

Detection of Driver's Lipothymia



V. Rukkumani, M. Aakaashe, V. AravinthaPrasath, K. Mukilan

Abstract: Health care systems are becoming very popular and are in demand extensively in recent years. Health care systems are almost in all the fields. In recent years, the vehicles are manufactured in large number. So, the road accidents also came into screen. Road accidents occurs mainly due to the over speed and unconsciousness of the driver during driving. By continuously monitoring the sleepiness of the driver, the alert can be given to the driver at right time to prevent the accidents. In this project, the sensitive electrode are placed on the head of the drivers in the eco-friendly manner (i.e. inside the band). So that, it will be eco-friendly to the drivers to use and it is the most easier to use. It will be wirelessly connected to the microprocessor, which will check the driver's sleepiness and the logs will be uploaded to the web. In recent years, Wi-Fi are in use in all the buses. So, all the passengers connected to the Wi-Fi are able to see the driver's sleepiness rate without any network connection by local Wi-Fi sharing features. Here, Microprocessor is connected to the Wi-Fi will act as a server. In case, if driver slept, passengers connected to the Wi-Fi will get an alert and the driver also get an alert to prevent the accidents. The alert may be a vibrating mechanism which will be fitted in the driver's seat (or) the sound that will wake up the driver from sleep without disturbing the passenger.

Keywords: Health Care, Data Acquisition, Monitoring, Diagnostic Analysis, Sleep Monitoring, Cloud Storage, Alert.

I. INTRODUCTION

Generally, the term 'Lypohtymia' means, the sleepiness or the drowsiness of the person. Here, it represent the sleepiness of the driver. That is, the sleepiness rate of the driver which will lead to accident. Here, the sleepiness is detected using the Electroencephalogram. This is the wave which is recorded from the brain. This brain wave is very useful for the prediction of sleepiness of the person. The main objective is to enable the continuous monitoring and logging the sleep status of a drivers, (it may be an adult or an aged person). At present, there are various health tracking devices available, but everything needs a supporting device such as computer, tablet or smartphone for them to work in a proper manner. But our system is standalone as it contains Microprocessor and Wireless Communication built within them which enables them to work without depending on any other external devices. Microprocessor, itself contains a Storage element which logs the reading so that this log can be used to track the measured parameters for diagnostic purposes if needed. The primary parameter measured is the sleepiness.

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The device also have the alert mechanism, which will alert the driver if he slept. In alert mechanism, it will generate sound or a vibrating mechanism to wake up the driver and make the driver conscious. It can also be able to give an alert to the passengers travelling in that bus. By making this alert, the major accidents can be prevented. It is detected by the sensors that is wirelessly connected to the microcontroller which will detect the driver's sleepiness state. So, on attaining the critical a critical sleep state, the microcontroller will generate an alert. The buzzer with red light near the driver may be fitted for alert. It may also include the vibrating mechanism which is fitted to the driver's chair. So, it will wake up the driver from the sleep. In this, Wi-Fi is enabled and connected to the microprocessor which will act as a local server or a local database or local cloud storage. Here, an electrodes (i.e. EEG electrodes) which are capable of reading the brain waves are placed on the driver's head. It is designed in the eco-friendly manner, that is, it is fitted in the cap which is easy to wear. These electrodes will record the brain wave voltages and store it in the microprocessor. These readings will be stored as log and the results will be uploaded to the webpage. That is, microprocessor will save the reading in the cloud and it will act as a server for the webpage. So, the systems (The systems may be smartphone, laptops, tablets etc.), which are connected to that server will be able to see the status of the driver's sleepiness. It also available in online webpage that is with their identity number. The microprocessor will decide whether, the driver is sleeping or not and the result is uploaded continuously to the webpage.

II. OVERVIEW OF EXISTING METHOD

The monitoring devices that are available on the market are based on the PIR (Passive Infrared) technology. [7] tells about the detection of drowsiness using the Infrared Camera. Here, this method is based on the non-contact type. It is mainly based on light rays (infrared). In this, driver's sleepiness is identified with their lazy movements of the driver by the infrared camera in front of the driver's seat. It will include the movements such as yawning, eye brow position, etc., But, this method will find difficult to identify the sleepiness of the driver within the limiting period. In this, time is playing the major role. Even the small amount of delay in alerting of sleep may lead to the minor accidents or major accidents which will lead to death. In PIR technology, it just monitor the driver's movement and it will not identify the sleep at the very beginning state. It also find it difficult to identify the sleepiness of the driver when he doesn't show their unbearable body movement due to sleepiness (i.e. yawning, random movement of head etc.). Here, the infrared camera are made to focus on the driver's body.



