories to ascendancy on demand. Hence these paper accouterments the system, which is advised to ascendancy computer and accouterments arrangement application academician after-effects electric signals. Systems will ascertain the variations in electric arresting backbone through voltage akin abreast the eye breadth and generates a wireless radio abundance signals in adjustment to control the automatic ancestor model.

***Keywords*—**Brain computer interface, Electroculogram, Electrodes, Wireless Radio Frequency Signals, Robotic Prototype Model

I. INTRODUCTION

A brain–computer interface (BCI) [3][4] often called a mind-machine interface (MMI), or sometimes called a direct neural interface or a brain–machine interface (BMI), is a straight communication between the human brain and an electronic or electromechanical external devices. Brain computer interface are in many situation directed at boosting, augmenting, or repairing human subjective or sensory-motor functions. .A brain-computer interface (BCI) [6] is a device that enables acutely disabled bodies to acquaint and collaborate with their environments application their academician waves. Utmost analysis investigating BCI in bodies has acclimated scalp-recorded electroencephalography or intracranial electrocorticography. Use of academician signals acquired from stereotactic depth electrodes to ascendancy a BCI has not ahead been explored.

The eye could be a seat of a gentle electric potential field that's quite unrelated to lightweight stimulation. It is also possible that, this field could also be detected with the attention in blackness and or with the eyes closed. It often represented as a stable dipole with positive pole at the cornea layer and negative pole at the retina layer. The magnitude of this corneoretinal potential is within 0.4-1.0 mV. It's not generated by sensitive tissue however, rather, is attributed to the upper rate within the retina. The polarity of this potential within the eyes of invertebrates is opposite to it of vertebrates. This potential and therefore the rotation of the attention area unit the premise for a symbol measured at a combine of periorbital surface electrodes. The signal is understood because the electro-oculogram, (EOG). It's helpful within the study of eye movement.

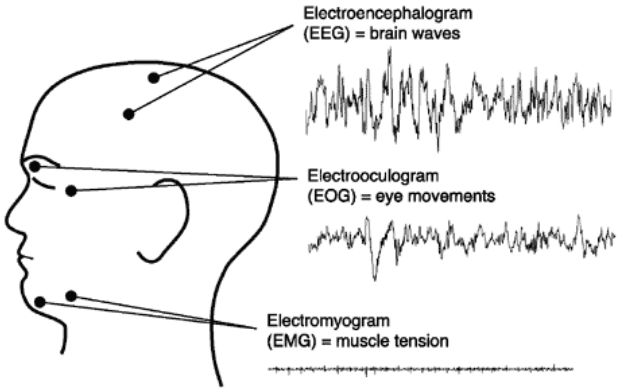

Figure 1: Different electrograms technologies

As per [1] Michita Imai, Tetsuo Ono, and Hiroshi Ishiguro, they projected a system that a joint attention mechanism to attain such joint attention also as a speech generation system. The joint attention procedure implies eye contact and a spotlight expression functions. All these functions are robot's physical expressions, and these functions permit the joint attention techniques to draw the person's attention to the equivalent sensor data information as that noticed by the robot.

The Nintendo Entertainment [2] has goal to manage system exploitation only by eye movement. This embody reading in eye position employing a technique that is understood as electrooculography (EOG) also as interfacing with the NES standard protocols to simulate a game controller. Electrodes placed on the face round the eyes feed a little electrical signal into isolation and analog input electronic circuitry that was custom designed on National Instruments Singleboard RIO daughter card.

II. RELATED WORK

An interface that allows people to interact with computers using their eye movements is bestowed. The system uses electro-oculography (EOG), so as to observe eye movements. EOG detects the eyes movement by measuring, through electrodes, the distinction of potential between the cornea and therefore the retina [9]. EOG has been employed in previous works to interact with different devices. As an instance, our research cluster used EOG to manage a robot arm [7], [10]. In [9], [11], EOG was accustomed escort a wheelchair, and in [12], an EOG interface was used as a primary person navigation system.

However, few or none research groups are developing a whole system that features physical support of electrodes, electronic sand the communications with the computer. A replacement device for holding dry EOG electrodes is designed during this work, creating a leap forward in the way to obtain a commercial pair of EOG glasses. They include the dry EOG electrodes, the electronic circuitry to acquire and send the EOG signals and therefore the batteries. This system might be used (put on and removed)easily and very quickly (avoiding the use of plasters to manually fix the electrodes). Furthermore, it might allow the popularization of the EOG technology to move an interaction with devices.

