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Eye Blinking Detection Based Emergency Alert and Automated Smart Environment for Patients with Severe Disorder

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Abstract - According to a new report prepared jointly by the World Health Organization and the World Bank, 15 percent of the world's population is being disabled for many reasons. This system makes them simple to use their room environment by their own without others help. Based on eye movement control, is the simplest way to control smart appliances such as on and off when the patient is alone. This method investigates the reliability of EOG signals for activating smart appliances. We proposed a novel EOG-based automated switch design, in which a visual trigger mechanism is introduced to guide the users' blinks and to assist in detecting eye blinks based on the GUI, which includes a switch button that flashes per every time interval. When an eye blink matches to a flash button's that it detected, the system issues an on/off command to enable the system and also provides emergency alert when the patients are at risk.

Keywords: Eye blink detection, EOG, GSM, Emergency Alert, AT- Assistive Technology, Smart Environment

I. INTRODUCTION

Assistive Technology (AT) is essential to lead a quite self-supportive & independent life for people with severe disabilities. Disabilities resulting from various reasons such as traumatic injuries, spinal cord injuries as well as road accidents make its victim to find that daily life is quite difficult without continuous help from others. For the purpose of improving their daily life the AT's are necessary. Among the different kinds of AT's, the most important AT's are considered those that provide communication as it can improve the users lifestyle quite drastically. Paralysis can cause loss of feeling or mobility in the affected areas. Paralysis can be localized, or generalized, or it may follow a specific pattern. Most paralyses caused by nervous system damage (i.e. spinal cord issue) are persistent in nature; which including sleeps paralysis, which are caused by other factors. Paralysis is most often caused by the damage to the nervous system, especially the spinal cord. According to a survey by the Christopher and Dana Reeve foundation, nearly 1 in every 50 people is paralyzed. Fully paralyzed patients require 24 hour support. But in the present day and age, it is not possible for anyone to be available at all times. So in those situations where the patient is alone in a room, he/she could use this application to call for help if required or switch on/off a light, a fan or any other appliance. Hence, our application will help the patient to be self-sufficient to a certain extent.

There are innumerable applications which can be derived from eye blink detection and these are not limited for usage by only paralyzed people. A smart blink detection algorithm [5] can be used for switching on/off appliances such as a Light or another connected Electronic equipment's. It can also be used to send an email or call someone on Skype. All this can be accomplished with just a few eye blinks. Innumerable techniques have been devised for face tracking in recent times. Cam Shift face tracking algorithm, Haar face tracking algorithm and face tracking using Eigen faces are some of these. Some blink detection is software-oriented i.e. using image processing, and a few are hardware-oriented using sensors. Some of the image processing techniques currently used include blink detection using Gabor filters, contour extraction, and eye blink detection[2],[4] using Median blur filtering. And for the hardware approaches are using a magnetic sensor. The advantage of using sensors is that the entire system would be more compact. However, risks involving the safety of the eye are too high and outweigh the advantages of a sensor system. If the frequency of the infrared light emitted by the sensor is outside the visible spectrum, it could cause permanent damage to the eyes. The primary purpose of this paper is to propose a system that can assist the patient with paralyzed. It does so by tracking the person's eye and counting the blinks, and employs this count to control various appliances and play pre-recorded audio messages. Although a number of techniques have been implemented for eye blink detection, there is no application that has been developed to actually

put the blink detection to practical use. The principal contribution of this paper is the conceptualization of system which will go a long way in helping the paralyzed and disabled to achieve some level of independence. Moreover, the algorithm provided by has been improved upon, by incorporating face tracking, so as to reduce the effect caused by movements in the background.

Therefore, the people with disabilities to replace traditional computer input devices such as keyboard and mouse. Human computer interface (HCI) has the potential way to enable device directly by bioelectricity rather than by physical means. In this paper our objective is to design a Human Machine interface, which can be controlled using EOG signals and final output is to be used to move cursor on the visual display which has queued buttons running on the screen with a specific time interval and each button on clicking by blinking of eyes activated corresponding appliance or action. With this we updated a RF interface between capturing and the process on the application that can easily install in all required environment such as hospital and home for the patient can access certain environment without others help. Furthermore, this application could be extended to the group of normal persons for game or other entertainments.

