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Mindwave-A New Way to Detect an Eye Blink

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Abstract: This paper presents the review on eye blink detection methods used for the purpose of physically challenged or people suffering from ALS, epilepsy like disease. Brain Computer Interface (BCI) is a methodology which bridges a way for communication with the objects using brain thoughts. This paper will introduce to the other methods of eye blink detection and also to the NeuroskyMindwave which is a revolutionary product to detect Electroencephalogram signal (EEG) which also detects blink of an eye. It gives a glimpse upon the limitations of previous approaches and advantages of proposed product. At the end it will also address the future work which we are doing using this hardware for people suffering from ALS and epilepsy.

Keywords : Neurosky, Mindwave, EEG, eye blinks.

I. INTRODUCTION

The eyes are directly connected to the brain, they are the last part of our body on which we can lose control. For some people, who are suffering from a brain-stem stroke, neuro motor disability or ALS [2] or cerebral palsy, the eyes are the option for communication with world. Blink of their eyes can be converted to vocabulary for such a person. But continuous understanding and monitoring is required for proper communicating with them. This is bit difficult for human to understand the meaning of those blinks continuously. There are many computer users all over the world who are not able to use their hands or any part of body due to their physical condition.

Communication with the world is done solely using the movement of their eyes or eye lids, as most of them have good control of their eyes. The mouse click functionality can be replaced with the eyes blink or eye lids movement. We thought about using blink detection mechanisms to enable hands-free communication with the computer for handicapped users using the NeuroskyMindwave mobileto fetch the EEG wave to check the Blink Strength and implying it to the software we made. The goal of our research is to propose a new technique for efficiently tracking an eye blink of a person from EEG signal sequences and using intentionally eye blink detection. Thins blink is used to control computer and do some specific task.

In the recent years, there has been an effort to augment traditional human- computer interfaces with artificial intelligent interfaces that allow users to interact with the Computer more naturally and effectively. The primary motivation of our research is to provide an alternative communication tool for people whose motor abilities are extremely limited by condition ranging from cerebral palsy and traumatic brain injuries to multiple sclerosis or ALS[2]. The access to information and enhanced communication that assistive technology provides is both practical and empowering for individuals with disabilities.

This paper is organized in following sections Section II presents a short literature survey of the existing methods of eye blink detection. Section III we draw some conclusions and Section IV discuss some possible future work.

II. LITERATURE SURVEY

The first eye tracking was done in 1947 for American Air Force to find out best position for the best control in an aircraft cockpit.[5]

The new technique of using a web-cam for the problem has been applied and the first tests showed promise for some people who have not had success with control and communication through their high- tech solutions.[4]

One of the most commonly presently used techniques using three small electrodes are attached to the skin with micro-pore tape around the oblicularis oculi muscle, which are obtained for people with brain stem injury is the one based on electromyography (EMG) readings.[6] Although in principle the EMG based system should be effective in detecting the muscle signals from patients eye blinks. The main disadvantage of EMG is, it is related to electrical noise in patient's environment and various factors concerned with the electrode and EMG signal quality. EMG is also liable to interface and increase in the signal to noise ratio, due to variability skin conductance and sight positioning changes of the electrodes it difficult to collect true EMG data, such as base line drift.

The system uses various computer vision techniques in combination. Eye blink motion is used to automatically locate the user's eyes for typing the alphabets.

A. Electroencephalograph (EEG) activity:

Usually after preparing the scalp area by light abrasion to reduce electrode-scalp impedance, the recording is obtained by applying electrodes to the scalp using a conductive gel or paste in the conventional scalp EEG.[2]Typically electrodes are used which are each attached to an individual wire for many systems. There exists some system which uses electrodes embedded in a cap. When high-density arrays of electrodes are required, the latter method is commonly used.

There are many artifacts which originate from outside the patient along with the internal artifacts which are produced by the blinks. Huge artifacts are generated from the movement of the patient, electrode drifts can be caused due to sweating or change in body temperature.

Neuro means brain and the signal related to the brain is neuro-signal. Electroencephalograph (EEG)[2] is the

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common approach to obtain neuro-signal information. In this method, measuring and recording of neuro-signal is done using electrodes placed on the scalp.

A.1. EEG electrodes
Small metal discs usually made up of stainless steel, tin, silver or gold which is covered with a silver chloride coating, which are placed in special position on the scalp.

The International 10/20 system is used in specified position, each electrode site is labeled with Letters and numbers where the area of brain underlying the electrode is referred as latters. Right side of the head is denoted by the even number and the left side of head is denoting by odd number.


Fig.1 EEG cap

A.2. EEG montages
The placement of electrodes is called montages. The EEG can be monitored with either bipolar montage or referential.