The interface presented in this paper uses a new processing algorithm to observe eye movement that improves the characteristics of a previous work [10]. The new algorithm is ready to detect the gaze direction of the eyes (right, left, up and down) also because the user's blink. This algorithm is more robust and efficient than the old one. Additionally, it decreases the time needed to get the stare direction. Using time windows of 1, 0.5 or 0.25 seconds, the algorithm works. Even the algorithm is developed in such the simplest way that it will observe the attention of eye movement performed between two processing windows by algorithm. The set of glasses and therefore the new processing algorithm has been tested intensively by many volunteers. The experimental result has shown that the whole system has high reliability.

The global or full-field electroretinogram (ERG) could be a mass electrical response of the retina to photic stimulation. The test used worldwide to assess the status of the retina in eye illness in human patients and in laboratory animals used as models of retinal disease is understood as ERG (Electroretinogram). The fundamental technique of recording the electrical response called as the global or full-field ERG is by stimulating the eye with a bright light source like a flash produced by LEDs or a scientific strobe lamp. The flash of light extracts a biphasic waveform recordable at the cornea. Most often, the two components that are measured are, a- and b- waves. The a-wave is that the massive negative component, and followed by b-wave which is corneal positive and typically larger in amplitude.

The EOG measures the electrical difference that exists between the cornea and the retina, known as resting or standard potential of the eye. The cornea is almost 6 m positive with respect to the retina, which changes with clashing retinal illumination. The potential of the eye is generated mainly by the transepithelial potential across the pigmented epithelium of the retina.

Electro-oculogram change under totally different states of retinal illumination. The EOG is employed to assess the function of the pigment epithelium. In dark adaptation scenerio, resting potential drops slightly and reaches a minimum ("dark trough") once many minutes. Once light is switched on, a substantial increase of the resting potential happens ("light peak"), which drops off after many minutes when the retina adapts to the light. The ratio of the voltages is known as the *Arden ratio*. The measurement is similar to eye movement recordings. The patient is asked to modify eye position repeatedly between two points. Since these positions are static, a amendment in recorded potential originates from a change within the resting potential. EOGs are most appropriate when diseases that affect the retinal pigment epithelium may be present. Fishman (1990) outlines those dystrophies of the pigment epithelium that may give rise to EOG abnormalities. The only one disease that consistently associated with abnormal EOGs, however, is Best (vitelliform) macular dystrophy.

Autosomal-dominant macular degeneration is an best disease that may be congenital or may have an onset of up to 7 years of age.

Recording of eye movements and eye position provided by the difference in electrical potential between two electrodes placed on the skin on either side of the eye. The electroculogram comprises of two potentials: the standing potential that is elicited by moving the eyes within the dark and originates from the retinal pigment epithelium and therefore the light potential (light rise) which is evoked by moving the eyes in a lighted environment and originates from the photoreceptors. The common magnitude ratio between the light and no light potentials (sometimes conjointly known as the Arden index or Arden ratio) is assessed. If that ratio is less than 1.8 it reflects a malfunction of the structures from which the potential originates.

A method of automated measurement of the EOG amplitude is described. The advantages are as follows:
1. The mean of amplitudes, at a series of time dots within a single EOG deflection recorded with DC-amplification, are automatically measured.
2. Artifacts due to blinks, overshoots or other irregular eye movements are automatically eliminated.
3. A base line drift is automatically compensated.
The Lift to Drag ratios acquire in 80 eyes with this method was essentially equal to those obtained by a manual measurement.

III. PROPOSED SYSTEM

This proposed system implements a human-computer interface based on electro-oculography (EOG) that permits interaction with a computer using eye movement. 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 robotic 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.

The main objective in system is to detection of electric signal near eye area and using electrodes system will try to identify the changes in electric pulse in order to conclude the motion to be taken. Proposed system includes the wireless robotic vehicle which can be controlled in 4 different directions. User can have access to this vehicle using radio frequency enabled circuitry through brain signals generated using eye motion.

Likewise user can control the computer cursor and the applications using electric signals. This will enable disabled patients to have good access over computer system. To implement this there will be a microcontroller to USB interfacing circuitry which will convert microcontroller signals in to computer understandable signals which will then get processed by software program.

IV. PROPOSED METHODOLOGY

Electroencephalography (EEG) is the most studied potential non-invasive interface, due to fine temporal resolution, ease of usability, portability and low set-up cost.But as well as the

technologyresponsibility to noise, another substantial barrier to using EEG as a brain–computer interface is the extensive training required before users can work the technology.For example, in experiments trained severely paralyzed people to self-regulate the slow cortical potentials in their EEG to such an extent that these signals could be used as a binary signal to control a computer cursor.

