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Driver Drowsiness Alert System

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***Abstract*: Detection of drowsiness is one of the biggest challenges for human beings. Especially during the night driving, it is very important for the person to be in awakening state. While driving, a matter of few seconds of the involuntary activity of humans may end in an accident. In order to detect the drowsiness, the brain wave sensor, along with the Brain-Computer Interface (BCI) technology is used in this proposed work. Millions of neurons play a major role in the human brain. During every movement of the human beings, the pattern of neuron changes while walking, running, sleeping mode etc. The special device of brain wave sensor helps to detect the blink rate and meditation period through variations occur in the eye movement. The detected frequency and blink rate compared with reference frequency and rate to check the attention level of the driver.**

***Keywords*: :(Electroencephalogram); BCI (Brain Computer Interface); Eye-Blink; Drowsiness**

1. Introduction

In 2011, the death toll of traffic accidents in Korea is 265.79 of them were died by drowsy driving. Since the death rate of drowsy driving has maintained remarkably high, many researchers have developed various driver's condition monitoring systems. A number of methods have been proposed to detect drowsiness state, and are mainly classified into three approaches. The first approach is to monitor driver's behavior related to drowsiness, such as the inclination of the driver's head, sagging posture, decline in gripping force on steering wheel, and lane departure using a camera to track rad markings [1]. The second approach is measuring physiological signal analysis of driver's, such as Electroencephalogram (EEG), Electrocardiogram (ECG), Electro Myo Gram (EMG), Electro Oculo Gram (EOG), heart beat rate and skin electric potential [6]. The third approach is to analyzing facial image changes using image processing, such as Eye-Blinking frequency, eye closure duration, and yawning [10]. Among these approaches, physiological signal analysis has known for identifying human's mental states accurately.

Each method has advantages and disadvantages. Because image processing techniques are non-contact, driver cannot be disturbed. Measuring the eye blinking frequency and eye closure duration is mostly used to determine the degree of drowsy driving [4]. Although image processing. Techniques are practical method, accuracy and precision is lower than using physiology signal. Especially, because the image processing techniques focus on only eyes closed state, they cannot be applied for detecting drowsiness with eyes open. Sometimes, people have experienced that hardly keeps their eyes open to stop themselves from falling asleep. The analysis of the eye blinking frequency and eye closure duration is no regard for drowsiness with eyes open [7]. This problem will lead to dangerous situations in case of drowsiness detection system for vehicle. For instance, if you driving at 100 Km/h on highway falls drowsiness for five seconds, the vehicle will travel 139 meters while completely out of the control of the driver. It can be directly related to driver's life. In this paper, EEG-based analysis by change of alpha power spectrum is used to detect drowsiness when subjects drowse with eyes open state that cannot be detected by image processing technique.

2. Electroencephalogram (EEG)

The electrical activity of the brain is commonly monitored to assess brain activity. Neural function depends on electrical events within the plasma membrane of neurons. The brain contains billions of neurons, and their activity generates an electrical field that can be measured by placing electrodes on the brain or on the outer surface of the skull. The electrical activity changes constantly, as nuclei and cortical areas are stimulated or they quiet down. A printed report of the electrical activity of the brain is called an Electroencephalo gram (EEG). The electrical patterns observed are called brain waves.

Delta waves are very-large-amplitude, low-frequency waves. Frequency range is up to 4Hz. They are normally seen during deep sleep in individuals of all ages. Delta waves are also seen in the brains of infants and in awake adults when a tumor, vascular blockages, or inflammation has damaged portions of the brain. Alpha waves are the frequency range from 8Hz to 13Hz. This activity is usually best seen in the posterior regions of the head on both sides, being higher in amplitude on the occipital lobe. Alpha waves appear in the brains of healthy, awake adults who are resting with their eyes closed. Beta waves are the frequency range from 14Hz to about 30Hz. This waves are most evident frontally and typical of individuals who are either concentrating on a task, under stress, or in a state of psychological tension. Theta waves are the frequency range from 4Hz to 7Hz and higher in occipital and temporal lobe. These waves may appear transiently during sleep in normal adults but are most often observed in children and in intensely frustrated adults. The presence of theta waves under other circumstances may indicate the presence of a brain disorder, such as tumor.

Electroencephalography (EEG) is the recording of electrical activity along scalp. EEG measures voltage fluctuations resulting from ionic current flows within the neurons of the brain. In clinical contexts, EEG refers to the recording of the brain's spontaneous electrical activity over a short period of time, usually 20-40 minutes as recorded from multiple electrodes placed on the scalp. Diagnostic applications Generally, focus on the spectral _content of EEG, that is, the type of neural _oscillations that can be observed in EEG signals.

