STM JOURNALS

International Journal of
Optical Innovations and Research

Volume 1, Issue 1, 2023
January–June
DOI (Journal): 10.37591/IJOIR

https://journals.stmjournals.com/ijoir

Review IJOIR

An approach of Computer Vision Methods for Driver's Drowsiness and Yawn Detection

Hrishita Jagtap[1], Madhuri Thote[1,*], Satyajeet Patil[1], Parth Ruikar[1]

Abstract

Numerous studies have demonstrated that 4,444 traffic crashes are primarily caused by driver drowsiness. Due to advancements in digital computer systems, tiredness behaviour may now be studied by researchers worldwide. The goal of this project is to increase road safety by preventing accidents caused by sleepy drivers. To view the driver's face, use real-time facial recognition technology. A driver's attentiveness and reaction time may be impacted by weariness, which raises the risk of being involved in a collision. According to an analysis of National Highway Traffic Safety Administration (NHTSA) data, between 22% and 24% of accidents are caused by sleepy driving. Compared to an awake driver, a fatigued motorist has a 4-6% higher near-miss/accident rate. The high crash rates are caused by fatigued drivers who fail to take preventative measures before colliding. An important irony in Driver Fatigue is that drivers are too exhausted to remember how much sleep they got. A lot of drivers ignore this crucial problem. The prevention of traffic accidents is greatly aided by programmes that track driver attention. The purpose of these devices is to alert drivers when they become fatigued or distracted. The duration of the driver's eye closure is examined in this article; the driver slept off and the alarm went off. A person's repeated yawns resemble. used the Haar cascade library and the image prediction library to programme Open CV and Python to detect yawns and facial expressions.

Keyword: Drowsiness detection, yawn, traffic, facial expression, CNN

INTRODUCTION

One of the most frequent causes of accidents is tired or drowsy drivers. Every year, more people die globally because of these kinds of incidents. The purpose of this study is to reduce the number of accidents caused by exhaustion and drowsiness among drivers. This will lead to an increase in transportation safety. Driving force fatigue detection is a feature in cars that helps prevent accidents and save drivers' lives when they are starting to feel sleepy. This project uses laptop vision to identify when drivers are sleepy. There has been a development in transport modes with the era's continuous innovation and progress. Keeping the population and increased vehicles on road in mind, there are some rules that every driver of a motor vehicle should follow. One must remain vigilant, while the other must be active while utilising. The current methods of detecting driver fatigue are either extremely expensive technologies that mimic high-end automobile models or structures that may be inexpensive but are no longer reliable.

The effective and reasonably priced design of a drowsiness detection device is the main goal of this work. The method that is desired in the current situation uses only the mouth's and eyes' geometric skills to identify tiredness. To demonstrate and avert a negative consequence from exhaustion, this research suggests developing a sleepiness detecting equipment. Driver fatigue is a major factor in the

*Author for Correspondence
Madhuri Thote
E-mail: madhurithote.nbnssoe.comp@mail.com

[1]Student, Department of Computer Engineering, NBN Singhad Technical Institute Campus, Maharashtra, India

Received Date: June 14, 2023
Accepted Date: October 30, 2023
Published Date: January 15, 2024

Citation: Hrishita Jagtap, Madhuri Thote, Satyajeet Patil, Parth Ruikar. An approach of Computer Vision Methods for Driver's Drowsiness and Yawn Detection. International Journal of Optical Innovations & Research. 2023; 1(1): 21–26p.

rising number of accidents that occur on today's roads, as extensive research has shown. Since driver fatigue is typically underestimated, it is difficult to determine the precise range of incidents caused by it. The driving force frequently fails to recognise the small change from being tired to nodding off. This explains why more research in this area is necessary to reduce the frequency of accidents linked to sleepiness and to motivate us to expand the use of driver drowsiness monitoring systems. Long drives negatively impacted drivers' performance, suggesting that the time-on-task effect may increase the likelihood of traffic accidents involving drivers.