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So, all the movements of the driver is recorded. In this method, all the unbearable body movements are recorded. So, if the recorded are similar with these pre-defined lazy movements, then it will identify that, the driver is in the sleep. Then, it will proceed to the alert section.

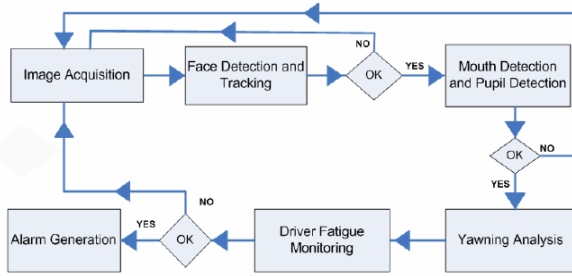


Figure 1. Flow Chart of Existing Method

The existing methodology is clearly explained in the Figure1. Here, all the process are explained with the help of the block diagram. Firstly, Images are acquired from the model and the face's identities are identified. All the features of the face are acquired and it is compared with the pre-existing samples. If it matches with the pre-existing one, it will proceed to the next block. Here, pre-existing samples includes the several features of the face. Hence, this block will identify the face. From this, all the features of the face are detected. The extracted features are compared with the samples which are extracted during Model's drowsiness. Hence, this phase will detect the drowsiness. If the drowsiness is detected, then the alarm is generated to wake up the driver. Here, these process are expressed in the looping. That is, feedback is used in the system. If the face's identity is not clearly captured, it will again go to the image acquisition step to re-acquire the image. If it is identified, it will go to the prediction stage and if it won't predict it will go the first stage. Similarly, if it predicts the drowsiness, it will generate an alarm. Otherwise, it will again go the first stage. So, it forms a closed loop system.

III. OVERVIEW OF PROPOSED METHOD

3.1. Methodology

The proposed system is based on the brain waves. Because, in this method the brain waves are continuously monitored to identify the sleepiness of the driver. Here, the EEG (Electroencephalogram) electrodes which are capable of reading the brain waves (By measuring the brain wave voltage) are attached to the head of the drivers. In this, the electrodes are placed inside the cap to make it ecofriendly for the drivers to wear. It won't be irritable for the drivers to wear while driving. It is adjustable, so all the drivers can adjust the band with the cap to their head size. It will be comfortable for the drivers to wear. It will generate a voltage as output. EEG signals are having very low voltage amplitude levels. The voltage ranges from (1 - 100) microvolts. These are also having very low frequencies ranging from about 1 Hz to 100 Hz. The EEG waveform differs in their shapes and they show dramatic changes to the different stages of sleep. Hence they are called EEG sleep patterns, Hence we have to use high gain, high CMRR input preamplifiers in order to boost these signals. [1] gives

the methodology to develop or design a single channel EEG for data acquisition. The details of five different categories of EEG bands are shown in the Figure 2.

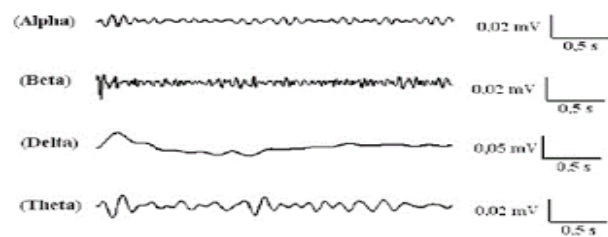


Figure 2. Different Types of Sleep States

The electrode setup also connected with a Bluetooth module inbuilt to transmit the monitored data to the microprocessor in order to detect the sleepiness of the driver. The microprocessor will identify the sleepiness level and decide whether the driver is slept or not. It will also generate an alert when the driver is identified as slept. The alert mechanism also contain a vibrating mechanism in combination with sound mechanism. Due to the vibrating and sound mechanism, the driver will awake from sleep and be conscious on the driving. The measured value which are send to the microprocessor are stored in the log format and it will act as a local server (cloud storage). Here, the microprocessor will have a Wi-Fi module which will connect to the Wi-Fi router.

3.2. Block Diagram

The block diagram has two parts. One is transmitting part and other is receiving part and are explained below. The data are transmitted and received via Bluetooth and their stages are represented as shown in the Figure 3 and Figure 4.