3. Existing system

Eyes movements of the facial changes are particularly the important factors in the drowsiness detection. Previous image processing technique studied drowsiness detection algorithm using eye blink pattern. That uses OpenCv's implementation of face recognition. After recognizing face recognition eye region located by using the feature of horizontal projection histogram. And then, Eye-Blink detected by checking the number of input symbols standing for closed eye state only. If eyes-Closed duration is more than 400 MS subject state is drowsiness and more than 800 MS subject state is sleep. This detection system is possible in all day and night light conditions and even if the driver is wearing glasses. But in this case driver have to look straight ahead. If driver's head hung down detecting face and eyes is difficult. Also drowsiness with eyes open state can't be detected.

4. Proposed system

If subjects are at rest with their eyes closed, alpha waves highly occur on the occipital lobe. Theta and delta waves are normally invisible in adult. Generally, 9~11 Hz alpha waves are most observed in normal adults but in each area frequency is slightly different. Alpha waves emerge with closing of the eyes open or mental exertion. Alpha waves were observed at the symmetrical part in left hemisphere and right hemisphere of the brain. Alpha waves attenuate and almost disappear following eyes open and are replaced by higher frequency beta waves which increase upon a subject opening their eyes. The conspicuous region of alpha activity is over occipital lobe. Frontal lobe and occipital lobe are area of EEG measurement related to alertness, drowsiness or sleep. Drowsiness, eyes open and eyes closed are closely related to alpha activity. When drowsiness forces the eyes to close, alpha waves are strongest EEG brain signals. Studies have reported that in drowsiness state alpha activity mainly corresponding to a higher alpha band (11~13 Hz) increases. However, supposing normal adults have their eyes open even if they drowse, alpha changes of cannot be explaining something logically. That's why normal adults have entered resting state then alpha activity is increased but if they are eyes open state, alpha activity is decreased. In other words, the assumption includes contradictory changes of alpha waves. Therefore, this paper determines drowsiness states by analyzing changes of alpha activities and these states are categorized into drowsiness with eyes open and drowsiness with eyes close through visual inspection.

5. Block diagram

Our project is focusing to avoid the accidents using brainwave sensor, by reading the meditation levels of the brain using dry electrode unit library. In the secondary section RF transmitter and receivers are used to transfer data packets. Whenever the meditation level is greater than the threshold then it will indicate drowsiness. At that moment we are going alert the driver with buzzer.

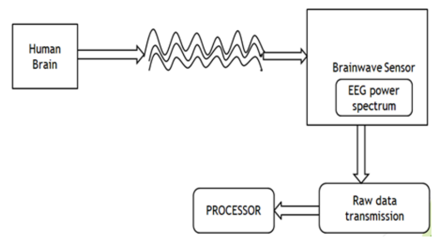

Fig. 1. Brain wave signal

The key work of the project is analyzing the brain signals. Human brain consists of millions of interconnected neurons. This neuron pattern will change according to the human thoughts. At each pattern formation unique electric brain signal will form. If a person is mentally sleeping with eyes open then the attention level brain signal will get changed than the normal condition. This project work uses a brain wave sensor which can collect EEG based brain signals of different frequency and amplitude and it will convert these signals into packets and transmit through Bluetooth medium in to the level splitter section to check the attention level. In the brainwave sensor unit, it consists of reference ground and dry electrode. Dry electrode is used to extract the brain waves from the forehead. This dry electrode unit will be used to collect the signal of different frequency and amplitude.

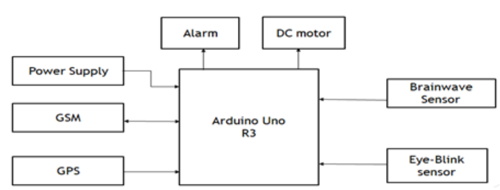

Fig. 2. Vehicle section

The brainwave sensor collects the EEG signal from the brain with different amplitude and frequency and will be compared with reference frequency. If the attention level change from normal state it will detect this state as drowsiness state. At the same time the alarm will generate for driver's alert and the notification id send to the client with vehicle's location by using GPS and GSM.

6. Brain wave sensor

The special technique of brain computer interface (BCI) is mainly used to interface both the external and internal device.

In the brain computer interface (BCI) scans the neuron pattern for each and every second. The neural pattern varies during the various metabolic activities of human beings. Electroencephalogram is a method used in measuring the electrical activity of the brain. At the root of all our thoughts, emotions and behaviors is the communication between neurons within our brains. Brainwaves are produced by synchronized electrical pulses from masses of neurons communicating with each other.

Brain waves are detected using sensors placed on the scalp. They are divided into bandwidths to describe their functions (below), but are best thought of as a continuous spectrum of consciousness; delta being slows, loud and functional to Gamma being fast, subtle, and complex. The brainwave sensor. It is a hand analogy to think of brainwaves as musical notes – the low frequency waves like a deeply penetrating drum beat, while the higher frequency brain waves are like a subtle high pitched flute. Our brainwave changes according to what we're doing and feeling. When slower brainwaves are dominant we can feel tired, slow, sluggish, or dreamy. The higher frequencies are dominant when we feel wired, or hyper-alert.

