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Drowsiness Detection System: A Literature Review

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Abstract

Road crashes are a top killer globally.As per many research and studies approximately 1.25 million deaths are calculated per year due to automobile accidents. From over all road accidents around 25% of accidents are caused due to drowsiness or feeling weakness of the driver. Drivers needs to be most attentive and active while driving any vehicle, drivers are very crucial person and any single mistake made by them can lead to a life of person in passenger seat or the driver himself. In our project we have gone through multiple research papers to know what type of project are already in the market and what are the ratios calculated for the deaths occurred by drowsiness in road accidents. We are developing a model which can help to reduce the road accidents caused due to drowsiness by alerting the driver, will make students more attentive in their online lectures and make an employee more productive. Our model is designed as using AI and OpenCV technology, it will detect the coordinates of eyes and as per the time till when they are closed it will alert the driver by alarming system through which they can stop driving and take rest to avoid any mishap. We can use our model not only for driver safety but also, we can use for online lectures and to keep student attentive during lectures.

Key Words: Drowsiness, Fatigue, AI, alarming system, OpenCV

1. INTRODUCTION

India is one of the countries where traffic accidents are responsible for an alarmingly high number of deaths. Not only are there casualties, but a large number of individuals are critically injured in traffic accidents every year, and many of these people become handicapped. According to a World Bank report, traffic accidents killed 13 lakh people in the last decade and injured another 50 lakh people in the country. Road crashes and related kinds of accidents are a standard reason for injury and death among the human population. As per 2015 data from WHO, approximately 1.25 million individuals died as a result of traffic accidents around the world, which means that a fatal crash occurs every 25 seconds. In terms of vehicular pollution, India has only 1% of the world's total automobiles, yet it accounts for 11% of all global deaths due to road accidents, the highest rate in the world. Every year, over 4.5 lakh traffic accidents occur in India, claiming the lives of approximately 1.5 lakh people. This means that every hour, roughly 53 traffic accidents occur in the country, with one person dying every four minutes.

According to NDTV Research 377 people die every day, equivalent to a jumbo jet crashing every day in India due to Road Accidents. Out of which around 40 percent of the Road Accident happens due to drivers dozing off the wheel as a study by the Central Road Research Institute states. Our focus in this project is to minimize that above mentioned 40 percent Accidents by our system. Drowsiness in drivers is a critical hazard and a big problem, and it has been identified as a direct or contributing cause in the majority of road accidents.

While there is no perfect measurement of drowsy driving, studies show that it is alarmingly widespread. 60 percent of adult drivers reported to driving when fatigued in the previous years, according to the National Sleep Foundation's Sleep in America Poll. According to the CDC, one out of every 25 Americans fell asleep behind the wheel. The causes of drowsiness or sleeping behind the wheels can be Sleep Deprivation, intake of Alcohol, sleeping disorders or Insomnia, if person is on medications, if person is driving at night, having long working hours, having rotational or irregular shifts, or may be the person have night shift or late-night parties.

Drowsiness is a complex phenomenon characterised by a reduction in the driver's alertness and consciousness. Although there is no direct way to detect drowsiness, there are various indirect approaches that can be applied. Our Drowsiness detection is a safety module which will help in prevention of accidents caused by any of the above mentioned reasons. Our system will alert the driver if he/she has eyes closed for some particular time threshold. Once the threshold is breached our system will start beeping the alarm to make driver alert to take break.

Objectives

The main objectives of drowsiness detection are:

- To detect eyes coordinates on one's face.
- To alert driver, student, employee etc if they are drowsy.
- To reduce number of road accidents caused due to fatigue.

- To make students more attentive in online lectures.
- To make an employee more productive during working from home.

2. REVIEW OF LITERATURE

Drowsy driving is one of the common causes of fatalities in car accidents. Truck drivers that travel for lengthy periods of time (especially at night), long-distance bus drivers, and overnight bus drivers are more vulnerable to this condition. Passengers in every country face the nightmare of drowsy drivers. Fatigue-related traffic accidents result in a substantial number of injuries and deaths each year. As a result, due to its wide practical application, detecting and indicating driver drowsiness is a hot topic of research. In general, there are three sorts of approaches for detecting drowsy drivers: vehicle-based, behavioural-based, and physiological based. A number of parameters such as steering wheel movement, accelerator or brake pattern,6 vehicle speed, lateral acceleration, deviations from lane position, and so on are continuously monitored in the vehicle-based method. Driver drowsiness is defined as the detection of any abnormal change in these parameters. Non-intrusive driver tiredness detection uses cameras to analyze behaviors like blinking, yawning, and head movement.[1].

