Real Time Driver Drowsiness Detection System

Research Paper submitted in partial fulfilment of the requirements for the award of the degree of

Bachelor of Technology

in

Computer Science and Engineering

by

Ajit Sharma (191500067)

Anuj Singh (191500138)

Sushant Gautam (191500833)

Vipul Kumar (181500802)

Under the Guidance of

Dr. Rakesh Kumar

(Assistant Professor)

Department of Computer Engineering & Applications

Institute of Engineering & Technology

Abstract:

Driver sleepiness is the primary cause of car accidents. In this work, a surveillance system designed to spot and warn tiredness in a driver is demonstrated. The Human Computer Interaction System is implemented utilising a small computer that resembles a smartphone and runs the Android operating system. The behaviour of the eyes, the lateral and frontal ascent of the head, and the yawn are the most important visual signs that indicate the driver's condition for sleepiness detection. Notwithstanding the usage of driver accoutrements like glasses, hearing aids, or hats, the system functions satisfactorily in environments with natural lighting. This concept aims to avoid accidents caused by driver fatigue in advance by offering a simple, non-invasive method without the need to buy a separate equipment. 93.37% of drowsiness is detected using this technique

.**Keywords:** Drowsiness Detection, Artificial Vision, PERCLOS, Face Detection.

Introduction:

One of a person's essential needs is sleep. When a person doesn't get enough sleep, their body reacts inefficiently, decreasing their wakefulness and reaction time. They also experience poor attentiveness and lose focus, which makes it harder to execute activities requiring care, like driving a car. Drowsiness is linked to thousands of traffic accidents annually, which, according to numerous studies, account for 50% of fatalities or serious injuries [1]. These collisions usually involve high-speed impacts because a driver who has fallen asleep is unable to brake or veer away from the collision to avoid it or lessen its impact. Drowsiness detection devices have been created by manufacturers to prevent these collisions by detecting potential sleepiness and warning the driver of their state. A smartphone-based driver safety monitoring system that uses data fusion is described in the study.

Using a data fusion strategy, Lee and Chung suggest a method to track driver safety levels utilising factors including ocular features, variations in biological signals, interior car temperature, and vehicle speed. This system is designed as an Android-based smartphone application, where measuring security-related data does not call for additional expenses or equipment. The technology is 96% effective at determining if the driver is awake and 97% effective at determining whether he is asleep. This knowledge enables recognising the symptoms of a tired driverIn the study, "Detection of Fatigue Using Smartphone," the goal is to use an Android or iOS smartphone to identify driver weariness. Roberson and others take pictures of the driver using the smartphone's front camera, and then they apply sophisticated computer vision algorithms to identify his face and eyes. There are signs of head rotation, head tilting, and eye blinking, is indicators of fatigue. The smartphone is utilised to help drivers by employing the front and rear cameras for drowsy driving detection systems, wavelet analysis of heart rate variability, a support vector machine classifier, and for identification of hazardous driving conditions. The "Eye tracking based driver tiredness monitoring and warning system" uses the PERCLOS (Percent of the time Eyelids are CLOSED) metrics to quantify sleepiness. The vehicle steering wheel variability is taken into consideration to evaluate the amount of sleepiness by the system since drivers increase steering wheel variability as they grow more sleepy. The system calculates drowsiness using a non-parametric methods. The PERCLOS metrics for alerting drivers are used to monitor and alert the driver, to identify tiredness in large vehicles, for line departure warnings, and to monitor and alert the driver. One of a person's essential needs is sleep. Without enough sleep, the body reacts slowly, diminishing both awareness and reaction time. It also results in low alertness and concentration problems, which make it harder to do activities requiring care, like driving a car. Drowsiness is linked to hundreds of traffic accidents annually, according to numerous studies. Since the driver who has fallen asleep cannot brake or deviate to avoid or reduce collision, the accidents typically involve impacts at high speeds, which accounts for about 50% of fatalities or major injuries. Manufacturers have created devices that identify indicators of potential drowsiness and warn drivers of their status in order to reduce these incidents.

