Driver Drowsiness Detection System

Prof- Abhijit Khadke[1], Ashutosh A. Nikalje[2], Omkar J. Domb[3], Ajay H. Jagadale[4], Suraj D. Bagdure[5]

[1]Professor, [2,3,4,5] Students, Department of Computer Engineering, SKN Sinhgad Institute of Technology and Science, Kusgaon (BK), Pune.

Abstract—

This proposed system can be used to reduce the number accidents on the road which are caused by the drowsiness or the tired driver.

Many survey shows that the number of accidents occured due to this reason has incresed drastically over the past few years. The system proposed in this paper aim to reduce those numbers of Accidents. Several body gestures can taken into considered as a sign of drowsiness and fatigue of the driver. Tiredness of the eyes and frequent yawning are indications that the driver condition is improper.

features are an indication that the driver's condition is improper. EAR (Eye Aspect Ratio) computes the ratio of distances between the horizontal and vertical eye landmarks which is required for detection of drowsiness. For the purpose of yawn detection, a YAWN value is calculated using the distance between the lower lip and the upper lip, and the distance will be compared against a threshold value.

We have deployed an eSpeak module (text to speech synthesizer) which is used for giving appropriate voice alerts when the driver is feeling drowsy or is yawning. The proposed system is designed to decrease the rate of accidents and to contribute to the technology with the goal to prevent fatalities caused due to road accidents.

Keywords- Drowsiness, eSpeak module, Eye aspect ratio, Yawn Detection.

I. INTRODUCTION

In this fast-moving world, the fatigue level of people is rising day by day. Rising fatigue level in people not only affect their performance in the day to day tasks but also deteriorates their driving performance. Fatigue causes a driver to sleep while driving, that leads to major accidents. Even if the driver does not sleep while driving, fatigue hampers the reaction time of driver, diminishes his steering performance and impedes his ability to keep a distance from the vehicle in front. Sometimes the driver tries to compensate for the fatigue by driving very fast to let the new sense of driving spur in adrenaline and attention levels. However, slowed reaction time increases the chance of accidents in such cases

As per the statistics, around 20% of road accidents involve driver drowsiness. Survey research suggests that more than half of the drivers face drowsiness while driving at least once every year [1]. Professional drivers and shift workers face drowsiness while driving on a frequent basis as a result of their work-related factors. Research shows that a person, who has not slept for 17 hours continuously, faces twice the risk of having an accident as compared to a person who is not fatigued. This risk increases to seven times if the person is awake since 24 hours.

Driver drowsiness detection is a technology in vehicles that is useful in preventing accidents and saving the lives of drivers when they are getting drowsy. This project uses computer vision for the detection of drivers' drowsiness. The existing technologies to detect driver drowsiness are either very costly systems that apply to the high-end car models or systems that are affordable but are not robust. This paper is focused on designing a drowsiness detection system that functions efficiently and is affordable.The method that is needed in the present scenario detects drowsiness based on the eyes and mouth geometric features. This paper proposes to achieve the same, by developing a drowsiness detection system to monitor and prevent a destructive outcome from the negligence of fatigue.There are an increasing number of accidents on roads today and driver drowsiness is an important factor and this has been accepted extensively.The transition from being fatigued to dozing off is subtle and generally goes unnoticed by the driver. This explains why it is important to do more work in this field with an aim to reduce the occurrence of accidents related to drowsiness and motivate ourselves to develop a driver drowsiness detection system.

II. LITERATURE REVIEW

From [4] titled **"Computer Vision based drowsiness detection for motorized vehicles with Web Push Notifications"**. In this paper, they have designed a drowsiness system that is based on computer vision for vehicles with alarm sounds and web push notifications. These notifications will alert the driver to prevent the accident from occurring. The system is also designed to generate an alert that shows nearby coffee shops which will increase the alertness

of the driver. As a result, the system detected the driver's drowsiness and showed successful performance in the trial run. The Eye Aspect Ratio was used to detect if the eyes are closed or open. Then, a buzzer was used to generate an alert and a web push notification was sent to the user which shows the nearby coffee shops. The limitations of the paper are that the Raspberry Pi camera was used and because of this, the system could not work during the nighttime. A night-vision camera should have been used.

