A Survey on Driver's Drowsiness and Unconsciousness Detection Methodologies

[1]N.Mathiarasi, [2]T.Sureshkumar
[1]PG Scholar, [2]Assistant Professor
[1]Department of Computer Science and Engineering,
[1]Nandha College of Technology, Erode, Tamilnadu, India

Abstract **- In recent days, research in driving support systems like navigation support, automatic accident notification, and drowsiness detection systems encourages the researchers to explore more driving support in several aspects. It is important for a driving support system to detect and alert the driver's drowsiness and unconsciousness to avoid accidents to the vehicle and injuries to the passengers. This survey paper represents various methods to detect driver's drowsiness and unconsciousness while on driving which helps to increase the vigilance of driver and to prevent the vehicle crashes on road due to driver's fatigue state.**

Index Terms **- Drowsiness detection methods, Driver's unconsciousness detection methods**

I. INTRODUCTION

Driver's drowsiness is the major factor for most of the vehicle accidents [1, 2, 3, and 4]. Some of the accidents related with the driver's mental condition but it also depends upon the driver's health conditions. There are number of techniques emerging for detecting the drowsiness and unconsciousness of driver such that they play an essential role in the accident avoidance. One can use different techniques for analyzing these conditions. Drowsiness detection system using image processing methods are most widely used because they are non-invasive. In all the cases the warning system should actively alert the driver and passenger to prevent major accidents in road.

II. TECHNIQUES TO FIND DROWSINESS AND UNCONSIOUSNESS

The major methods available to predict the drowsiness and unconsciousness (Figure 1) is given below

1. Measuring Driver's Physiological Signals
    a) Tracking Eye Blink pattern
    b) Measuring Pulse rate of Driver
    c) Measuring Heart beat Rate (ECG)
    d) Measuring Brain waves (EEG)

2. Using In-vehicle sensors
    a) Steering wheel
    b) Gas pedal
    c) Air Bag

3. Computer Vision Systems
    a) Facial motion detection
    b) Head Movement
    c) Change in Driver's pose and position

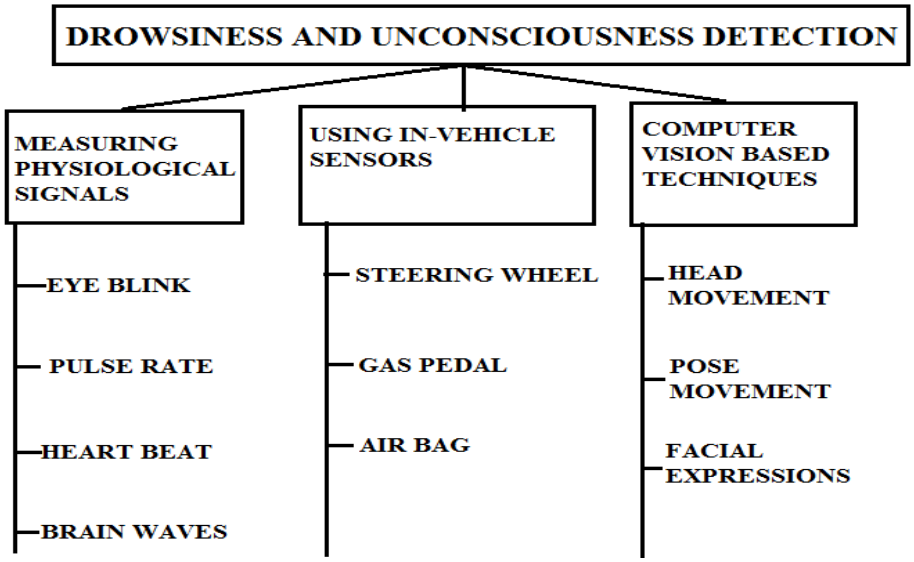

Figure 1 shows major available methods to predict the drowsiness and unconsciousness

III. MEASURING DRIVER'S PHYSIOLOGICAL SIGNALS

Tracking Eye Blink Pattern

Here the eye blink pattern is measured with the help of eye blink sensor. The sensor is in the form of spectacle or can be mold within the spectacle which is used to monitor the eye blink patterns. Figure 2 represents the eye blink sensor molded within spectacle, which alerts the driver and passenger at the vehicle when he goes to the sleeping state or unconscious state.

