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Offline Prediction of Driver Distraction Based on Brain Waves Activity Patterns.

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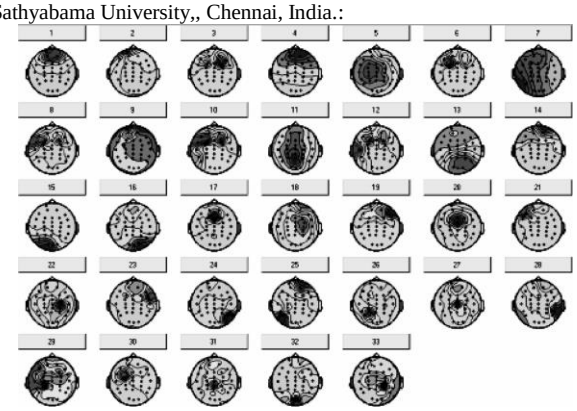
***Abstract*—A real time wireless Electroencephalogram (EEG) sensor system for drowsiness detection and display module as its core, came up with complete solutions of hardware and software, achieved the real-time transmission of Driver self-tested EEG measurement, EEG sensors data to CorrespondingPerson. This data is able to provide evidence to the doctor's diagnosis and treatment. This system has good expansibility and it's very convenient to use for doctors and patients. It lays a solid foundation for disease surveillance, tracking treatment, analysis and study.**

1.Introduction

LONG-DISTANCE, monotonous, or night time driving often lowers driving performance. As is widely assumed, drowsiness significantly contributes to automobile accidents, Manuscript received on July 24, 2013; revised December 25, 2013; accepted March 19, 2014. Date of publication May 19, 2014; date of current version May 23, 2014.



Scalp topography.

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online at http://ieeexplore.ieee.org.

RELATED WORK

[1]The activity of Brain associated with attention sustained on the task of driving safe has received considerable attention recently in many neurophysiological studies. Those investigations have been accurately predicted shifts in drivers' levels of arousal, fatigue, and vigilance, as evidenced by variations in their task consummation, by evaluating electroencephalographic (EEG) variations. Whatever, monitoring the neurophysiological activities of automobile drivers poses a major measurement challenge when using a Laboratory-oriented biosensor technology. This work projects a novel dry EEG sensor based mobile wireless EEG system (referred to herein as Mindo) to monitor in real time a driver's vigilance status in order to link the fluctuation on driving performance with changes in brain activities. The proposed system contains the use of a wireless and wearable EEG device to record EEG signals from hairy regions of the driver competently. Additionally, the proposed system can process EEG recordings and translate them into the vigilance level. The study compares the system performance between different regression illustrations. Moreover, the proposed system is implemented using JAVA programming language as a mobile application for online analysis..

[2]Anticipating accidents caused by drowsiness has become a major focus of active safety driving in recent years. It requires an optimal technique to continuously recognize drivers' cognitive element related to abilities in perception, recognition, and vehicle control in (near-) real-time. The main points in developing such a system include: 1) the lack of significant index considering detecting drowsiness and 2) complicated and pervasive noise interferences in a realistic and dynamic driving environment. In this paper, we develop a drowsiness-estimation system depend forth on electroencephalogram (EEG) by combining independent component analysis (ICA), power-spectrum Analysis, correlation evaluations, and linear regression model to estimate a driver's cognitive category when he/she drives a car in a virtual reality (VR)-based dynamic simulator. The driving error is defined as deviations between the centre of the vehicle and the centre of the cruising pathway in the lane-keeping driving task. These results explain the feasibility of quantitatively estimating drowsiness level using ICA-based multi stream EEG spectra.

[3]Disturbance during driving has been recognized as a significant cause of traffic accidents. The aim of this study is to investigate Electroencephalography (EEG) -based brain dynamics unresponsive to driving distraction. To study human cognition under specific driving tasks in a simulated driving experiment, this study utilized two simulated events including unexpected car divergence and mathematics questions. The raw data were first separated into independent brain sources by Independent Component Analysis. Then, the EEG power spectra were used to evaluate the brain dynamics using time and frequency. Results showed that increases of theta band and beta band power were observed in the frontal cortex. Further analysis demonstrated that reaction time and numerous cortical EEG power had high correlation. Thus, this study suggested that the features extracted by EEG signal processing, which were the theta power increases in frontal surface, could be used as the distracted indexes for early detection of driver inattention in real driving.

