Driver Drowsiness Detection System

Akhil Jaywant, Ruturaj Deshmukh ,Sara Ahmed, Sneha Bagul

Department of Electronics Engineering

Abstract — **Drivers who do not take regular breaks when driving long distances run a high risk of becoming drowsy a state which they often fail to recognize early enough according to the experts. Studies show that around one quarter of all serious motorway accidents are attributable to sleepy drivers in need of a rest, meaning that drowsiness causes more road accidents than drink-driving. Attention assist can warn of inattentiveness and drowsiness in an extended speed range and notify drivers of their current state of fatigue and the driving time since the last break, offers adjustable sensitivity and, if a warning is emitted, indicates nearby service areas in the COMAND navigation system.**

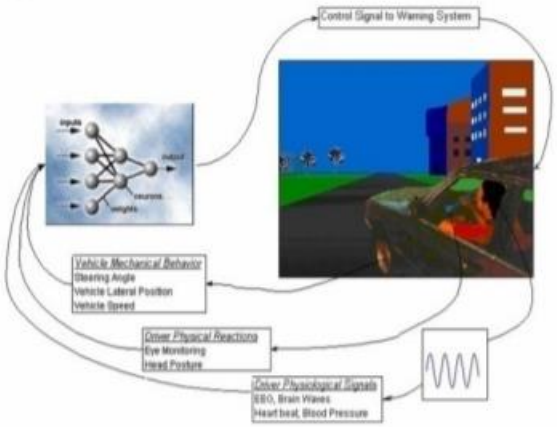
Keywords *— —Drowsiness Detection, Eyes Detection, Blink Pattern, Face Detection, LBP, SWM.*

I. INTRODUCTION

Driver drowsiness detection is a car safety technology which prevents accidents when the driver is getting drowsy. Various studies have suggested that around 20% of all road accidents are fatigue-related, up to 50% on certain roads. Driver fatigue is a significant factor in a large number of vehicle accidents. Recent statistics estimate that annually 1,200 deaths and 76,000 injuries can be attributed to fatigue related crashes. The development of technologies for detecting or preventing drowsiness at the wheel is a major challenge in the field of accident avoidance systems. Because of the hazard that drowsiness presents on the road, methods need to be developed for counteracting its affects. Driver inattention might be the result of a lack of alertness when driving due to driver drowsiness and distraction. Driver distraction occurs when an object or event draws a person's attention away from the driving task. Unlike driver distraction, driver drowsiness involves no triggering event but, instead, is characterized by a progressive withdrawal of attention from the road and traffic demands. Both driver drowsiness and distraction, however, might have the same effects, i.e., decreased driving performance, longer reaction time, and an increased risk of crash involvement. [1].
"Fig.1", shows the block diagram of overall system. Based on Acquisition of video from the camera that is in front of driver perform real-time processing of an incoming video stream in order to infer the driver's level of fatigue if the drowsiness is Estimated then the output is send to the alarm system and alarm is activated

II. LITERATURE REVIEW

Drowsiness detection can be divided into three main categories (1) Vehicle based (2) Behavioural based (3) Physiological based. [4]"Fig.2", shows the three different approaches for drowsiness detection. Drowsiness detection is based on these three parameters. A detailed review on these measures will provide insight on the present systems, issues associated with them and the enhancements that need to be done to make a robust system. Vehicle based measures: A number of metrics, including deviations from lane position, movement of the steering wheel, pressure on the acceleration pedal, etc., are constantly monitored and any change in these that crosses a specified threshold indicates a significantly increased probability that the driver is drowsy.



Behavioural based measures: The behaviour of the driver, including yawning, eye closure, eye blinking, head pose, etc. is monitored through a camera and the driver is alerted if any of these drowsiness symptoms are detected. Physiological based measures: The correlation between physiological signals ECG (Electrocardiogram) and EOG (Electrooculogram). Drowsiness is detected through pulse rate, heart beat and brain information.
Several authors have proposed different approaches for Drowsiness detection system, most of them using ECG, Vehicle Based approaches. A robust real- time embedded platform to monitor the loss of attention of the driver during day and night driving conditions. [5] A drowsiness detection system using both brain and visual activity is presented in this paper. The brain activity is monitored using a single