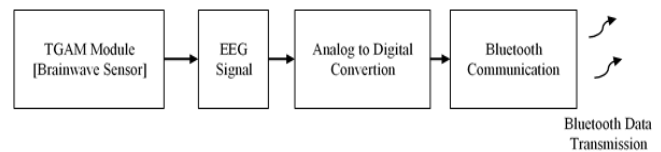


Figure 3. Block Diagram of Transmission Unit

The signals are acquired from the EEG Sensor and it is wirelessly transmitted to the Raspberry Pi using Bluetooth connectivity protocol.

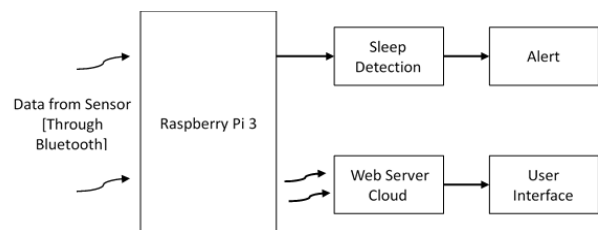


Figure 4. Block Diagram of Reception Unit

First of all, the brain waves are taken from the drivers. These values are transmitted to the microprocessor via Bluetooth (BT/BLE technology). The Bluetooth module is inbuilt with the headband.

The microprocessor will process the data and the result will be uploaded to the cloud storage. The microprocessor also connected to the Wi-Fi router. The values are fixed according to the values in the below table. Here, the first stage is delta which is the highly concentrating state. Second state is Theta, which is the normal state. Third one is the Alpha state, which the begging state for the sleep.

Fourth stage is the Beta which is the deep sleep state and so on. Here, we process the data and final obtained will be either in the frequency or in the millivolt. So, the values are fixed to generate an alarm if the sleepiness is detected. The table containing the rages are shown in the Table 1.

Table 1. Frequency and Voltage range from an EEG Electrode

Sleep States	Frequency	Voltage
Delta	1 – 4 Hz	Less than 100µV
Theta	4 – 8 Hz	Less than 100µV
Alpha	8 – 13 Hz	Up to 10µV
Beta	13 – 22 Hz	2 - 20µV
Gamma	30 Hz or higher	Up to 2µV

The webpage is created and the results are uploaded to the webpage. [2] gives the best idea about the controlling of robotic arm with the help of brain waves. In this, the processing of data is the main part which will help to attain the desired output. The URL are created with the Vehicle's Unique Identity Number. So, all the passengers are able to access the webpage. Here, the result from the microprocessor are uploaded to the webpage continuously. If the driver is slept, then it will generate an alert which may be a sound or vibrating mechanism to the driver to wake up from the sleep. The passengers also get an alert when the driver went to unconsciousness. Thus, all the passenger will find it easy to monitor the driver without any difficulties. Here, the results also made to view in the android application. The application will open with the page which shows the drivers sleepiness rate, speed of the vehicle and the feedback form to be filled by the passenger in which they can mention their complaints as well as their suggestions. The application page also have previous results of the driver's sleepiness and also the records of the speed. So, passenger can analyse the driver's state and also the bus's condition by analysing the records. It is best suited for both online as well as for offline monitoring. The only need of the customer is to enter the vehicle's unique number. Here, the electrodes are easy to wear by placing in the cap. These electrodes will be connected to the EEG module where the Bluetooth module also connected. Battery is connected to all the component to power it up. Thus, the setup consist of the electrode connected to the EEG Module, Bluetooth Module connected to the EEG Module and Battery for power. The cloud storage used is the phpMyAdmin. Here, the data are retrieved from the cloud

storage. At first, the program is executed to retrieve the value from the sensor through the Bluetooth and it is uploaded to the cloud storage. The program is made to start at the beginning of the boot up of the microprocessor. So, there will not be required any initiation to start up the program. After that, the php code is developed to display the records in the webpage. Here, the URL is made with the Vehicle's Identity Number. So, all the passengers will find it easy to use. In Android Application, the page is open with the

textbox, where the user have to type the Vehicle's Identity Number. Then, page with the records which are stored in the cloud are retrieved and displayed in that page. It also have the records of the previous events. It also have the link for the feedback submission. In that, they can give their opinion about the travel. It will be saved and it can be viewed for any discussions. In advance, the measured speed value also uploaded to the cloud and it will be viewed in the application as well as in the webpage. [9] tells about the application of EEG signal in diagnosing and monitoring of Epilepsy in adults. It is the disease related to sleep. This method gives the better results when compared to other methods. It also then uploaded to the online cloud to store the data. So, the control room can be able to see the live status of the driver along with the bus. So, if any accidents occurs, the reason can be easily revealed by these records which are available on the online databases.