From [5] titled **"Real-time monitoring of driver drowsiness on mobile platforms using 3D neural networks"**. In this paper, they have used depth-wise separable 3D convolution operations to detect drowsiness in drivers from real-time face video and also, they have identified micro sleeps and alerted the drivers. The results obtained show that the method can decide which features are important and it does not depend on the developer to pre-specify a set of features because they might miss some features like nose wrinkles, eyelid movement, and other facial gestures. The limitations of the paper are that the dataset which is used consists of just 18 persons and also, the frames were not labeled properly.

From [9] titled **"The detection of drowsiness using a driver monitoring system"**. In this paper, they have made use of a driver monitoring system (DMS) to detect drowsiness along with different kinds of sensors. They have also collected data in the form of signals from other vehicle-based sensors. The results obtained show that the models were effective at dividing the drowsiness into three levels - low, moderate, and severe drowsiness. But, while differentiating between moderate and severe levels, the model was not efficient enough. The limitations of the paper are that the model was not effective while differentiating moderate drowsiness from severe drowsiness. Another limitation is that the size of the sample used in this paper is small.

From [6] titled **"Driver Drowsiness Detection System Using Computer Vision"**. The objective of the paper is to detect driver drowsiness by analyzing human eye blinks using a recent facial landmark detection and to make use of E.A.R(eye aspect ratio) for easy, fast, and efficient blink detection. The results showed that the system was successful in driver drowsiness detection by providing a reliably precise enough estimation of the level of eye openness. This alert system can be used in real-time due to a very negligible performance cost experienced in facial landmark detection. The limitations of the paper are that a fixed blink duration is assumed even though everyone's blink duration lasts differently. EAR is estimated from two-dimensional data which cannot account for out-of-plane head orientation and the model depends only on eyes for drowsiness detection.

From [7] titled **"Drowsiness Detection Based on Eye Closure and Yawning Detection"**. In this paper, driver's eye and mouth movements are tracked using Haar-cascade classifiers. This will help to detect the closing of eyes and frequency of yawning. The system also generates alarm sounds if the driver is drowsy or already asleep. As a result, in 85% of the cases, the system detects faces and facial features which are required, accurately. The system is prompt in detecting drowsiness once the feature detection of the face is positive. The limitation of the paper is that it is observed that the system's accuracy decreases in bad lighting conditions.

III. METHODOLOGY

Firstly, the face is localized in the image using facial landmark detection. Then, shape prediction methods are used to detect important features on the face. Face detection [14] is done by OpenCV built in HAAR cascades, which are pre-trained. In the next step, to estimate the location of 68 (x, y)-coordinates that map to facial structures, a facial landmark detector which is pre-trained and included in the dlib library is used. It is also trained on the iBUG 300-W dataset. The EAR [8] is computed using the ratio of distances between the horizontal and vertical eye landmarks for drowsiness detection. For the purpose of yawn detection [9], a YAWN value will be calculated using the distance between the upper and the lower lip, and the distance will be compared against a threshold value. eSpeak module (text to speech synthesizer) is used for giving appropriate voice alerts when the driver is feeling drowsy or is yawning.

IV. SOFTWARE REQUIREMENT SPECIFICATIONS

The proposed system must be able to detect drowsiness given a proper real-time driving environment. The performance will depend upon the quality of the camera as well. The proposed system due to its well-designed and easy-to-use interface can be used by both day-time and night-time drivers. Users can follow up the interface step by step for their purpose. The proposed system must be available for use to the user as and when needed provided that the user's system meets the specified requirements. The proposed system must be able to recover from failure in case of the application crashing abruptly and become ready-to-use after recovery. The prototype of the drowsiness detection system will be implemented on the Raspberry Pi microcontroller board, along with the necessary peripheral hardware, and Python 3 will be used to implement the software functionality of drowsiness detection.

V. SYSTEM DESIGN

A.   **System Architecture:**

When the driver is driving, the driver's face is captured by a camera and it is converted into a video stream. The application then analyzes the video to detect drowsiness and fatigue and also checks the level of drowsiness. In this stage, the main parts which should be considered for analysis are: the driver's face tracking, driver's fatigue state, and recognition of key regions of the face based on eye closure and yawning . Finally, if the drowsiness is detected, a warning voice alert is given.