Figure 2 represents the eye blink sensor molded within spectacle

Human eye should normally blink 15-20 times per minute. While in driving it blinks about 10-12 times. These values are considered as threshold values. If any change in the threshold value will intimate the microcontroller and is warns the driver and people in vehicle using an alarm or an active warning system.

Measuring Pulse Rate of the Driver

Pulse rate of the driver is measured with the help of pulse rate sensor as shown in Figure 3. The pulse rate sensor is mounted on the wrist of the driver, which captures the pulse rate continuously. The normal human pulse rate should be 72 pulses per minute. If the change in pulse rate occurs, then the system informs to the microcontroller about the change of value and then it alerts the driver with the help of warning system.

Figure 3 shows pulse rate sensor

Measuring Heart Beat Rate of Driver (ECG)

Heart beat rate is measured with the help of heart beat sensor, which is fixed at the skin near the chest of the driver. It continuously monitors the driver's heart rate. Normal human heart rate should be 60-80 beats per minute. It is the threshold value. Change in any threshold value will result in alarming condition. Figure 4 shows the working of heart rate sensor.

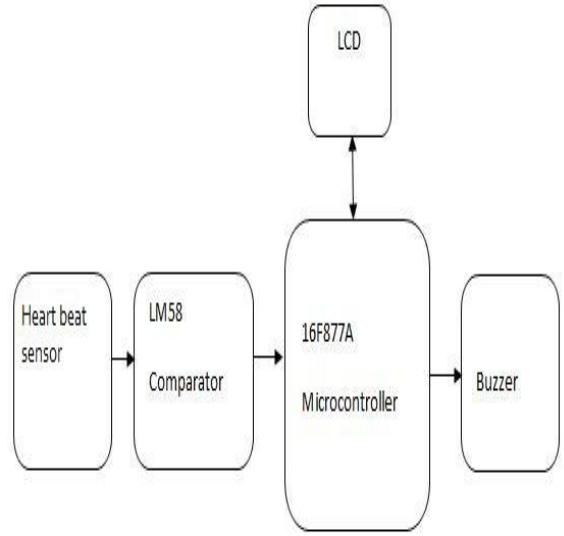

Figure 4 shows the working of heart rate sensor

Measuring Brain waves of the Driver (EEG)

The Electroencephalogram waves are measured with the help of EEG electrode molded on a cap like structure. The driver wears the cap like structure at the head so that is monitors the brain waves. The brain waves are classified into two types of waves called

- Alpha
- Beta
- Theta
- Delta
- Gamma waves

All these waves and their nature are shown in Figure 5 and Table 1. Delta, Theta and Gamma waves are meant for sleeping and unconscious states. If the system detects these waves, then it alerts the driver and passenger.

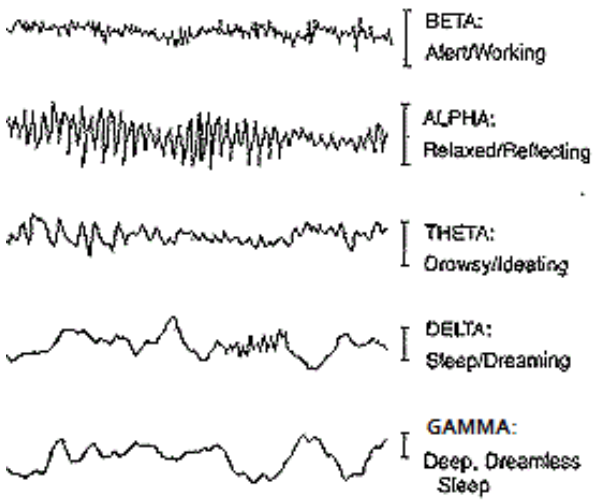

Figure 5 shows different type of brain wave and their meaning

TABLE 1: Shows Different Brain Waves and Their Meaning, Frequency Range

Brain Wave Type	Meaning Of The Wave	Wave Frequency
ALPHA	Waking Consciousness and Reasoning Wave	14-40Hz
BETA	Deep Relaxation Wave	7.5-14Hz
THETA	Light Meditation and Sleeping Wave	4-7.5Hz
DELTA	The Deep Sleep Wave	0.5-4Hz
GAMMA	The Insight Wave	Above 40Hz

IV. USING IN-VEHICLE SENSORS

In-vehicle sensors are usually in built in the vehicle to monitor the vehicle's condition. There is numerous sensors available to monitor the vehicle vigilance level as shown in Figure 6.