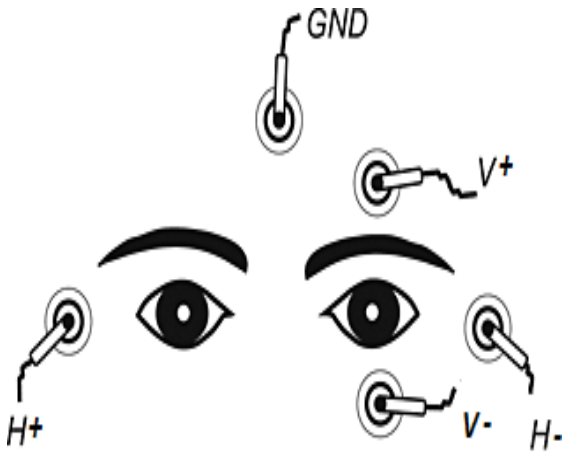

Figure 2: Placement of electrodes

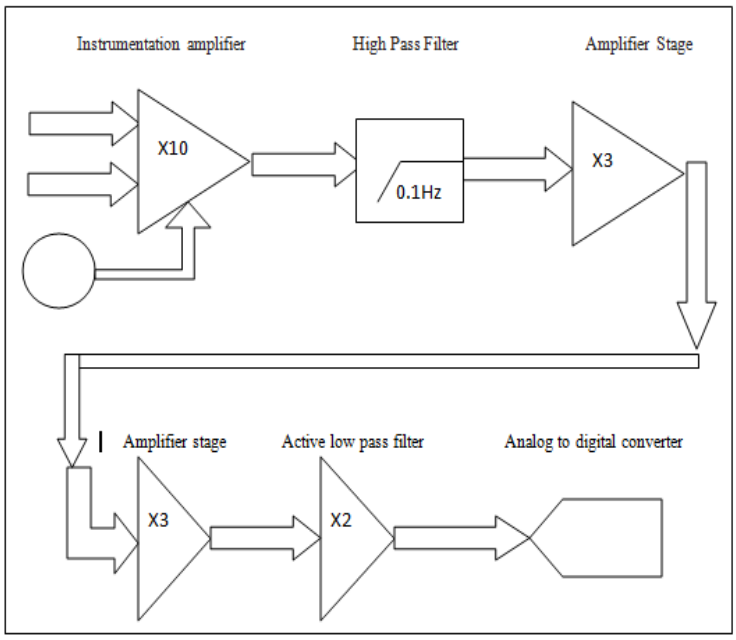

Figure 3: Block diagram of proposed system

An instrumentation amplifier is a type of differential amplifier that has been outfitted with inputbuffer amplifiers, which eliminate the need for input impedance matching and thus make the amplifier particularly suitable for use in measurement and test equipment. A high pass filter is an electronic filter that passes high-frequency signals but attenuates signals with frequencies lower than the cutoff frequency. A low pass filter is a filter that passes low frequency signals with frequencies higher than the cutoff frequency. The actual amount of attenuation varies depending on specific filter design.

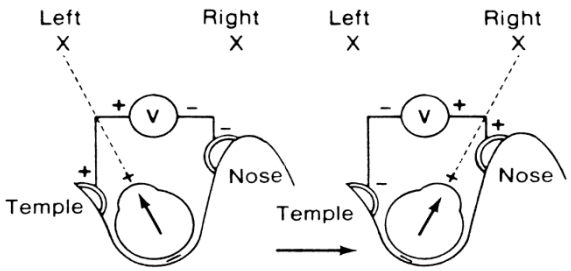

Figure 4: Electro-oculogram schematic

The eye can be considered a dipole with the anterior part relatively more positive than the posterior pole. EOG electrodes have become fixed for the outer and inner canthi of the left eye. On the left of the diagram as the eye moves to the left, the outer canthal electrode (being closer to the positive pole of the eye) becomes more positive than the inner canthal electrode. This change in potential can then be recorded on a voltage meter. When the eye moves to the right side direction, the inner canthal electrode then becomes positive and again a change in potential can be recorded but with opposite polarity.

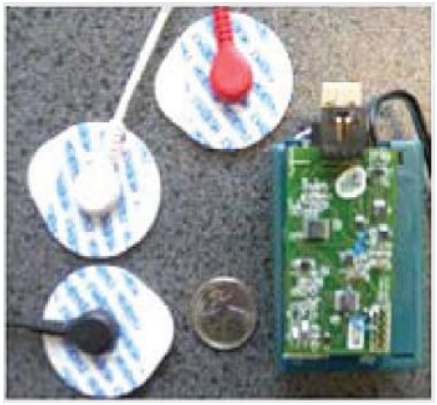

Figure 5: Electrodes with AVR processor

V. RESULT ANALYSIS

A. How Windows API Works

Sound recorder is an audio recording program enclosed in Microsoft Windows. The Vista Version will record for a extended length however contains fewer choices, and can't reproduce or play back recorded sound. Many alternative utilities are unit accessible foe transfer, as well as the open supply tool Audacity. Microsoft conjointly developed the sound recorder Windows 8.1 app that is mobile optimized and is enclosed with Windows 8.1, its interface has been revived.