1.1 ELECTRO OCULOGRAPHIC PRINCIPLE

To acquire the (EOG) signal, placing electrodes on user's forehead around the eyes to record eye movements. EOG based human interaction with the smart applications is becoming the hotspot of bio-based HCI study in latest centuries [9], [10]. The objective is to sense the potential (EOG) for better accuracy and resolution works in real time and is cheap.

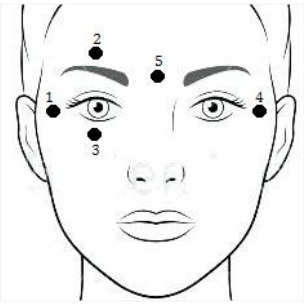

Figure1. Placement of Electrodes

The signal was produced by the potential difference between the retina and the cornea of the eye (cornea) [8]. The method can be used for communication and also to control the applications by their own. The derivation of the EOG is achieved placing two electrodes on the outer side of the eyes to detect horizontal movement and another pair above and below the eye to detect vertical movement. A reference electrode is placed on the forehead. The advancement of the technologies has always fascinated us. On the other hand, we also found that, there are not significant researches on automation devices for physically challenged or disabled people. Therefore, we started to look into the published papers and innovations around us. Now-a-day‘s medical science improving day by day. On this developing procedure human beings innovating greater strengthen scientific accessories such as smart belt which locate patient respiration as well as electro dermal activity (EDA) sensors to sequentially display for physiology symptoms of seizures at night time. Medical operations are now getting easier. Newly developed high-tech gadgets implemented in patient‘s body to restore normal activities. It's now highly important to develop a system which may help paralysis patients like Tetraplegia Patients. Moreover, people are highly interested to digitize their daily life with less physical movement. To fulfill both requirements it's high time to develop a system which may help Tetraplegia Patients as well as people who are interested to use for efficient and comfortable life.

After researching a lot in lab and over the internet, we found an Idea to develop such a system which may help a person to control any appliance which we use in our daily life by less physical effort. We found a concept to develop such a system which we can use by eye blink to automate our home electrical appliance. Though, there are many prototypes developing earlier but most of them are not user friendly or not innovative solutions. The Project aims to develop a system eye blink based sensor for home automation which is compact hardware and simple to use for control home electricity appliance. This will also help to reduce electricity wastage and help a paralysis patient to control light and fan without any assistance of other person.

1.2 OBJECTIVE

a. Develop user friendly sustainable appliance control system: Developing a system that relies on minimum effort of learning curve but works efficiently as our targeted groups of peoples are physically disabled, therefore we decided to work with eye motion. So, depending on a pattern and series of eye blinking [1], the system can be activated, take command and execute.

b. Reduce Electricity Bills: This device will also help to reduce electricity wastage as the patient has no need to call anyone to switch off or on any electronic device as this system will help them to do all these tasks instantly without any third person‘s assistance so, as the system works instantly, it reduces electricity wastage by saving the time between arrival of assistance and performing tasks.

c. Design innovative solutions: Wireless technology used to communicate so that wire-hassle is reduced and various sensors and modules shape up this as an innovative solution.

d. Provide hands free control system: This system helps a person or patient to operate almost everything with eye

blinks so that there is no need of helping hands for physically disabled person or paralysis patients.

e. Provide unique feature to control different appliance: Our system can perform at least 24 commands and follow the pre-defined instruction as predefined. Moreover, we use android application to notify the supervisor for an emergency Call or SMS [15]. For this project, we decided to work on 4 commands set due to the limitation of hardware. However, the system can be equipped with 24 commands at 4 least efficiently. Though, we are using 4-bit sequential data pattern as we are using only one set of sensor for right eyes, but the system is capable of processing two sensors on both of the eyes. In that case we can process any combination of 4-bit data pattern. If we consider each eye can separately blink, then we can get patterns like 0000 or 0101 or 1100 or 1010 etc. This enables us to control a huge number of appliances just by using eye blink.

II. PROBLEM STATEMENT

Now-a-days, the rapid growth of technology has made our PC become outdated. The tasks that once we used to do with PC are now being handled by mobiles or other smart devices. Introduction of network enabled devices or IOT devices [12], [13] have led to advanced home automation systems. However, the usage is limited for people with physical disorders as remote control of an appliance becomes difficult. In this paper the project is about for those people who are suffering from Paralysis (As example, Tetraplegia Patients) and the difficulties which they face while controlling home appliances. Tetraplegia Paralysis is brought about by harm to the cerebrum or the spinal line this patient; client needs to control the appliance.