If there are two electrodes one per channel and hence we have reference electrode for each channel. If there are common reference electrode for all channel are referential montage.[7]

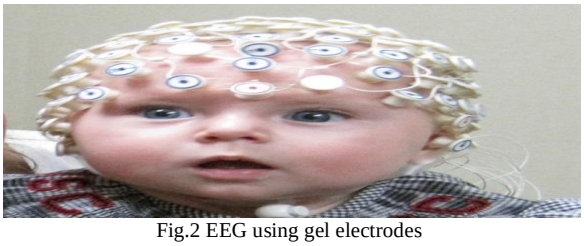
Fig.2 EEG using gel electrodes

In EEG recording they receive, electrodeswhich do not discriminate the electrical signals, the recorded activity generated from subject from sources other than the brain or which is not an activity of the cerebral origin is termed artifact and they can be divided into physiologic and extra physiologic artifacts which arise from outside the body which have equipment including the electrodes and environment.

B. Electromyogram (EMG) activity :
Common artifacts are EMG activity. The myogenic potentials generated in brain is of long duration as compared to myogenic potentials generated in the temporalis muscles i.e. clenching of jaw muscles and frontails muscles i.e. raising eyebrow.[6]

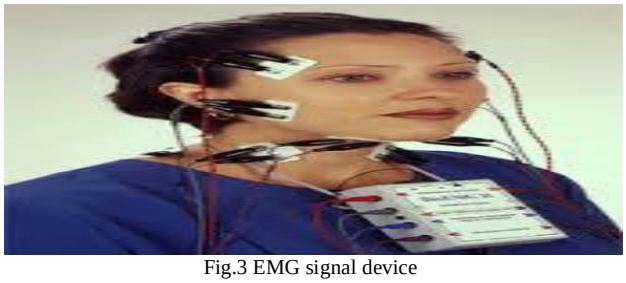
Fig.3 EMG signal device

C. Image processing :
Another dominating way of blink detection is done by image processing which use camera and uses the following algorithms:
C.1. Haar Cascade Classifier and Camshiftalgorithm [6] for face and eye axisdetection.
The steps involved in the blink detection via the image processing are:
1. Frame capturing – getting a snap or frame using the camera (video).
2. Face detection – identifying the facial region (Haar Classifier)
3. Eye detection – locate the eyes on the facial region (Haar Classifier)

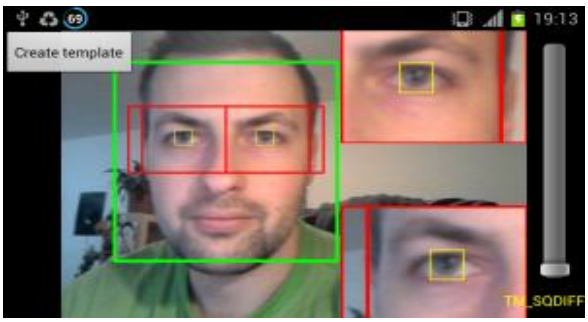

Fig.4 Identifying regions by Haar Cascade Classifier

Eye blinking - to compare the present image of user from the frame with the close or open eye state image (image converted to grey by HSV method).[4]

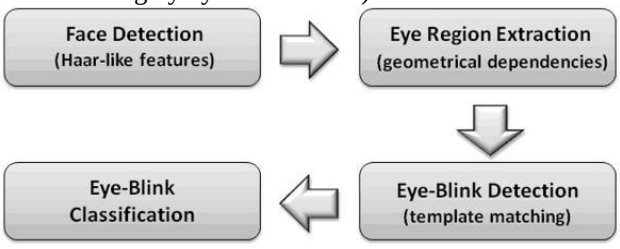

Fig.5 Steps for Blink Detection

C.2. Eye blink detection by Image Processing has few disadvantages as
1. Face should be in steady position so camera can take proper frame
2. Ample amount of light should be there.
3. Lots of initial data is required just to identify the position of eye for detecting the blink.
4. Hard to implement in real time applications.
5. Quality of camera and the response time of the software.
6. Costly and bulky system.[4][5]

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III. CONCLUSION

On studying the various techniques for blink detection we found that the existing methods need lots of data for identifying the blink of the user such as the face detection and eye detection.

Our method of blink detection is using the EEG signals. In this method there is only one hardware which extracts the EEG signals using the dry electrode. Also it is more efficient than the existing systems for the blink detection and this method overcome the shortcomings of the EMG and the image processing methods as this is involves less calculations and uses less accessories. This system has an accuracy rate of 96% claimed by the neurosky white paper.

IV. FUTURE WORK

Our study can be used to design an application for mobile phones for the physically disabled people helping them to do basic task and communicate on their devices in affordable price.

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