Fatigue of Drivers: Major Cause of Concern

"Driver fatigue" term has been widely employed to designate a variety of driving states, each with its own unique causative mechanism. Fatigue of drivers has an impact on road safety and is a major contributing factor to accidents [1]. There are presently technologies that allow for the identification of driver drowsiness and interventions that have the potential to significantly lower the chances of crashes. Depending on the kind and cause of fatigue, these technologies may not be successfully implemented. Most studies have employed a range of psychophysiological characteristics as markers of exhaustion, with electroencephalography possibly showing the greatest promise. Extended periods of wakefulness, troughs in the circadian cycles [5], or cumulative sleep debt are the causes of sleep-related (SR) forms of driver tiredness. Most therapeutic measures fail to alleviate SR tiredness. either the other hand, technologies that identify and counteract task-related (TR) fatigue which is brought either by mental overload or underload are showing themselves to be useful instruments for enhancing transportation safety. The following methods have been used by researchers to try and identify driver drowsiness:

1. vehicle-based methods.
2. behavioural measures; and
3. physiological measures.

It is also described how tiredness has been artificially induced in various methods [7].

Most studies discovered a robust correlation between shifts in theta and delta activity and the onset of weariness [4]. Thus, electroencephalography monitoring during driver fatigue could be a useful variable for fatigue countermeasure devices. Anxiety and emotional states were also noted in the analysis as potential contributors to driver weariness. Moreover, temperament and personality may also have an impact on weariness. Considering the, improving fatigue management may result from knowledge of the psychology of exhaustion [2]. The multidimensional fatigue model was supported by Saxby et al [3], which also show the various subjective reaction patterns that might be classified as "fatigue."

It is never appropriate to deploy hardware technology as the company's fatigue management system. Hardware innovations are limited to use as a last resort safety measure. However, the output of hardware technologies might be a helpful addition to business fatigue management systems, allowing for real-time risk assessment [6].

Seen et al demonstrated that prolonged driving in a monotonous setting alone greatly increased drivers' levels of weariness [8].

SYSTEM ARCHITECTURE

The methodology works on a predefined process as presented in Figure 1.

For Eye Detection

To detect eyes, the image is first captured by the camera. once that, a Region of Interest (ROI) is created once the face is recognised and converted to grayscale. After that, it pulls the ROI's eye detection data and feeds it to the CNN classifier.

The state of the eyes will be classified by the CNN classifier as either open or closed.

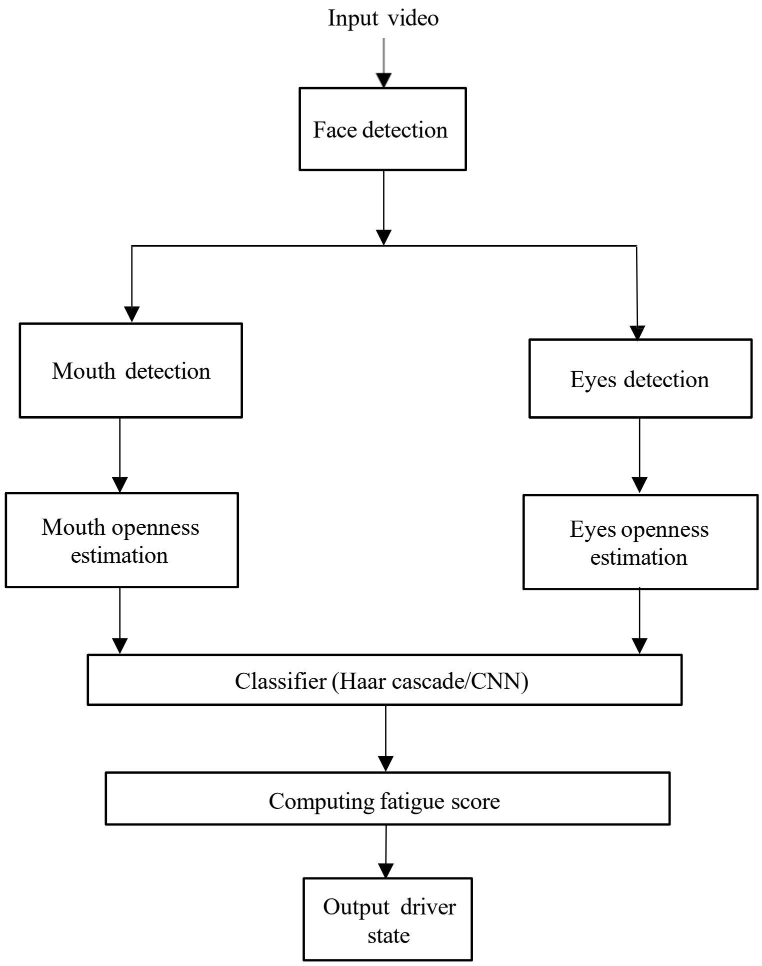

Figure 1. System architecture.