The following figure depicts High-Level System Architecture consisting of the input to the model and the preprocessing and evaluation in stages. Stage 1 involves pre-processing of video stream for human face tracking. Stage 2 involves extraction of facial key regions such as eyes and mouth. Stage 3 involves detection of drowsiness symptoms like eye closure, blinking, and yawning.
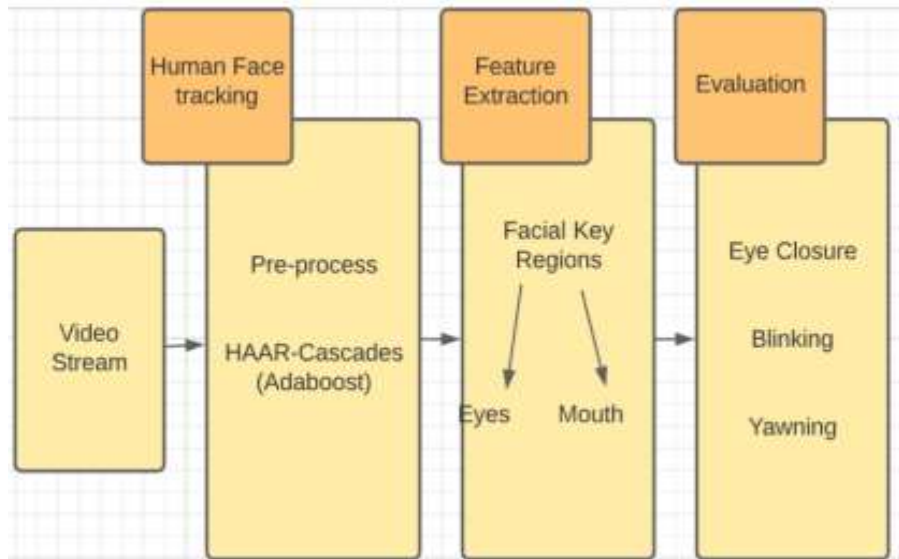

Fig.1 High-level System Architecture

B. Detailed Design :

The system has been designed such that the face and hence the eyes and mouth of the driver are always monitored and if the predefined levels of alertness are observed to be defaulted and compromised, then an appropriate alarm is set off, and accordingly, action is taken to prevent any fatalities. Fig. 2 depicts the System Design of Driver Drowsiness and Yawn Detection System. It can be seen that the camera is used for monitoring the driver's face continuously and upon detection of drowsiness or fatigue, the system in the dashboard generates a voice alert type warning to the driver.
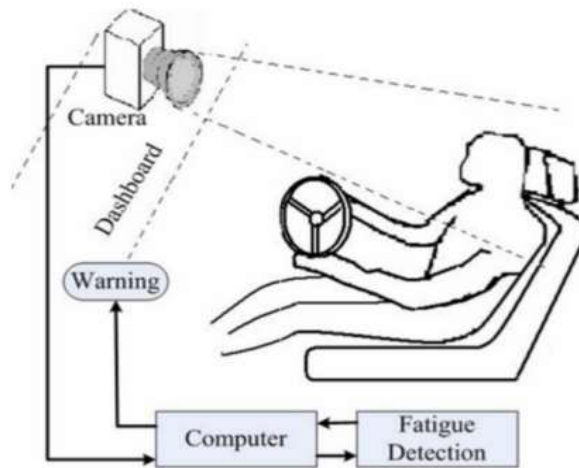

Fig. 2. System Design

VI. EXPERIMANTAL RESULTS

A. Experimental Dataset

The experimental dataset used in our project is the iBUG-300w Dataset, which consists of 300 indoor and as many outdoor images. The dataset covers a large variety of identities, face size, lighting conditions, pose, etc. The images in the 300-W dataset cover more expressions than the common neutral smile such as surprise or scream. Annotations on the image were done using 68-point markup covering all the key facial landmarks including eyes, mouth, nose, etc. [19] But with regards to this project our region of interest (ROI) includes only the eyes and lips region which can be extracted using python slicing techniques.

Table- I: iBUG 300w Dataset split up

Total Images	Number of Annotated faces involved
293	1
53	2
53	[3,7]

B. System Testing

The following table represents five test cases for drowsiness and yawn detection of the driver.

Table- III: System Testing

Test Cases	Eyes Detected	Eye closure	Yawn detected	Result
Case 1	No	No	No	No result
Case 2	Yes	No	No	No result
Case 3	Yes	Yes	No	Voice alert
Case 4	Yes	No	Yes	Voice alert
Case 5	Yes	Yes	Yes	Voice alert

