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[Gupta, 6(5): May 2019] ISSN 2348 – 8034
DOI- 10.5281/zenodo.3253195 Impact Factor- 5.070

GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

Drowsiness Monitoring System Using Machine Learning

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ABSTRACT

The research consists of the software and the hardware modules. The main idea behind this research is to develop a non-intrusive system which can detect fatigue of driver and issue a timely warning. Since large number of road accidents are caused by driver drowsiness. Hence, this system will be helpful in preventing many accidents, and consequently save money and reduce personal suffering. Most of the conventional methods are either vehicle based, or behavioral based or physiological based. Few methods are intrusive and distract the driver, some require expensive sensors and data handling. Therefore, in this study, a low cost, real time driver's drowsiness detection system is developed with acceptable accuracy.

Keywords: *Drowsiness, machine learning, sensors, SVM ,etc.*

1. INTRODUCTION

Drowsiness is defined as a decreased level of awareness portrayed by sleepiness and trouble in staying alarm, but the person awakes with simple excitement by stimuli. It might be caused by an absence of rest, medicine, substance misuse, or a cerebral issue. It is mostly the result of fatigue which can be both mental and physical. Physical fatigue, or muscle weariness, is the temporary physical failure of a muscle to perform ideally. Mental fatigue is a temporary failure to keep up ideal psychological execution. The onset of mental exhaustion amid any intellectual action is progressive, and relies on an individual's psychological capacity, furthermore upon different elements, for example, lack of sleep and general well-being. Mental exhaustion has additionally been appeared to diminish physical performance. It can show as sleepiness, dormancy, or coordinated consideration weakness [1]. In the past years according to available data driver sleepiness has gotten to be one of the real reasons for street mishaps prompting demise and extreme physical injuries and loss of economy. A driver who falls asleep is in an edge of losing control over the vehicle prompting crash with other vehicle or stationary bodies [2]. Keeping in mind to stop or reduce the number of accidents to a great extent the condition of sleepiness of the driver should be observed continuously. Drowsy driving is one of the major causes of deaths occurring in road accidents. Driver drowsiness is an overcast nightmare to passengers in every country. Every year, a large number of injuries and deaths occur due to fatigue related road accidents.

2. RELATED WORK

The study states that the reason for a mishap can be categorized as one of the accompanying primary classes: Human, Vehicular and surrounding factor. The driver's error represented 91% of the accidents. The other two classes of causative elements were referred to as 4% for the type of vehicle used and 5% for surrounding factors. Several measures are available for the measurement of drowsiness which includes the following:

2.1 Vehicle based measures: It monitors the vehicle's position as it identifies with path markings, to determine driver weakness, and accumulate steering wheel movement information to characterize the fatigue from low level to high level. In many research projects, researchers have used this method to detect fatigue, highlighting the continuous nature of this non-intrusive and cost-effective monitoring technique [3]. This is done by:

- Sudden deviation of vehicle from lane position.
- Sudden movement of steering wheels.
- Pressure on acceleration paddles.

For each measure's threshold values are decided which when crossed indicated that driver is drowsy.

2.2 Physiological measures: Physiological measures are the objective measures of the physical changes that occur in our body because of fatigue [4]. These physiological changes can be simply measure by their respective instruments:

ISSN 2348 – 8034
Impact Factor- 5.070

- ECG (electro-cardiogram)
- EMG (electromyogram)
- EOG (electro-oscillogram)
- EEG (electroencephalogram)

2.3 Monitoring Heart Rate: An ECG sensor can be installed in the steering wheel of a car to monitor a driver's pulse, which gives a sign of the driver's level of fatigue indirectly giving the state of drowsiness. Additionally, the ECG sensor can be introduced in the back of the seat.
Monitoring Brain Waves: Special caps embedded with electrodes measures the brain waves to identify fatigue in drivers and report results in real time [5]. Then each brain waves can be classified accordingly to identify drowsiness.

2.4 Monitoring muscle fatigue: As muscle fatigue is directly related to drowsiness. As known during fatigue the pressure on the steering wheel reduces and response of several muscle drastically reduces hence it can be measured by installation of pressure sensors at steering wheel or by measuring the muscle response with applied stimuli to detect the fatigue [6].

2.5 Monitoring eye movements: Invasive measurement of eye movement and eye closure can be done by using electro oscillogram, but it will be very uncomfortable for the driver to deal with it [7].