In the study: "a data-fusion powered driver safety monitoring system based on smartphones. Sensors "Using a data fusion approach, Lee and Chung suggest a method to monitor driver safety levels utilising factors like: ocular characteristics, variations in biological signals, interior car temperature, and vehicle speed. This system is designed as an Android-based smartphone application, where measuring security-related data does not call for additional expenses or equipment. The technology is 96% effective at determining if the driver is awake and 97% effective at determining whether he is asleep. This knowledge enables recognising the symptoms of a tired driver. In the study, "Detection of Fatigue Using Smartphone," the goal is to use an Android or iOS smartphone to identify driver weariness. Roberson and others take pictures of the driver using the smartphone's front camera, and then they apply sophisticated computer vision algorithms to identify his face and eyes. The head turning, tilting, and eye blinking are recognised as signs of weariness. The smartphone is utilised to aid drivers by using front and rear cameras for drowsy driving detection systems, a support vector machine classifier, wavelet analysis of heart rate variability, and for the identification of hazardous driving conditions. In the paper "Eye tracking based driver tiredness monitoring and warning system," drowsiness is measured using the PERCLOS (Percent of the time Eyelids are CLOSED) metrics. The vehicle steering wheel variability is taken into consideration to evaluate the amount of tiredness by the system since drivers increase steering wheel variability as they grow more sleepy. The PERCLOS driver warning metric is used to offer lane departure warnings, monitor and alert drivers, and identify driver fatigue in large trucks.

Related Work:

Mkhuseli Ngxande proposed this system. To assess behaviours like blinking, yawning, and head movements, machine learning techniques including support vector machines, convolutional neural networks, and hidden Markov models are used. The outcomes are tabulated after applying each of the three machine learning techniques. Although expensive, support vector machine methods provide accuracy that is comparable to support vector machines but are more expensive than hidden markov models. The convolutional neural network approach offers high accuracy at a reasonable price. They also provided a list of accessible data sources for sleepiness detection techniques. Another strategy used by Ashish Kumar takes into account facial features including the eyes, mouth, and nose. Use a histogram of directional gradients and a linear support vector machine to detect faces. The 2D image frames that were taken from the video are then subjected to a detection algorithm. Fiducials are presented on facial landmarks when they are identified. Extraction of features is used for classification. Compute the mouth opening ratio, eye aspect ratio, and nose length ratio (NLR) (MOR). The driver is labelled as drowsy if the value of this parameter is higher than the threshold. Using created system data, the system produces precise outcomes. Numerous researchers have used machine learning to create drowsiness detection systems by studying visual behaviours.

Additional systems under development include vehicle parts or bio-signaling apparatuses without any joint usage of machine learning methods. Several machine learning techniques have been utilised, including the Bayesian classifier, Support Vector Machine (SVM), Hidden Markov Model (HMM), and Convolutional Neural Network (CNN). Each technique provides decent precision. The methods support vector machine, hidden markov model, and bayesian classifier cost more to train than convolutional neural networks, yet they all provide good accuracy for many facial traits. The cost and computing needs rise as the model gets bigger.

The Proposed System:

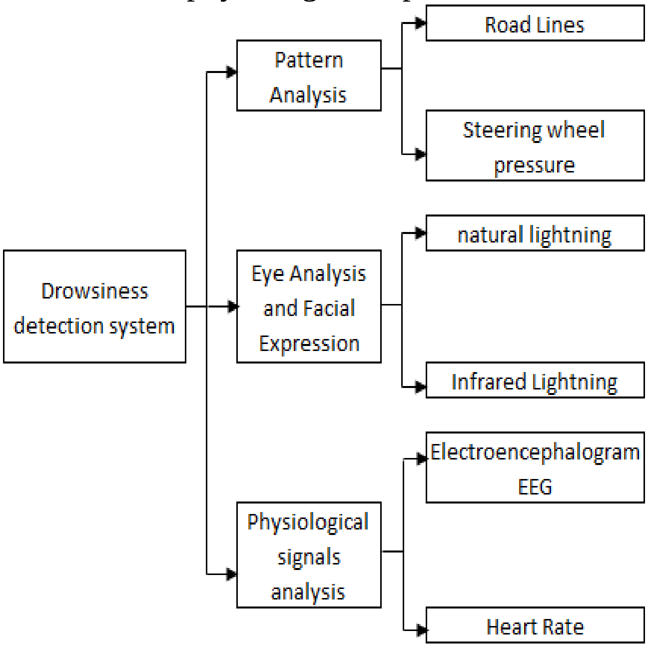
The two primary categories of detection techniques are techniques based on driving condition and techniques based on driver performance. The two main categories of driver state-based approaches are those that use physiological signals and those that use artificial vision. with figs. The classification of sleepiness detection techniques is shown in Figure 1.

Fig. 1. Drowsiness detection methods.