According to the methodology of the system, when the eyes are closed for more than the set threshold number of frames or when the driver is yawning [12], then the driver is feeling tired. Henceforth, one of these distinguished cases arises, and the corresponding result happens. The accuracy as measured in the performance analysis phase is almost found to be 100% in the case when the face is properly aligned and no wearable obstacle is present. Accuracy drops down a little when an obstacle is present (e.g., Hat). Ambient lighting conditions are very essential for getting proper results. In case, the user's eye closure and yawn occur simultaneously, a voice alert is raised but the system behaves in an erroneous and unsynchronized fashion. Hence, such a situation should be avoided to prevent any inconsistent results. drowsiness. [18] The outer factors may be weather conditions, state of the vehicle, time of sleeping and, mechanical data. Driver drowsiness is among the major threats to road safety, and in the case of commercial motor vehicle operators, the problem is particularly severe. The factors that contribute to this serious safety issue are twenty-four-hour services, unpredictable conditions of the environment, high annual mileage, and an increase of work schedules that are demanding. One important step of preventive measures that are needed to solve this problem is by continuously observing the driver's drowsiness state [17] and giving information about their state to the driver so that they can take necessary action. Presently, no adjustment can be done concerning the zoom or direction of the camera during the system operation. [20] In the future, more work can be done to automate the zoom on the eyes after they are localized.

VII. LIMITATIONS

The accuracy of the model degrades if the eye frames are not captured clearly due to any kind of obstacles such as goggles or spectacles having reflection). Camera operations such as auto adjustments with respect to zoom and rotation are not considered in conducting experiments. Once the eyes are localized, zooming in automatically will help increase the accuracy. The accuracy of detection of eyes and mouth reduces when the driver is not facing the camera.

VIII. CONCLUSION

Hence, with help of this model by monitoring the eye and mouth drivers drowsiness can be detected. Shape prediction methods are used to detect important features on the face The facail landmarks obtained from facial landmarks detection are used as inputs to these methods. The Eye Aspect Ratio (EAR) function is used to compute the ratio of distances between the horizontal and vertical eye landmarks. An eSpeak Model is also used to give appropriate voice alerts when the driver is feeling drowsy or is yawning. The purpose of this project is the decrease the number of accidents.

IX. ACKNOWLEDGEMENT

X. REFERENCES

1) **"Real-Time Driver Drowsiness Detection using Computer Vision"** By Mahek Jain, Bhavya Bhagerathi, Sowmyarani C N, 2021

2) **"Drowsy Driver Alerting System"** By Sanya Gupta, Prerit Jain and Elizabeth Rufus School of Electronics Engineering, Vellore Institute of Technology, Vellore

3) T. Danisman, I.M. Bilasco, C. Djeraba and N. Ihaddadene, **"Drowsy driver detection system using eye blink patterns"** , Universite Lille 1 & Telecom Lille 1, Marconi, France, 2010.

4)	Rahul Atul Bhope, **"Computer Vision based drowsiness detection for motorized vehicles with Web Push Notifications"**, IEEE 4th International Conference on Internet of Things, IEEE, Ghaziabad, India, 2019.

5)	Jasper S. Wijnands, Jason Thompson, Kerry A. Nice, Gideon D. P, Aschwanden & Mark Stevenson, **"Real-time monitoring of driver drowsiness on mobile platforms using 3D neural networks"**, Neural Computing and Applications, 2019.

6)	Aditya Ranjan, Karan Vyas, Sujay Ghadge, Siddharth Patel, Suvarna Sanjay Pawar, **"Driver Drowsiness Detection System Using Computer Vision."**, in International Research Journal of Engineering and Technology(IRJET), 2020.

7)	B.Mohana, C.M.Sheela Rani, **"Drowsiness Detection Based on Eye Closure and Yawning Detection"**, in International Research Journal of Engineering and Technology(IRJET), 2019

8)	S. Abtahi, B. Hariri and S. Shirmohammadi, **"Driver drowsiness monitoring based on yawning detection"**, Proceedings of the IEEE International Control, Measurement and Instrumentation (CMI), IEEE, pp. 1-4, May 2011

9)	Chris Schwarz, John Gaspar, Thomas Miller & Reza Yousefian, **"The detection of drowsiness using a driver monitoring system"** , in Journal of Traffic Injury Prevention (Taylor and Francis Online), 2019.

10)	X. Fan, B. Yin, and Y. Sun, **"Yawning detection for monitoring driver fatigue",** Proceedings of the International Conference on Machine Learning and Cybernet, vol. 2, pp. 664-668, Aug. 2007.

11)	N. Wang and D.-Y. Yeung, **"Learning a deep compact image representation for visual tracking"**, Proceedings of the 26th International Conference on Neural Information Processing Systems., vol. 1, pp. 809-817, 2013.