Though this method gives the most accurate results regarding drowsiness. But it requires placement of several electrodes to be placed on head, chest and face which is not at all a convenient and annoying for a driver. Also, they need to be very carefully placed on respective places for perfect result.

3. PROPOSED WORK

Driving in fatigue not only affects those who are driving while drowsy, but it puts all other road users in danger as well. Therefore, behavioral measures use new technologies to design systems, which can monitor driver's level of vigilance through the whole driving process. Fortunately, people in fatigue exhibit many visual characteristics. Taking advantage of these visual characteristics, computer vision is the viable and felicitous technology to deal with this problem.

This research presents a fatigue detection system that detects fatigue by analyzing the status of driver's eyes and yawning. Certain behavioral changes take place during drowsing like

1. Yawning
2. Eye blinking frequency
3. Eye gaze moments
4. Head movements
5. Facial expressions

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4. DESIGNING & MODELING

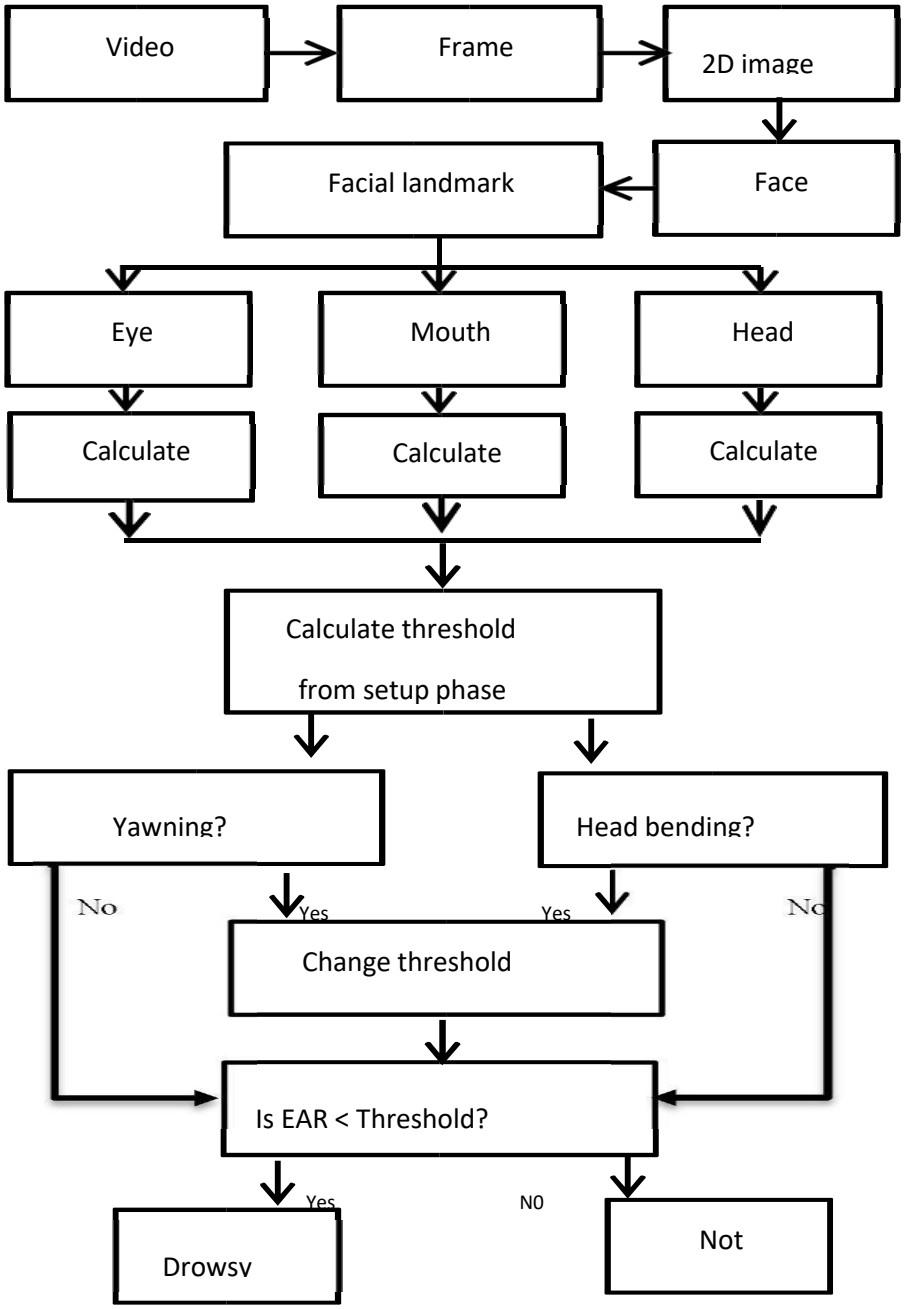

Figure 4.1: The block diagram of the proposed drowsiness detection system

At first, the video is recorded using a webcam. The camera will be positioned in front of the driver to capture the front face image. From the video, the frames are extracted to obtain 2-D images. Face is detected in the frames using histogram of oriented gradients (HOG) and linear support vector machine (SVM) for object detection.

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5. IMPLEMENTATION & RESULTS

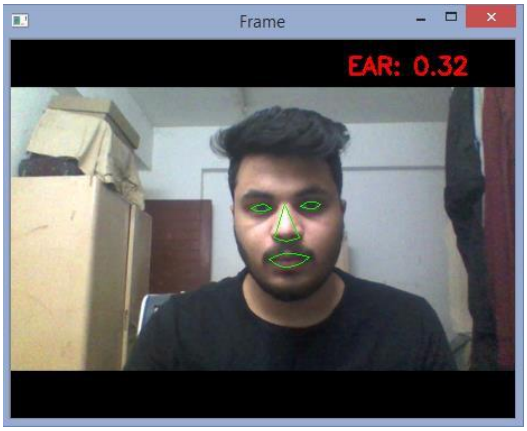

Figure 5.1: Before Yawning