III. RESULTS AND DISCUSSION

When this prototype was put into working, it worked as expected. The device was tested by using many models, so that to obtain the accurate state of sleep. Since, many models have different sleep state (Sleep at different level), the most average one is taken for the consideration. So that, it will applicable for all the modals. The Emergency Response algorithms were tested by feeding sample data to the inputs instead of sensor values to study the working of these algorithms at different levels of sensor readings. These sample data can be obtained from the online Databases and it is fed to the microprocessor for testing under different conditions.

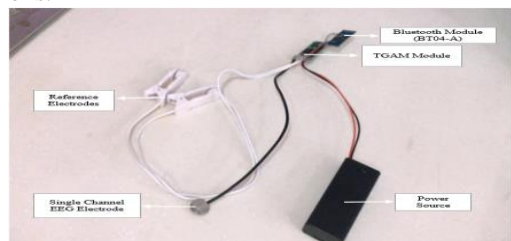


Figure 5. Project Setup at Transmission End

The Figure 4.6 shows the project setup which will send the data to the Raspberry Pi. The Bluetooth connection is used here for wireless data transfer.

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The setup consist of the power source, an ear clip for reference signal and a main electrode for the measurement of the EEG Signal. It also consist of the Bluetooth module for wireless data transfer. All these component will be fitted in the head band. So that, it will be very easy to wear and it will very easy for acquiring the EEG signals.

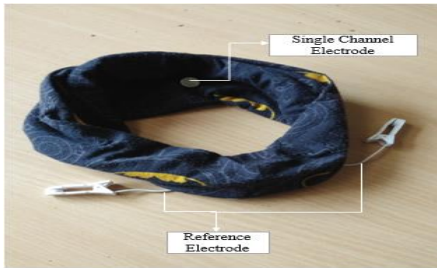


Figure 5. Complete Setup at Transmission End

The receiving part will be attached to the Wi-Fi router of the bus. So that, it will act as the server or local database. Here, the data will first transmit from the band and the data will receive and process in the raspberry pi and the data will uploaded to the databases, both local and online databases. It also generates an alarm if it detects a sleepiness. The Project Setup at reception end is shown in Figure 6 and the Values stored in Database is shown in Figure 7. This is the local database to store the data locally. The data are fed into it from the Raspberry Pi 3 through Python IDE. [3] gives the analysis of data under the simulated condition. It is mainly for analysis purpose. So, it is used for study also. The data



are first gotten from the TGAM module wirelessly.

Figure 6. Project Setup at Reception End

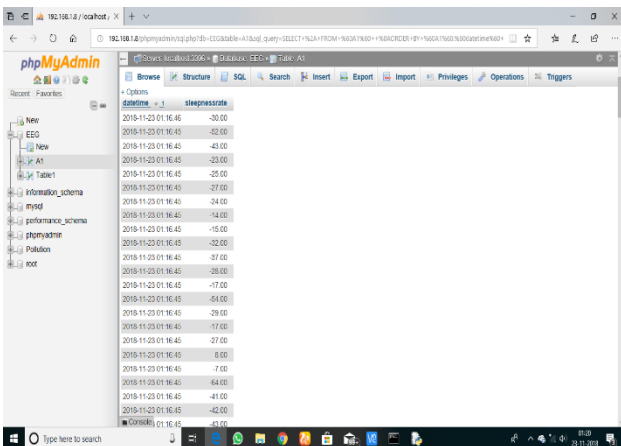


Figure 7. Value Stored in Database

The Brain Wave reading which was taken from the sensor is stored in the database, which is shown in the Figure 7. It is received from the microcontroller which produces the require result. The execution starts from the boot-up, so no initiation is needed. The server also starts when the microcontroller starts. Since, the values and the results are in the database, the webpage has to be created to show the results for the user's interface. It also have an admin account to view the feedback given by the passengers at the time of travel.