Ultimately, a score is produced to determine if the subject is sleepy. In essence, the score is a number that indicates how long a person has closed his eyes.

For Yawn Detection

Yawn detection involves detecting the face, converting it to grayscale, and establishing a region of interest (ROI) then determines the yawn counter's length, sets the threshold, and makes a comparison with it. A warning is issued if the yawn counter's length exceeds the threshold for yawn detection. A feature that detects whether the driver is yawning or experiencing sleepiness is used to provide the relevant voice alerts.

Motivation

The major objective is to develop a system that can recognise sleepy drivers from eyelid movement and yawning accurately and promptly issue the necessary audio warning. The creation of a system that monitors a driver's eyes, namely the retina, to identify driver fatigue is another objective. When a driver yawns a lot or closes their eyes for a brief period, the system ought to notify them. If the driver wears glasses, the system still functions. Inadequate lighting has no effect on the system.

METHODOLOGY

Step 1: Using the webcam, capture a picture from the camera and use it as input. To view the webpage, we thus establish an indefinite loop that captures each frame. We define the capturing object and use the cv2.VideoCapture(0) method that OpenCV provides to the camera. Every frame will be read by Container.read(), which will then save the picture in a new frame.

***Step 2**:* Find the faces in the picture and remove the area of interest (ROI). Understanding colour is not necessary for us to see. To identify faces, we'll employ haar-digit classifiers. To set our distinct faces = cv2. CascadeClassifier ('path to our cascading xml file'), use this line of code. We'll see to it that face = face is used.findMultiScale (grey). yields a detection array with the height (the bounding box width of the object) and the x,y coordinates. Now that we've gone over the faces, we can create a bounding box for every one of them. cv2.rectangle(frame, (x, y), (x+w, y+h), (100,100,100), 1) is the face for (x, y,w,h).

Step 3: The same method used to recognise faces, ROI the eye and input it to the classifier. To identify the eye, we first set up cascade classifiers for each eye in leye and reye, respectively. We then use left_eye = leye to detect the eye.multiscale detection (grey). The eye data must now be extracted from the entire image. This may be accomplished by deleting the bounding box around the eye. After that, we can use this code to remove the eye's picture from the frame. frame [x: x + w, y: y + h] = l_eye Image data for the eye alone is contained in l_eye. Our CNN classifier will use this information to determine if the eye is open or closed. In a similar manner, we will deduct r_eye from the right eye.

***Step 4**:* Whether the eye is closed or open will be classified by the classifier. A CNN classifier is employed to forecast the eye. Since the model requires the correct proportions to start, we will have to put in some work to input our image into it. First, we use r_eye = cv2.cvtColor(r_eye, cv2.COLOR_BGR2GRAY) to convert the colour image to grayscale. Then, since our model was trained on the 24×24 pixel picture cv2, we alter the image to 24×24 pixels. We now use our model, lpred = model.predict_classes(l_eye), to estimate each eye. An open eye is indicated by lpred[0]=1, and a closed eye is shown by lpred[0]=0.

***Step 5**:* Determine the score to see if the person is dozing off. The crucial factor that will help us ascertain how long the person has been off is their score. As a result, if the eyes are closed, the score will increase, and if the eyes are open, the score will fall. Using the cv2.putText() function, we illustrate the outcome on the screen to display the behaviour in real time.cv2.putText(font, 1, (255,255,255), 1, cv2.LINE_AA), frame, “Open”, (10, height-20), Defines the threshold; for instance, a score of more than 15 indicates that the area is closed for an extended period. At this point, we use sound to sound the alert.play().