Pattern analysis is used to detect drowsiness and is based on empirically determined factors. Speed, acceleration, braking, gear changes, hand pressure on the steering wheel, and the car's trajectory inside its lane are a few examples of these variables. This method's drawback is that the simulation is reliant on the characteristics of each car and each driver's driving habits. The status of the driver can be checked via image processing. With the face image, you can tell whether the driver is awake or sleepy. The fact that the motorist is attempting to close his eyes indicates that he is drowsy. This technique can be utilised with techniques like the template pairing technique, where a driver template is established, and has the benefit of not being obtrusive. In order to calculate the rate of drowsiness, the technique of eye behaviour measures how frequently the eyes blink and how long they remain closed. PERCLOS (Percent of the time Eyelids are CLOSED), which counts the percentage of time a person's eyes are closed at 80% to 100% in a period, is one of the most popular indexes to quantify the amount of sleepiness. For automobile sleepiness detection systems, PERCLOS is one of the most crucial real-time alert measures, according to a study by Walter Wierwille and their colleagues..

PERCLOSE = (time with eyes closed / (time with eyes closed + time with eyes open))*100.

The method of yawning is based on the driver's rate of yawning. The driver's mouth opens further when yawning than it does during normal talking. The sleepiness index is calculated by counting the number of yawns the driver makes and comparing them to a reference point that the programmer experimentally determined. Analyses of drowsiness based on alterations in physiological parameters employ sensors that evaluate physiological aspects of the



body. These factors include blood pressure, respiration, peripheral skin temperature, heart rate, brain activity, and heart rate variability. This section discusses various system implementation considerations, such as the functional requirements and the methods and devices chosen for system testing in various study scenarios. The algorithm in use converts the image's colour information to grayscale after processing it. The image is separated into subregions, with each subregion being evaluated to see if it contains a face or not. By using this approach, processing only the subregions that include faces is sped up. The residual error that is estimated using a linear combination of facial movement models is used to determine the gesture. Similar models are thought to control the position and tilt of the face. It has a mechanism for detecting facial motions while the head moves. in Fig. 2 shows the block diagram of the system. The technique is implemented using code that takes into account the limits of mobile devices, including usage scenarios, slow or unreliable hardware, and interfaces with limited content or capability. The way Android is created and optimised by the business that controls it determines how well a feature works.

Fig. 2. General scheme of the drowsiness detection system.

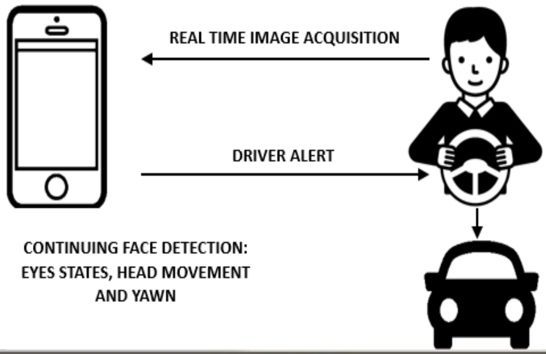


Figure 5 shows the system's user interface and the detection system that are used to display information about the driver's status, which is important for research purposes. Also, there are indicators that reveal whether the driver is looking at the interface or not, such as open eyes, a left or right face tilt, a left or right distraction, and the presence of a yawn. Technical details on the system's operating characteristics are also offered, however the user doesn't necessarily need to know them. 20 drivers of all ages, 10 men and 10 women, were used to test the system. accompanied by a "co-pilot" who was in charge of controlling the controlled occurrences of tiredness only when the road and the area around the car were safe.

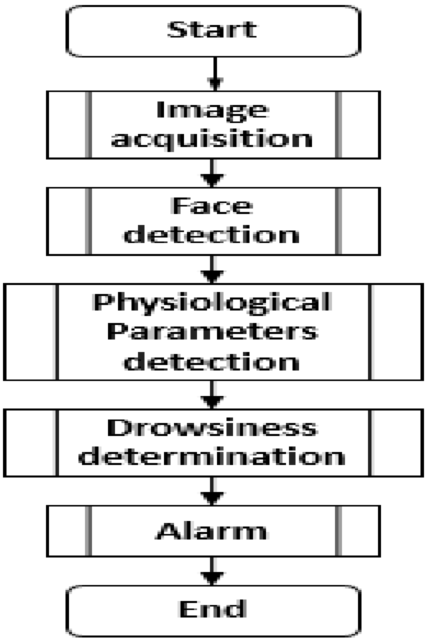


Fig. 3. Drowsiness detection methods.