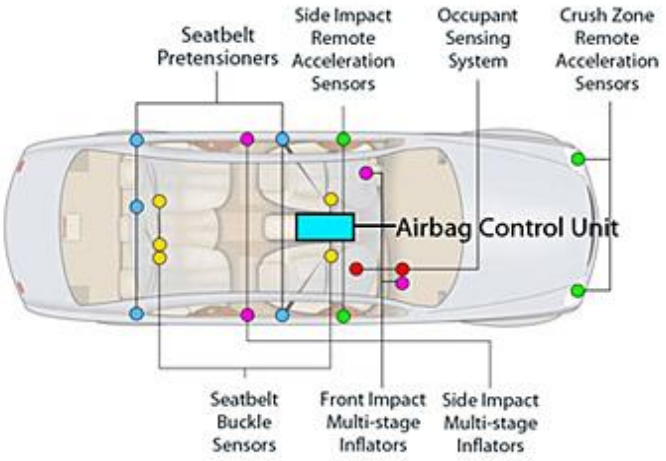

Figure 6 shows the sensors in-built in a vehicle

V. COMPUTER VISION SYSTEMS

Facial Motion Detection

Here the facial motion of the driver is monitored with the help of a camera. It needs extra care to predict the unconsciousness. People usually prefer with these techniques because these are non-invasive. They include four types of data acquisition methods are shown in Figure 7.

- Image acquisition
- Pupil detection
- Pupil tracking
- Detecting visual behaviors

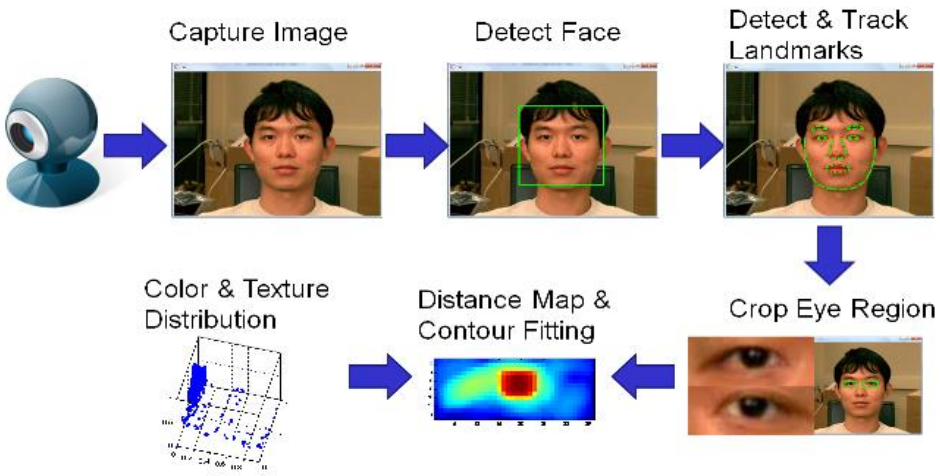

Fig. 7 shows Facial Motion Detection

Head movement and change in Drivers pose

They are also done with the help of a motion detection camera. People usually prefer for these methods because these are more non-invasive. They do not give any pain or injury to the body. The major factor is that separate and manual inspection is needed to monitor the change in pose when one use these computerized visualization methods.

VI. ARTIFICIAL NEURAL NETWROK BASED DETECTION METHOD

Artificial intelligence in drowsiness detection allows neurons to participate in the detection process. Here the sample set of neuron (5 neurons is enough for practical examination) of the driver is taken into account. Their behavior is monitored and based upon the values in the behavior; the decision is made whether the driver is in drowsiness or unconsciousness. While comparing with other methods artificial neural network method is most efficient one by which one can easily predict the fatigue condition of the human.

VII. CONCLUSION

After a deep review of all drowsiness and unconsciousness detection techniques, we can conclude that artificial neural network based method gives the accurate results but it is difficult to implement in real time. EEG based method also gives good results but it is invasive in nature. The driver needs to wear it in his/her head continuously. Pulse rate method is most suitable one. Computerized visualization method needs more manual and computerized tracking but gives good results. It is also non-invasive in nature. One can implement any method based on their own interest based upon their driving and environmental factors.

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