We try to take care of their issue utilizing eye blink sensor. An eye blink sensor is a transducer which detects an eye blink, and gives a yield voltage at whatever point the eye is shut. This project is about eye blinking for instance, in systems that monitor a paralyzed human so that he/she can operate home appliances, such as- light, fan, Air Condition and so on. Also, this is connected with Android Smartphone Bluetooth radio, so that patients can communicate with others in case of emergency via sending text SMS, just by blinking their eyes.

III. IMPLEMENTATION

This system delivers a method to guide and control the appliances for disabled people based on movement of the eye. The signal is measured by the electrodes and depending on the signal frequency the appliances can be controlled by the eye blink detection system.

3.1 EOG signal acquisition and blink detection

The electrodes can reduce the drift by an application, to check the motion artifact and contact with the eye, EOG is a new technology of placing electrodes on user's forehead around the eyes to record eye movements based on the polarization potential, which is the resting potential between the cornea and the retina. This potential is commonly known as electrooculogram. This system of HCI five electrodes are engaged to attain the EOG signals.

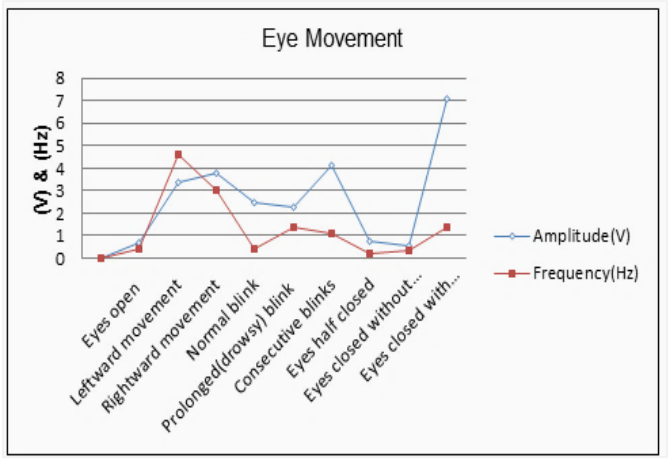

Figure 2. Eye Blink Detection

The placement of Electrodes are 1 & 4 for detecting vertical movement, 2 & 3 for detecting horizontal movement, 5 can be omitted or place at forehead. With eye blinks as gestures, our objective is to develop a Brain Computer Interface (BCI) with a single channel of EOG Signal. By capturing an eye blink as input to a device, a person may be able to communicate with Visual cue to get simple chores done.
Electrodes are placing on the region surrounding of the eye to acquire the EOG signal from horizontal and vertical. Once the system is started, menu is shown to the display by system, in which focus is rotating between every menu option. Patient can enter in particular menu by eye signal, when focus is on menu that he/she wants to select. Same way he/she can make selection in sub menu. All question or selection on screen is controlled by eye signal. By this way patient can control home appliances (ON/OFF) without need of anyone's help. EOG is a very small electric potential that can be detected using electrodes. The EOG ranges from 0.05 to 3.5mV in humans and is linearly proportional to eye displacement. Basically EOG is a bio-electrical skin potential measured around the eyes but first we have to understand eye itself. Many experiment shows that the corneal part is the positive pole and the retinal part has the negative pole in the eyeball whereas, the eye movement is monitored by using electrodes. Further, the measured information is given to microcontroller as input. The information is processed in PC using python and data is transferred to load via microcontroller. According to the received data the load will be ON/ OFF condition. This property of the relay makes it more convenient for our application. And also we include one more module as

emergency alert notification system, here the GSM services will activated along with the application in which enables when the user/ patient goes to critical situations.