As per study in 2004 the findings of study demonstrate that, like with automobile incidents, the risk of a TWMV driver causing a collision is substantially impacted by various individual factors. When speeding violations were taken into account as a driver-dependent risk factor, our findings revealed that driving at an improperspeed for the road or traffic conditions was the strongest predictor of the probability of causing an accident for both mopeds and motorcycles. There was also a significant link between excessive speed and the chance of causing a collision, but to a smaller amount. The disparity in estimates for the two primary categories of speed-related offences is understandable, as excess speed refers to exceeding the legal speed limit, which moped and motorbike drivers, to a lesser extent, rarely do [2].

Several factors, including the drivers' age, marital status, annual mileage, number of daily trips, and ordinary and aggressive infractions, were found to impact accident involvement in the study[3].

Image processing, EEG, vehicular, and voice metrics are among the approaches used in the system. Any of these approaches isn't guaranteed to yield 100 percent outcomes. EEG- based techniques yield the best results, but they're also the most obtrusive. Other procedures, however, have limits that prevent them from producing faultless outcomes[4].

As per neural network based technique it is concluded that according to the circumstances, several strategies will be appropriate. Although EEG-based approaches are effective, wearing electrodes while driving is not practical. The technique based on Artificial Neural Networks is straightforward, however if you want a better outcome, 3 neurons are the best option. One of the most popular methods used by researchers is image processing. These are the methods. These methods are far more straightforward and user-friendly. This is complicated by the driver's spectacles, although research is underway to minimise this disadvantage. As a result, employing Image Processing to detect tiredness has a lot of potential[5].

Eye blink detection is used to investigate the loss of attention of vehicle drivers in this article. The use of facial landmark detection to detect the presence of an eye is investigated. After that, Eye Aspect Ratio is used to identify eye blink. The driver's weariness is determined by comparing the time of eye closure to a specific timeframe. To identify drowsiness, the total number of eye blinks in a minute is counted. Driver's blink rate is monitored and compared to an alert baseline. If any of the requirements listed above are met, the system determines that the driver is unconscious. The light source was placed front, back, and side for a total of 120 samples. For each location of the light source, 40 samples were taken. When the light source was reinstalled with a 15% error rate, the maximum error rate was achieved. The best case scenario had a 7.5 percent mistake rate when the light source was located in the front. Depending on the position of the light source, the eye blinking process resulted in an average inaccuracy of 11.67 percent. A total of 120 samples were gathered at various times throughout the day in order to calculate total eye blinks per minute. Drivers blink most in the morning (5.78 blinks/minute) and least at midnight was 3.33 percent. The device worked well and accurately replicated the eye blink pattern 92.7 percent of the time[6].

This research develops a low cost, real-time driver sleepiness detection system with satisfactory accuracy. A webcam recordsthe video in the created system, and image processing algorithms are used to detect the driver'sface in each frame. Facial landmarks on the identified face are pointed, and the eye aspect ratio,mouth opening ratio, and nose length ratio are computed, and tiredness is recognised using established adaptive thresholding based on their values. Offline implementations of machine learning algorithms have also been made. Support Vector Machine-based classification has a sensitivity of 95.58 percent and a specificity of 100 percent [7].

Based on data of steering wheel angles (SWA) obtained from sensors positioned on the steering lever, this research proposes a sleepiness on-line detection system for monitoring driver fatigue level under real-world driving scenarios. On real-time steering wheel angles time series, the proposed approach extracts approximate entropy (ApEn) features from fixed sliding windows. After that, this method uses an adaptive piecewise linear fitting with a given deviation to linearize the ApEn features series. The detecting