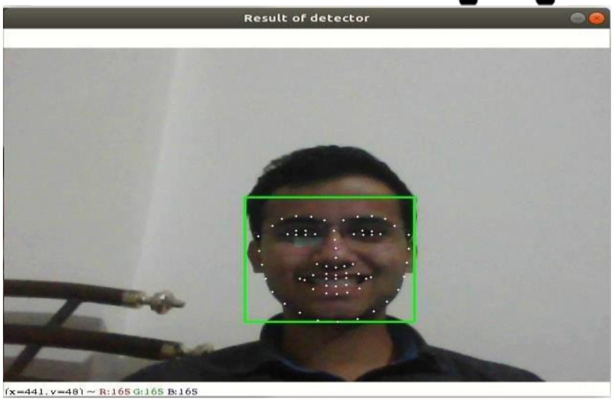


Fig.5 System User Interface

Figure.5 shows the system's user interface and the detection system that are used to display information about the driver's status, which is important for research purposes. Also, there are indicators that reveal whether the driver is looking at the interface or not, such as open eyes, a left or right face tilt, a left or right distraction, and the presence of a yawn. Technical details on the system's operating characteristics are also offered, however the user doesn't necessarily need to know them.

20 drivers, 10 men and 10 women of various ages, participated in the system tests. Each driver was accompanied by a "co-pilot" who was

in responsibility of controlling the regulated events of sleepiness only when the external conditions on the road and in the vicinity of the car were safe.

Results:

This section presents the results of detecting visual indicators of drowsiness. Gatheringa data set to adequately evaluate the system is difficult because there is no guarantee that dangerous sleep events will occur during daily driving for application testing.

Test	Number of observations	Number of hits	Percentageof hits
Yawn detection	170	143	84.11 %
Front nodding	200	184	92.0 %
Assent of the head to the right	200	190	95.0 %
Assent of the head to the left	200	191	95,5 %
Distraction to the right	200	184	92.0 %
Distraction to the left	200	193	96.5 %
Blink detection	200	197	98.5 %

Table 2 presents the results obtained when a hat and glasses were added to the driver'sclothing. The average hit rate is 88.5%.

Test	Number of observations	Number of hits	Percentage of hits
Hair covering driver’s face	70	65	92.8 %
Hair not covering driver´s face	70	49	70.0 %

Table 3. Detection levels for different drowsiness parameter considering the hair covering face.

Table 3 presents the results obtained when considering the hair covering the driver's face.The driver was a woman and the average hit rate was 81.4%.
The results presented represent a much higher level of system performance than the othersystems mentioned in this article. A low level of accuracy occurs when users include elements that do not correctly identify facial gestures, but the level is satisfactory nonetheless.

Table 1 shows the drowsiness detection results considering the normal operation of the system and sent to the address issued by the co-pilot, who received responses from eachdriver and recorded the results. Total hit rate on detection is 93.37% on average.

Test	Number of observations	Number of hits	Percentage of hits
Driver with a cab	1400	1295	92.5 %
Driver with glasses	1400	1183	85.5 %

Table 1. Detection levels for drowsiness parameter under normal conditions.

Conclusions:

Face, eyes, and mouth characteristics were recognised in certain driving footage in order to detect driver tiredness. To categorise eyes as open or closed, a convolutional neural network was used. The frequency of eye closure was used to gauge sleepiness. Using Python's OpenCV and Dlib, yawn ratios were studied. When discovered, alarms have been set to notify the driver.
Due to things like darkness, light reflection, objects in the driver's hand, and sunglasses, the driver's emotional state and ability to communicate themselves may be limited. Face extraction is frequently used with other methods of face extraction because the Convolutional Neural System performs better and is a companion sleepiness detection approach.

References

1. Ashish Kumar, Rusha Patra, “Driver Drowsiness Monitoring System usingVisual Behaviour and Machine Learning”, IEEE Conference, 2018.

2. Kyong Hee Lee, Whui Kim, Hyun Kyun Choi, Byung Tae Jang, “A Study onFeature Extraction Methods Used to Estimate a Driver’s Level of Drowsiness”, International Conference on Advanced Communications Technology (ICACT), 2019.

3. Anjith George, Aurobinda Routray, “Real-time Eye Gaze Direction Classification Using Convolutional Neural Network”, IEEE, 2016.