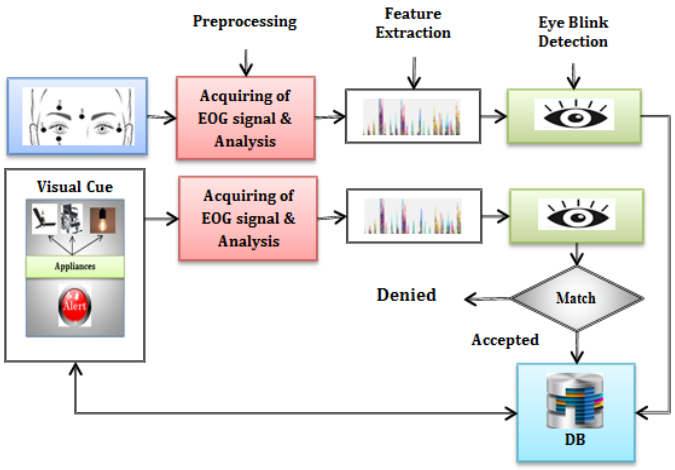

Figure 3. Architecture Diagram

In this architecture diagram we applied two phases, the primary phase is to initial enrollment phase which the eye blink was acquired with the help of the electrodes and given as input to the preprocessing to produce the quality input without noise to extract the feature. Based on that the preprocessing section get the eye blink acquired signal and analysis the EOG signal, and then we use the eye blink detection algorithm to extract the feature signal that was stored in the data base. Secondary phase will do the same processes with real time visual cue. It is a device with flash button information that can be queued in an order and frequently the flash message was run automatically with a time interval of 5 seconds. Now the user can look at to the visual cue and blinking the eye to choose the options, initially we used 4 applications (Light, Wheelchair, Fan, Emergency alert). Based on the users selection the feature was extracted and it moves to the decision box whether the blinked user was authorized or not and the selected application was enabled with the help of sensors, so many no of sensors are used to enable automation system thus the application was executed by blinking signal. And in advance the emergency alert system was also implemented with the help of GSM system in this application by selecting the flash button alert, BP, HBR, pulse sensors are inbounded with a single system and it measures all parameters and inputs are given to the GSM system, this forwards the message to the guardian or the attender and also to the concern doctor. This system helps the patient with disorder or unable to access their home environment and also for the old ages, and it can prevent them in an emergency situation.

IV. RESULT

The experiment is done for our system which is shown in the figure 4 (a) for light, (b) and (c) for emergency alert system which send the health information such as Pulse, Temperature and Blood Pressure through the GSM system to the doctor and the guardian.

Figure 4. (a) Output for the Light OFF

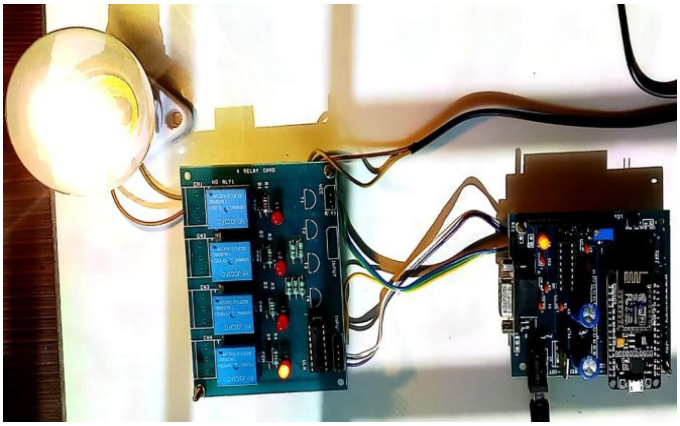

Figure 4. (b) Output for the Light ON

Thus the EOG based eye blink detection system executes efficiently and produces accurate result to controls the appliance.

Figure 4. (c) Notification SMS to the mobile phone

V. CONCLUSION

Eye movement based detection device for emergency alert and controlling smart environment appliances has been discussed in this paper. The device is developed mainly for the paralyzed people, for whom mobility is a point of concern. Based on the acquisition of eye blinks device is comparatively inexpensive, efficient in terms of linear relationship of the signal over the eye movements that make it suitable for the application. So that the device incorporates on and off of appliances such as light, fan, bulb, GSM and alarm, EOG acquisition is a more primitive method for tracking eyeball movements, also precise filters are required for this method to reduce noise. The method of eye tracking using camera requires a fully dedicated system with image processing software during the entire working of the unit. But while using eye blink sensor we not need pc support & future expansion is possible in future this method can be drawn-out by using a RF Trans-receiver that will help to operate in a wider area.

REFERENCES

[1] Choi, I., Han, S., & Kim, D. (2011). Eye Detection and Eye Blink Detection Using AdaBoost Learning and Grouping. 2011 Proceedings of 20th International Conference on Computer Communications and Networks (ICCCN). doi:10.1109/icccn.2011.6005896.