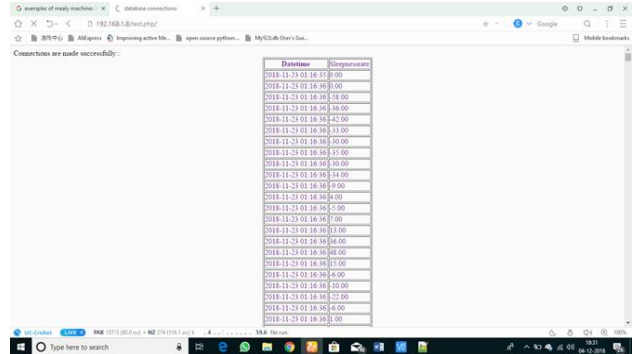


Figure 8. Result Displayed in the Webpage

The Results are already stored in the database as shown in the Figure 7. Then the php code included in the Raspberry Pi to display the results from the database to the webpage. The results page is shown in the Figure 8. [4] gives the analysis report based on the graph which is used for theoretical understanding. The php code is used in the Web-Designing in combination with the HTML and CSS. The HTML is used for the webpage creation and the php part is used to communicate with the database. Hence, the data can be retrieved from the database. The CSS plays a main role in Web-Designing. It is used to design the webpage. By using these, the webpage is designed, and the results are posted in the webpage. The web address are created with the Vehicle's Unique Identity Number. So, all the passenger are able to see the results in the webpage. Here, the php codes are developed to display the data in the webpage which is represented in the table. These data also send to the online database. The online webpage also created to display the data remotely. So, it will be easy to monitor in the control room.

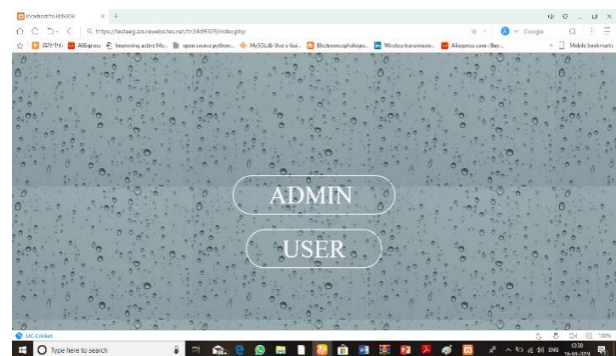


Figure 9. Online Webpage Created using Azure

Here, the Figure 9 shows the data which are fed into the online database and webpage is created to display the data in the front end. The webpage can be viewed by anyone with the active network connection.

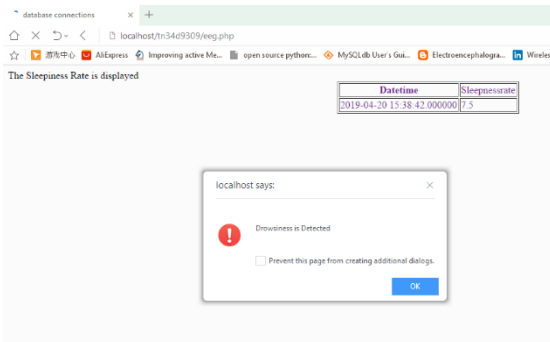


Figure 10. Drowsiness Detection in Webpage

The drowsiness rate is detected as shown in the Figure 10. Here, fixed range is mentioned and all the values above the range will be considered as sleepiness and the alert will be generated. The Android application for monitoring the driver online and offline is shown in the Figure 11.

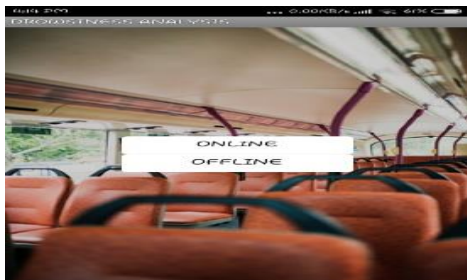


Figure 10. Android Application for Monitoring Sleepiness

[5] tells about the prediction of drowsiness for the past and future with the help of the present data. Thus, it can help for future prediction. [6] tells about the sleepiness and experience of sleepiness on the road while driving. This will tell about the factors which cause the sleep. It will be used for prediction of cause. [8] tells about the algorithms used to detect the drowsiness using the computer and the further analysis of EEG signal. In case, if accidents occur the data will be available in the cloud. So, it will be very useful in the investigations. That is, the investigation about the cause for the accident. It will also alert the driver if he sleeps. So, the accidents will be prevented and if occurs the cause can be analyzed. The output can be expressed in the table as below.

Table 2. Output Table

Sample	Calculated Value	Predicted Result
Person 1	18	Active
Person 2	2	Slept
Person 3	22	Active

The above table displays the output of the process (i.e. Active or Slept). From that, Alarm can be generated to wake up the driver.

IV. CONCLUSION

The Sleepiness detection system paves the way for the continuous monitoring the driver's brainwave. This makes it easy to detect the driver's drowsiness. On the detection of the driver's drowsiness, many major as well as minor accidents can be prevented and also many lives can be saved by giving the correct alert on the correct time. It also paves the way for the analysis of the driver who slept for many times. They can be penalised, when they often are in a sleepy state. So, the passengers will be always in a safe side. It also provides the platform for receiving comments from the passengers about their suggestions. The android application also paves the way for the user-friendly interface for displaying the driver's details.

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