Figure 5.2: After Yawning

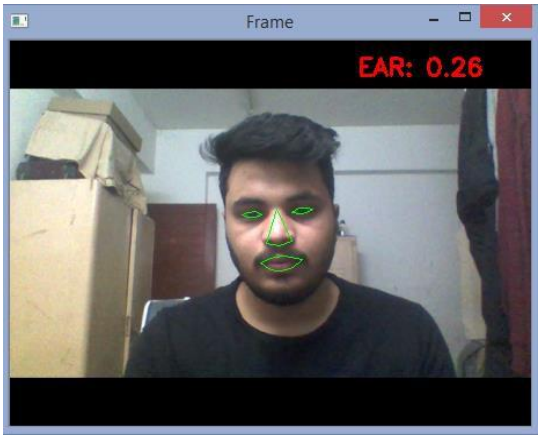

Figure 5.3 : Before Head bending

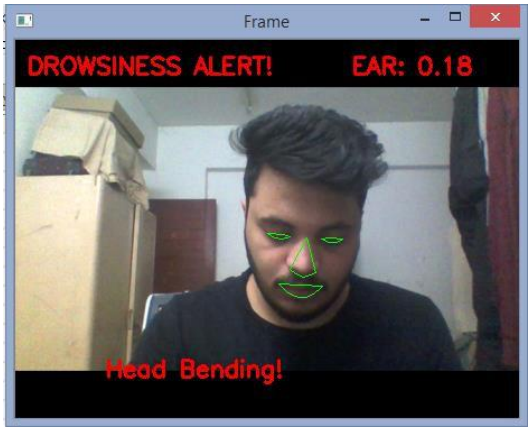

Figure 5.4 : After Head bending

To obtain the results three subjects were taken and their accuracy in determining eye blinks, yawning, head bending, and drowsiness was tested. For this project we used the webcam connected to the computer. The webcam had inbuilt white LEDs attached to it for providing better illumination. In real time scenario, infrared LEDs should be used instead of white LEDs so that the system is non-intrusive.

The system was tested for different people in different ambient lighting conditions (daytime and night-time). When the webcam backlight was turned ON and the face is kept at an optimum distance, then the system can detect blinks as well as drowsiness with more than 95% accuracy. This is a good result and can be implemented in real-time systems as well.

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6. CONCLUSION

This study achieves a design and development of a driver drowsiness monitoring system for the advanced driver security which detects driver drowsiness in seconds. A low cost, real time driver drowsiness monitoring system has been developed based on visual behavior and machine learning. Here, visual behavior features like eye aspect ratio, mouth opening ratio and nose length ratio are computed from the streaming video, captured by a webcam. Adaptive thresholding technique has been developed to detect driver drowsiness in real time. The developed system works accurately with the generated synthetic data. Subsequently, the feature values are stored, and machine learning algorithms have been used for classification.

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