[2] T. Jamil, I. Mohammed and M. H. Awadalla, "Design and implementation of an eye blinking detector system for automobile accident prevention," SoutheastCon 2016, Norfolk, VA, 2016,pp.1-3.doi: 10.1109/SECON.2016.7506734.

[3] A. Udayashankar, A. R. Kowshik, S. Chandramouli and H. S. Prashanth, "Assistance for the Paralyzed Using Eye Blink Detection," 2012 Fourth International Conference on Digital Home, Guangzhou, 2012, pp. 104-108.

[4] K. Malik and B. Smolka, "Eye blink detection using Local Binary Patterns," 2014 International Conference on Multimedia Computing and Systems (ICMCS), Marrakech, 2014, pp. 385-390. doi: 10.1109/ICMCS.2014.6911268.

[5] Amardeep Singh and Amardeep Singh Virk, "Real Time Drowsy Driver Identification Using Eye Blink Detection". International Journal ARCSSE, Vol 5, Issue 9, September 2015, pp 335-340.

[6] Wu, J. & Trivedi, M.M. "Simultaneous Eye Tracking and Blink Detection with Interactive Particle Filters", EURASIP J. Adv. Signal Process.(2007) 2008: 823695. https://doi.org/10.1155/2008/823695

[7] M. Lalonde, D. Byrns, L. Gagnon, N. Teasdale and D. Laurendeau, "Real-time eye blink detection with GPU-based SIFT tracking," Computer and Robot Vision, 2007. CRV '07. Fourth Canadian Conference on, Montreal, Que., 2007, pp. 481-487. doi: 10.1109/CRV.2007.54

[8] Anderer P, Roberts S, Schlögl A, Gruber G, Klösch G, Herrmann W, Rappelsberger P, Filz O, Barbanoj M, Dorffner G, Saletu B. Artifact processing in computerized analysis of sleep EEG - a review. Neuropsychobiology. 1999;40:150–157. doi: 10.1159/000026613. [PubMed] [CrossRef] [Google Scholar]

[9] Hari Singh, and Jaswinder Singh "A REVIEW ON ELECTROOCULOGRAPHY" Singh et al., International Journal of Advanced Engineering Technology E-ISSN 0976-3945 IJAET/Vol.III/ Issue IV/Oct.-Dec., 2012/115-122 IJAET/Vol.III/ Issue IV/Oct.-Dec., 2012/115-122

[10] Ayush Bhandari, Vijay Khare, Mrinal Trikha and Sneh Anand, "Wavelet based Novel Technique for Signal Conditioning of Electro-oculogram Signals", Annual IEEE India Conference, September 2006, pp 1-6.

[11] A B Usakli, S Gurkan, E Aloise, G Vecchiato and E Babliloni, "On the Use of Electrooculogram for Efficient Human Computer Interfaces", Hindawi Publishing corporation, Computational Intelligence and Neuroscience, pp 1-5, Volume 2010.

[12] Masafumi Hashimoto, Kazuhiko Takahashi, and Masanari Shimada, "Wheelchair Control using an EOG and EMG based Gesture Interface" , 2009 IEEE/ASME International Conference on Advanced Intelligent Mechatronics, Suntwc Convention and Exhibition Centre, Singapore, July 14-17, 2009, pp 1212-1217.

[13] A Survey on Developing Secure IoT Products Priyang Bhatt1*, Bhasker Thaker2 , Neel Shah 3 1Gujarat Technological University, V. V Nagar, Anand , India Isroset-Journal (IJSRCSE) Vol.6, Issue.5, pp.41-44, October (2018) E-ISSN: 2320-7639

[14] IOT Survey: The Phase Changer in Healthcare Industry Gurpreet Kaur* , Manreet Sohal Department of computer engineering and technology, Guru Nanak Dev University, Amritsar, India IJSRNSC Volume-6, Issue-2, April 2018 ISSN: 2321-3256

[15] Mohammed Ghazal ; Samr Ali ; Marah Al Halabi ; Nada Ali ; Yasmina Al Khalil "Smart Mobile-Based Emergency Management and Notification System" 2016 IEEE 4th International Conference on Future Internet of Things and Cloud Workshops (FiCloudW)

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