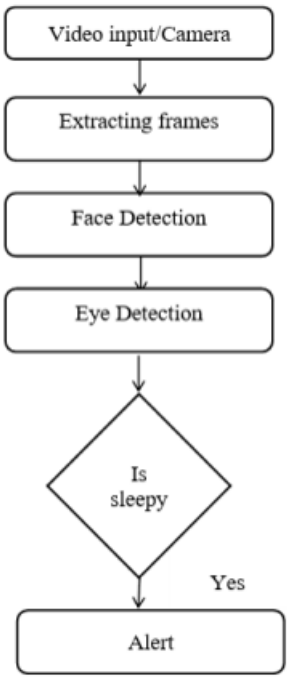
system then determines the warping distance between the sample data's linear features series. Finally, according to a predefined binary decision classifier, this system employs the warping distance to assess the driver's drowsy status. The experimental data was gathered over the course of 14.68 hours of driving under real-world situations, with two levels of fatigue: "wake" and "drowsy." The results reveal that the suggested system can work online with an average accuracy of 78.01 percent, with 29.35 percent erroneous "awake" state detections and 15.15 percent false "drowsy" state detections. The findings also show that the proposed SWA signal-based strategy is useful for avoiding traffic accidents caused by driver weariness [8].

Table 1: LITERATURE REVIEW SUMMARY

Sr. No.	Title	Algorithm and Methods	Description and Results
[1]	Drowsy Driver Detection	Visual behavior and machine learning	In this paper, a low cost, real time driver drowsiness monitoring system has been proposed based on visual behavior and machine learning.
[2]	Driver dependent factors and the risk of causing a collision for two wheeled motor vehicles	Quasi-induced exposure method	It should be noted that single vehicle crashes represent only 17% of all crashes involving mopeds and 28% of all crashes involving motorcycles. On the other hand, CC represent 78% of all collisions involving TWMVs in the Spanish registry of traffic crashes.
[3]	Aberrant Driving Behaviour, Risk Involvement, and Their Related Factors Among Taxi Drivers	Sampling method	The authors found the positive influence of young age on the higher accident involvement of truck drivers.Single drivers are more likely to be involved in an accident and receive traffic tickets.
[4]	A Survey Paper On Drowsiness Detection & Alarm System for Drivers	Image Processing based techniques	We can combine some image processing approaches with some vehicular measures and physiological measures. Heart rate and respiration rates can be a good example of physiological measures which are clear indicators of drowsiness.
[5]	A Survey on Driver's Drowsiness Detection Techniques	Artificial vision techniques.	Study suggests smartphone cameras with AI can effectively monitor driver drowsiness.
[6]	A Study on Tiredness Assessment by Using Eye Blink Detection	Eye blink detection	A major concern of this paper is to build an automatic system that can detect consciousness of the driver. It can be developed using a simple human-computer interaction using a single camera.
[7]	A SIMPLE SYSTEM FOR MONITOR OF DRIVER DROWSINESS BASED MACHINE LEARNING	Deep CNN (Convolution Neural Network)	We seek and detect faces in individual frames in the given photos. Region of interest will be marked within face if a it is detected. Then, eyes are checked from the region of interest and if eyes are detected and there is no blink then counter will be decremented and a buzzer will sound when it will reach 0.
[8]	Online Detection of Driver Fatigue Using Steering Wheel Angles for Real Driving Conditions	Steering Wheel Angles (SWA) fatigue detection	The drowsiness detection system achieved decent accuracy (78%) but has room for improvement. It identified some alert drivers as drowsy (29.35%) and missed some drowsy drivers (15.15%).

3 . METHODOLOGY

General Architecture of Drowsiness Detection System.



Process description

1.Video Input**:** The system receives video input, likely from a webcam pointed at the driver.

2.Extracting Frames: The first step involves extracting individual frames from the video stream.

3.Face Detection: Each frame is then analyzed to detect the presence of a face.

4.Eye Detection**:** If a face is found, the system focuses on the facial region and attempts to locate the driver's eyes.

5.Drowsiness Decision: Based on features extracted from the eyes (not specified in the image), the system determines if the driver is drowsy or not.

- **Yes:** If drowsiness is detected, the system likely triggers an alert (not shown in the flowchart).
- **No:** If drowsiness isn't detected, the system presumably continues processing the next video frame (loops back to step 2).

4 CONCLUSION

Combining computer vision and machine learning through tools like dlib and OpenCV allows us to create drowsiness detection systems. These systems have great potential. The ability to prevent accidents and save lives makes this technology highly desirable across many fields, including transportation and healthcare. With ongoing advancements, drowsiness detection systems will become more intricate, reliable, and efficient. This will lead to safer environments on the road and at work.

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