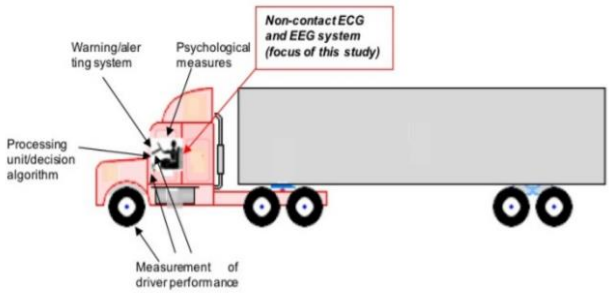
electroencephalographic (EEG) channel.[6] A method to monitor driver safety by analyzing information related to fatigue using two distinct methods: eye movement monitoring and bio-signal processing. A monitoring system is designed in Android-based Smartphone. [7] A support vector machine (SVM) classifies a sequence of video segments into alert or non-alert driving events. Experimental results show that the proposed scheme offers high classification accuracy [8]. The aim of this paper is to maximize the amount of drowsiness-related information extracted from a set of electroencephalogram (EEG), electrooculogram (EOG), and electrocardiogram (ECG) Signals during a simulation driving test.[9] The system is a software prototype of this system in vehicles, where images that are captured will be processed using image processing techniques and accordingly issue warning.[10] A robust eye detection algorithm is introduced to address the problems caused by changes in illumination and driver posture. Six measures are calculated with percentage of eyelid closure, maximum closure duration, and blink frequency, average opening level of the eyes, opening velocity of the eyes, and closing velocity of the eyes.[11]

III. Methodology/Experimental

If car technologies are going to prevent or at least warn of driver fatigue, what symptoms does the driver give off that can be detected? According to research, there are multiple categories of technologies that can detect driver fatigue. The first is the use of cameras to monitor a person's behavior. This includes monitoring their pupils, mouth for yawning, head position, and a variety of other factors. The next of these technologies is voice recognition. Often a person's voice can give off clues on how fatigued they are. The detail explanation of the underlying techniques of drowsiness detection that are mostly used for the detection purpose:

A. ECG and EEG

Many researchers have considered the following physiological signals to detect drowsiness: electrocardiogram (ECG), electroencephalogram (EEG). The heart rate (HR) also varies significantly between the different stages of drowsiness, such as alertness and fatigue. Therefore, heart rate, which can be easily determined by the ECG signal, can also be used to detect drowsiness. Others have measured drowsiness using Heart Rate Variability (HRV), in which the low (LF) and high (HF) frequencies fall in the range of 0.04–0.15 Hz and 0.14–0.4 [12]" Fig.3", shows physiological signal sensing system that can be integrated into vehicles to detect driver drowsiness.



The Electroencephalogram (EEG) is the physiological signal most commonly used to measure drowsiness. The EEG signal has various frequency bands, including the delta band (0.5–4 Hz), which corresponds to sleep activity, the theta band (4–8 Hz), which is related to drowsiness, the alpha band (8–13 Hz), which represents relaxation and creativity, and the beta band (13–25 Hz), which corresponds to alertness . A decrease in the power changes in the alpha frequency band and an increase in the theta frequency band indicates drowsiness.

B. LBP (local binary pattern):

Local binary patterns (LBPs) have aroused increasing interest in image processing and computer vision. As a nonparametric method, LBP summarizes local structures of images efficiently by comparing each pixel with its neighbouring pixels. The most important properties of LBP are its tolerance regarding monotonic illumination changes and its computational simplicity. This technique is mostly used for detecting emotions on the face like, happiness, sadness, excitement etc. LBP (local binary pattern) is used in drowsiness detection for detecting face of the driver, it divides the image into four quadrants then the top and bottom part are detected."Fig.4", shows LBP extract the image from the video then the image is divided into blocks, after that LBP histogram are generated from the each block and feature histograms are formed[14] Figure Shows the LBP technique.

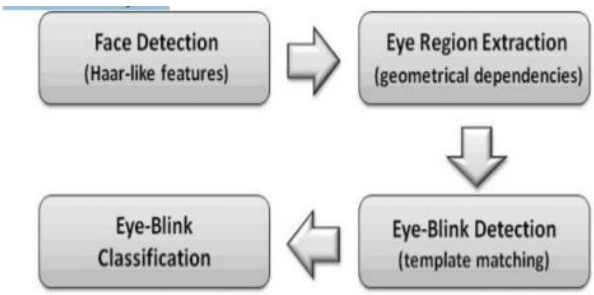
C. *Optical Detection :*

The most common implementation of an optical sensor system uses infrared or near-infrared LEDs to light the driver's pupils, which are then monitored by a camera system. Computer algorithms analyse blink rate and duration to determine drowsiness. The camera system may also monitor facial features and head position for signs of drowsiness, such as yawning and sudden head nods. Depicts the use of an optical detection system [17]