The sound APIs provide the media for audio applications to access audio end point devices like headphones and microphones. The sound APIs developed for higher-level audio APIs named as Microsoft DirectSound and the Windows multimedia wavexxx procedures. Many of the applications interact with the higher-level APIs, however some of the applications with genuine requirements need to interact directly with the sound API interface.

The sound APIs are used in the user-mode system components mainly in Audioses.dll and Mmdevapi.dll. Client applications do not access the entry points in these DLLs directly. Apart from this, user calls the CoCreateInstance or CoCreateInstanceEx procedures to obtain the IMMDeviceEnumerator interface of the MMDeviceEnumerator class instance. This object enumerates the sound end point devices in the system.
The IMMDeviceEnumerator interface is the basic part of the MMDevice API. Using this interface, user can directly or indirectly access the other interfaces in the MMDevice API, including the IMMDevice interface. IMMDevice represents a particular sound end point device.

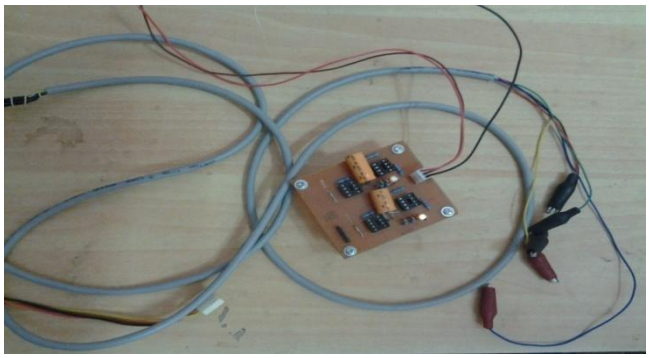

Figure 6: Designed stereo amplification circuit with connecting cables which is responsible for the amplification of left and right movement of eyes

B. Limitation of EOG with different aspects

The fundamental assumption of this methodology of recording eye movements is that the movement of the electrical field in the conducting tissues encompassing the eye is related, in a simple (usually assumed to be linear) way to the movements of the eye itself. Because of the non-uniformity of those tissues and the shapes of the tissues encompassing them, this could solely be an approximation to the biological reality. But, for horizontal eye movements within the range of 30 degrees, the potential calculation is assumed to be linear to the particular movement of the eye within the orbit. The resolution of EOG is considered to be concerning 1 degree.

For a hard and fast eye position, the EOG is way from being constant in magnitude, however may be influenced by a many of external factors. These factors embody

1. the noise generated between the electrodes' contacts and also the skin
2. the metabolic state of the tissues (pO2, pCO2, and temperature)
3. visual stimulation
4. shrinkage of facial muscles

C. Configuable trigger point

To get the amplified signals from eye movement using electrode the application must set the trigger value setting. Because of this the left and right movement of eye should not go beyond the range which is previously set by the trigger slider. As soon as the trigger values are set then the eye detection is ready to start. When the eye detection is started the trigger value which is set for left and right movement will not go beyond the pre set value and hence

proper movement signal generated successfully. Illustrate figure will show how the trigger value are set and hence the movement signals are acquired.

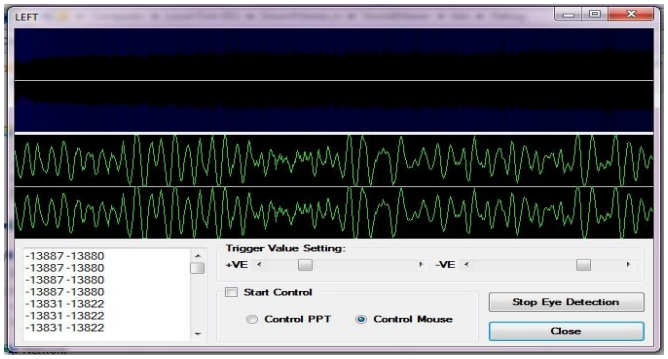

Figure 6: Configuration of trigger point

VI. CONCLUSION

In this paper we propose a effective and realtime application of well known but less utilized electroculography technology. A patient or disabled person can use a electro-oculogram to control the appliances as well as computer system in day today life. The assumed result are getting the nearby values, which leads that the development towards the implementation of proposed system

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