[4]Distressed driving might lead to many catastrophic consequences. Developing a countermeasure to track drivers' focus of attention (FOA) and engagement of operators in dual (multi)-tasking surrounding is thus imperative. Ten healthy volunteers participated in a dual-task experiment that comprised two tasks: a lane-keeping driving task and a mathematical problem-solving task (ex.,24+15=37?) in which there and behaviors were concurrently recorded. Independent component analysis (ICA) was employed as a spatial filter to separate the supplement of independent sources from the recorded EEG data. The power spectra of six components (i.e., frontal, central, parietal, occipital, left motor, and right motor) extracted against single-task conditions were fed into support vector machine (SVM) based on the radial basis function (RBF) kernel to build an FOA assessment system. The system achieved 84.6±5.8% along with 86.2±5.4% classification accuracies in detecting the participants' FOAs on the math versus driving tasks, respectively. This assessment system was then applied to evaluate participants' during dual-task conditions. The detected FOAs revealed that participants' cognitive attention and strategies dynamically changed between tasks to optimize the overall performance, as attention was limited and competed. The concerned results of this study demonstrate the feasibility of a practical system to continuously estimating subjective attention through EEG spectra.

[5]In Now a days, driver drowsiness has been one of the major causes of road accidents and can lead to severe physical injuries, deaths and significant economic losses. Statistics indicate the charge of a reliable driver drowsiness detection system which could alert the driver before a mishap happens. Previously everyone have attempted to determine driver sleep using these measures: (1) vehicle-based measures; (2) behavioral measures and (3)

physiological measures. A detailed review on these measures will provide insight on the present systems, issues associated among them and the enhancements that need to be done to make a robust system. In this paper, we review these three measures as to the sensors used and discuss the advantages and limitations fetch. The various ways through which drowsiness has been experimentally manipulated is also discussed. A number of road accidents might then be avoided if an alert is sent to a driver that is deemed drowsy.

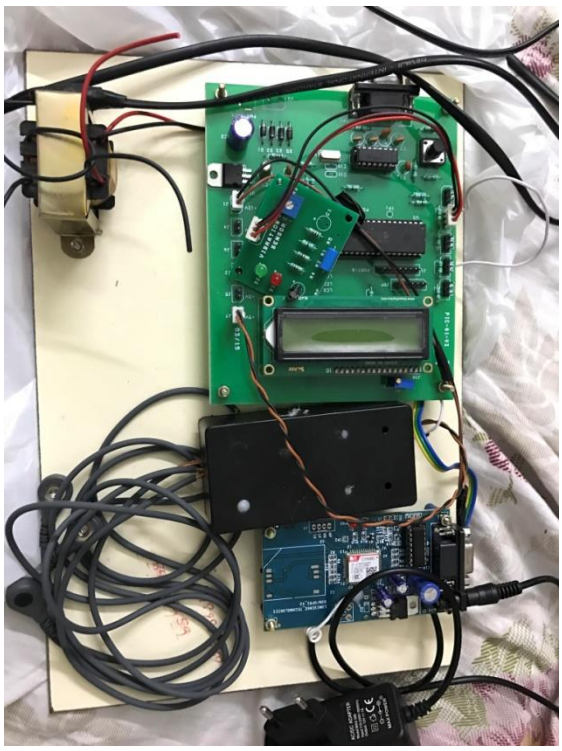
[6]The operator fatigue is one of the major causes of accidents in the world. Detecting the drowsiness of the driver is one of the surest ways of measuring driver fatigue. In this project we focused to establish a prototype drowsiness detection system. This system works by monitoring the eyes of the driver and sounding an alarm when he/she is drowsy. The system so designed is a non-intrusive actual-time monitoring system. The priority is on improving the safety of the driver without being obtrusive. The driver remain his eye closed for more than a certain period of time, the driver is said to be drowsy and an alarm is sounded.

[7]In this mode of new approach based on bio-signal sensing was used for real time accident avoidance. A wireless embedded system with real time bio-signal processing technique was proposed. The confession-signals sensor module consists of ECG, EEG, EOG and alcohol sensor. These bio-signals were first acquired by the sensor module Then the signal is processed and scheduled in the slayer with the help of the RTOS installed in it. The processed signal is transmitted to the receiving section by using the wireless data communication. The receiver unit can read the sensor data against wireless receiver module using zig-bee protocol. This received real time sensor data is compared with the pre-determined data stored in the processor memory and the decision was taken. we can provide warning to the driver by giving alarm and also having vehicle engine ignition control for stopping the vehicle. The parking light must be turned at before engine off so that the driver's coming behind can control the vehicle and thereby accident can be avoided.

[8]Paralysis of driver is one of the causes for accidents. Here is proposal for drowsiness detection and alert using mobile phones. In this system driver has to wear USB EEG headset which is connected via mobile device. EEG will capture live brain signals and send to mobile device. Mobile device has application installed in it which classifies these live signals and capture sleep /drowsiness related signals. Also, if mobile device finds drowsiness signals it will activate alert in it this enables the driver to wake up or be alert. This proposal involves development of mobile function which classifies the live sleep signals from brain and activates the alert in it.