Fig. 3. Brainwave sensor

The descriptions that follow are only broadly descriptions in practice things are far more complex, and brainwave reflect different aspects when they occur in different locations in the brain. Brainwave speed is measured in Hertz (cycle per second) and they are dived into bands delineating slow, moderate, and fast waves. This device should be placed perfectly then only it can able to detect the brain signals in an efficient manner.

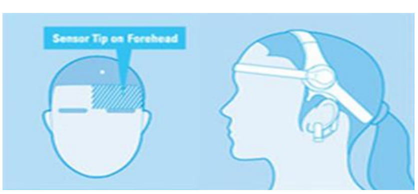

Fig. 4. Placement of brain wave sensor

The dry electrode should touch the forehead to capture the brain signals without any interruption. The ear clip must be positioned at the bottom of the ear which helps to place the device in the correct position.

7. Eye-blink sensor

The objective of this project is to develop a system to keep the vehicle secure and protect it by the occupation of the intruders. We can't take care for ours while in running by less conscious. If we done all the vehicle with automated security system that provides high security to driver, also gives alarm. This eye blink sensor is IR based. The variation across the eye will vary as per eye blink. If the eye is closed means the output is high otherwise output is low. This to know the eye is closed or opening position. This output is given to logic circuit to indicate the alarm. This can be used for project involves controlling accident due to unconscious through eye blink.

8. Kit configuration

The brain wave sensor and eye blink sensor used to detect the drowsiness of the driver. The frequency and the blink rate considered input for the processor. After detecting the state as drowsiness by using the reference frequency and blink rate the GPS will track the location of the vehicle and this location details send to the vehicle's owner by using GSM.

9. Results and discussions

In this proposed work the brainwave sensor is used to detect only the alpha wave. The alpha wave is generated during the eyes open and close state. The neural pattern changes according to the variations occur in the alpha waves. We have confirmed that enhanced alpha waves occur when the subjects are relaxed with eyes closed and alpha waves decrease when the eyes are open. The changes of alpha waves power spectrum in drowsiness period is shown below in the figure 5.

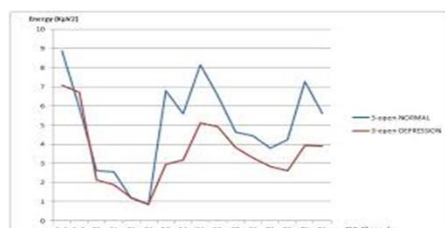

Fig. 5. The changes of alpha waves power spectrum in drowsiness period

The power spectrum analysis of signals was obtained for delta, theta, alpha, beta, and gamma frequencies. We checked changes in alpha, beta, theta, and delta power percentage (change over time) of the electroencephalogram (EEG).

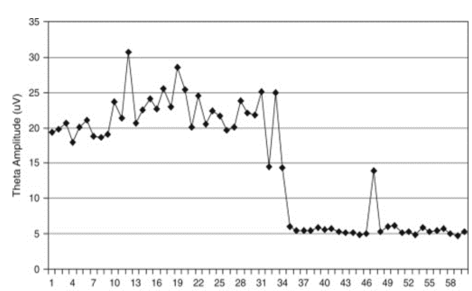

Fig. 6. Increase and decrease of alpha waves

Increase and decrease of alpha waves are shown despite eyes open, alpha power spectrum is increasing trend, therefore, subject is considered drowsy. However, every section could not quite correspond to such alpha patterns. In order to accurately analyze, we sought expert advice. The expert said EEG raw data corresponding to these sections have artifact no effect on the data and the wave forms of data are normally seen during drowsiness. Consequently, these sections could be identified as drowsiness with eyes open.

10. Conclusion

The drowsiness is related to eyes movement such as eyes open, eyes closed. Drowsiness can be explained that related to eyes open and eyes closed. Alpha activity changes by drowsiness and alpha activity changes by eyes open and eyes closed corresponded with each other. Although eyes open and drowsiness were seen in opposite trends, sometime occur at the same time. In this case, in this paper mentioned about changes of alpha waves in drowsiness with eyes open. In drowsiness the alpha occurred such as reported study. We confirmed that alpha increasing appears before alpha changes by eyes closed and eyes open. As a result, the increase of alpha in drowsiness with eyes open like normal drowsiness could be identified. Since this proposed work is based on detecting the drowsiness level at the initial stages itself by scanning the neural patterns using the brain-computer interface (BCI) technique it is most successful in detecting the drowsiness even with the eyes open state. In future, the brainwave module can be modified to increase its accuracy state and new algorithm can also be designed

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