RESULTS

One of the primary methods for detecting driver fatigue or distraction and preventing accidents is the use of driver face monitoring devices. Driver face monitoring systems take pictures of the driver's face and identify signs of exhaustion and distraction in the eyes, lips, and head and according to that predict the drowsiness and yawn as shown in Figure 2. Typically, these symptoms include eyelid distance, eye blink rate, eye blink speed, gaze direction, eye saccadic movement, yawning, head nodding, and head orientation. They can also include percentage of eyelid closure over time (PERCLOS). Using collected symptoms and, if necessary, alarms, the system determines the driver's level of awareness.

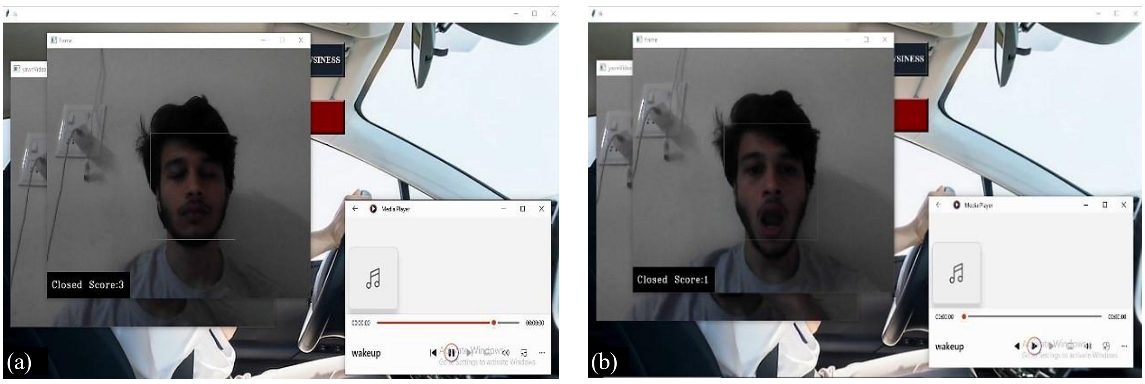

Figure 2. (a) Drowsiness detection, (b) Yawn detection.

When thinking about technologies intended to detect or counter driver fatigue, these causative variables must be differentiated, even though the same forms of performance degradation may be observed for both SR and TR fatigue. Countermeasures will only be effective against the sort of exhaustion that drivers are experiencing; devices for detecting fatigue in drivers may be suitable for both types of fatigue. Differentiating between active and passive weariness is also crucial. Passive fatigue may be mitigated by giving the driver an extra task to complete, such as a response time task. Indeed, there are devices on the market that work in this manner. On the other hand, giving a motorist who is experiencing TR active tiredness an extra task would be harmful. Devices designed for crash prevention, fatigue reduction, and tiredness detection are categorised together. The efficiency of these tools in identifying or combating (sleep-related) SR and (task-related) TR tiredness is assessed.

CONCLUSION

The eyes and mouth are two ways the model can identify signs of weariness. When the driver yawns or falls asleep, Computer Seaker can also be utilised to play the proper warning noises. The project's overall goals are to lower accident costs and advance technologies to stop accidents-related deaths. Subsequent research in this area might concentrate on assessing weariness and sleepiness using different metrics. Meteorological circumstances, traffic patterns, sleep schedules, and mechanical data are examples of external influences. One of the risks to road safety is driver weariness, which is especially problematic for commercial drivers. This significant safety concern is caused by several factors, including year-round printing, unpredictability in the environment, 24-hour service, and more than just operating requirements. Constantly monitoring the driver's state of weariness and alerting him to it so he may take the appropriate action are crucial steps in taking preventive actions to address this issue.

Acknowledgment

It is indeed a great pleasure and moment of immense satisfaction for we to present project report on *"Driver's Drowsiness Detection Using Computer Vision"* amongst a wide panorama that provided us inspiring guidance and encouragement, we take the opportunity to thanks to thanks those who gave us their indebted assistance. We wish to extend our cordial gratitude with profound thanks to our internal guide Prof. *Manasi Wete* for her everlasting guidance. It was his inspiration and encouragement which helped us in completing our project. Our sincere thanks and deep gratitude to Head of Department, Prof. *Shailesh Bendale* and other faculty members and to all those individuals involved both directly and indirectly for their help in all aspect of the project. At last, but not least we express our sincere thanks to our Institute's Principal Dr. Shivprasad Patil, for providing us infrastructure and technical environment.

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