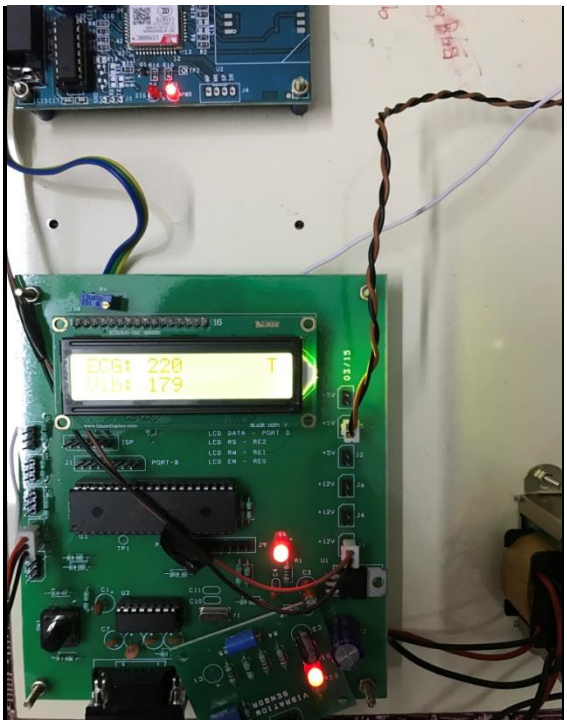
Review on drowsy driver monitor and warning system

The evaluation suggests that the EEG-based system using the RBF-based SVR is a highly promising means of predicting the driver's vigilance level. An attempt was also made to verify the feasibility of the proposed system by further implementing the SVR model in Java language as an Android application, in which the parameters of the implemented model (including slack parameter of SVR, shows a temporal relationship between the vigilance levels predicted by the proposed system and driver's behaviour in response to regular traffic events or emergencies when the participant performed the lane-departure driving task for approximately 70 min. The evaluated results were converted into eight degrees of vigilance level every 2 s which shows the conversion of predicted RT into vigilance level. In the starting of the experiment, the relatively alert state (bluish bars) was predicted and lasted continuously for several minutes.



HARDWARE KIT WITHOUT OUTPUT

The error from the people who is driving is defined by the deviations between the center of the vehicle and the center of the cruising lane in the lane-keeping driving task. Experimental results demonstrate the feasibility of quantitatively estimating drowsiness level using ICA-based multi stream EEG spectra. The ICA based prototypeis mainly applied to power spectrum of ICA components successfully (1) remove most of EEG artifacts, (2) suggest an optimal montage to place EEG electrodes, and estimate the driver's drowsiness fluctuation indexed by the driving performance measure. Finally, we present a benchmark study in which the accuracy of ICA-component-based alertness estimates compares favorably to scalp-EEG based.This research aims to develop a driver drowsiness monitoring system by analyzing the electroencephalographic (EEG) signals in a software scripted environment and using a driving simulator. The signals are been captured by a multi-channel electrode system. Any muscle movement impacts the EEG signal recording which translates to artifacts. The, noise from the recording signal is therefore eliminated by subtracting the noisy signal from the original EEG recording. The actual EEG signals are then subjected to band pass filtering with cut-off frequencies 0.5 Hz and 100 Hz. The filtered signals are analyzed using a time-frequency technique known as the Discrete Wavelet Transform (DWT). A third order Debauchies' wavelet and five level decomposition is utilized to segregate the signal into five sub-bands, namely, delta (0.5 – 4 Hz), theta (4 – 8 Hz), alpha (8 – 12 Hz), beta (12 – 30 Hz) and gamma (> 30 Hz). The main four order statistical moments such as mean, median, variance, standard deviation and mode of the sub-bands are calculated and stored as features. These features serve as an input to the next stage of system classification. The learning of unsupervised K-means clustering is employed from the classes of the signals are unknown. This provides a strong decision making tool for a real-time drowsiness detection system. The developed protocolfrom this work has been tested on twelve samples from the Physionet sleep-EDF database.



HARDWARE KIT WITH OUTPUT

The driver's drowsiness is one of the major causes for accidents. Here is proposal for drowsiness detection and alert using mobile phones. In this system driver equipped with USB based EEG headset which is connected to mobile device. EEG will capture live brain signals and send to mobile device. The device has an installed application in it which classifies these live signals and capture sleep /drowsiness related signals. Also, if mobile device finds drowsiness signals it will activate alert in it this enables the driver to wake up or be alert. This proposal involves development of mobile application which classifies the live sleep signals from brain and activates the alert in it.

Conclusion

Although tremendous work has been done on driver's fatigue detection but those work has been based on image processing or physiological signal such as electromyography (EMG) in which a system continuously monitors the driver's face and evaluates the fatigue level. If we can tap into drivers' brain signals and develop a system which responses on those signals, it will be of great use. To the date, very few research groups are working in this field but surely in the coming time many research scholars will starts doing work in this field.

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