D. *Eye Blinking Based Technique :*

In this eye blinking rate and eye closure duration is measured to detect driver's drowsiness. Because when driver felt sleepy at that time his/her eye blinking and gaze between eyelids are different from normal situations so they easily detect drowsiness."Fig.6", shows the eye blinking based drowsiness detection In this system the position of irises and eye states are monitored through time to estimate eye blinking frequency and eye close duration. [18]. And in this type of system uses a remotely placed camera to acquire video and computer vision methods are then applied to

sequentially localize face, eyes and eyelids positions to measure ratio of closure.[19] Using these eyes closer and blinking ration one can detect drowsiness of driver. Such a system, mounted in a discreet corner of the car, could monitor for any signs of the head tilting, the eyes drooping, or the mouth yawning simultaneously. The following figure shows the eye blink detection.



E. *Yawning Based Technique Detection of drives'*
drowsiness based on yawning measurement. This involves several steps including the real time detection and tracking of driver's face, detection and tracking of the mouth contour and the detection "Fig.7", shows of yawning based on measuring both the rate and the amount of changes in the mouth contour area. APEX™ automotive smart camera platform developed by Connive Corp. In our approach, the driver's face is continuously captured using a video camera that is installed under the front mirror inside the car, as shown in "Fig.8", Next, detecting drowsiness involves two main steps to properly measure changes in facial gestures that imply drowsiness.
First, the driver's face is detected and tracked in the series of frame shots taken by the camera. After locating the driver's face, the next step is to detect and track the location of the mouth. We have chosen to detect and track the face prior to tracking the mouth as this makes the mouth tracking procedure more robust against false detections. After detection of the mouth, the yawning state is detected based on measuring the rate of changes in the area of the mouth contour and the aspect ratio of mouth area [22].
F. *Head Nodding Detection:*
Another method currently use is the Head Position Detection. This technology simply determines the head tilt angle. When the head angle goes beyond a certain angle, an audio alarm is transmitted in the driver's ear.

IV. Results and Discussions

The function of code area is to implement correct algorithm for finding whether the eye is open or closed and give the corresponding signal if eye is closed or open. It consists of the determination of eye position or the state of eyes followed by the removal of noise factors of the picture by implementing image processing functions and finally judges the drowsiness of the driver.

The state of the eyes (whether it is open or closed) is determined by distance between the first two intensity changes found in the above step. When the eyes are closed, the distance between the y – coordinates of the intensity changes are larger if compared to when the eyes are open. Criteria for judging the alertness level on the basis of eye closure count is based on the amount of intensity levels of the image. The binaries values are thoroughly analyzed and synthesized by the algorithm and detected if the driver eye caught in the image is an open eye or closed eye. Thus, if the eye is open the hardware produces no effect but when the driver's closed eye is detected the corresponding signal goes high producing an alarm which wakes up the driver.

V. Limitations

- There is difficulty in recognizing eyes pattern during night.
- EEG determination is difficult in this case.

VI. Future Scope

This technology is still in the early research stage of development. Based on the work completed thus far, researchers at GWU have identified and recommended the following areas for further research:
• Capture individual driver's steering activity while drowsy, • Conduct additional simulator experiments to validate the algorithm, test additional road conditions, and test a more diversified group of drivers, • Test the ANN technology on the road in an instrumented vehicle, and refine the Algorithm based on the road test data, and Conduct research on warning systems integrated with the detection system. • In future work, we will incorporate motion capture and EEG facilities to our experimental setup. The motion capture system will enable analyzing the upper torso movements. In addition, the EEG will provide a ground-truth for drowsiness.

VII. Conclusion

As described throughout the paper, many technologies exist to detect driver fatigue. This paper tries to look at the emerging technologies and determine the best approaches in trying to prevent the number one cause of fatal vehicle crashes. Currently, the number one selling product in the market is the market is nothing more than a reed switch to detect head angle tilt. This product is extremely limited and not very effective. The product made by BMW and integrated into their high-end cars to detect driver fatigue behavior is slightly more effective is detection but lack proper notification to warn a driver. The current market and technologies are in its infancy mode. New technologies keep emerging using different techniques.

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