Driver's Drowsiness Detection System

DHRUV PANDEY[1], ROHAN GARG[2], SAVITA SHARMA[3]
[1, 2] Student, Dept. of CSE, Maharaja Agrasen Institute of Technology, Delhi, India
[3] Assistant Professor, Dept. of CSE, Maharaja Agrasen Institute of Technology, Delhi, India

Abstract—The proposed system aims to lessen the number of accidents that occur due to drivers' drowsiness and fatigue, which will in turn increase transportation safety. This is becoming a common reason for accidents in recent times. Several faces and body gestures are considered such as signs of drowsiness and fatigue in drivers, including - tiredness in eyes and yawning. These 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.

Indexed Terms—Drowsiness, Eye Aspect Ratio, Yawn Detection, Speak Module.

I. INTRODUCTION

Driver drowsiness and fatigue are one of the most common reasons for accidents. The number of fatalities due to such accidents is increasing worldwide each year. This paper aims to lessen the number of accidents due to driver drowsiness and fatigue. This will in turn increase transportation safety. 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. With the constant improvement and novelty in technology, there is an advancement in transportation modes. Our dependencies on it have started increasing at a high rate. It has greatly affected our lives in many ways. Considering any social status, there are some rules which should be followed by any vehicle driver. One is to stay alert and the other one is being active while driving.

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.

II. METHODOLOGY

Firstly, the face is localized in the image using facial land- mark detection. Then, shape prediction methods are used to detect important features on the face. Face detection is done by OpenCV built in HAAR cascades, which are pre- trained. In the next step, to estimate the location of 68 (x, y)-co- ordinates 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 is computed using the ratio of distances between the horizontal and vertical eye landmarks for drowsiness detection. For the purpose of yawn detection, 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.

III. SOFTWARE REQUIREMENTS

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 sys- tem 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 pro- vided 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.

IV. 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. Fig. 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.

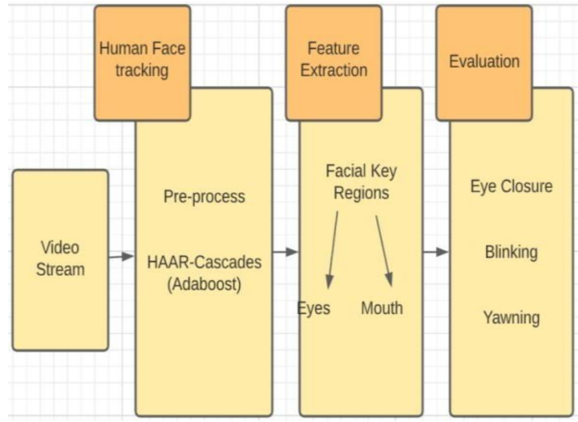


Fig. 1: System Architecture

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.

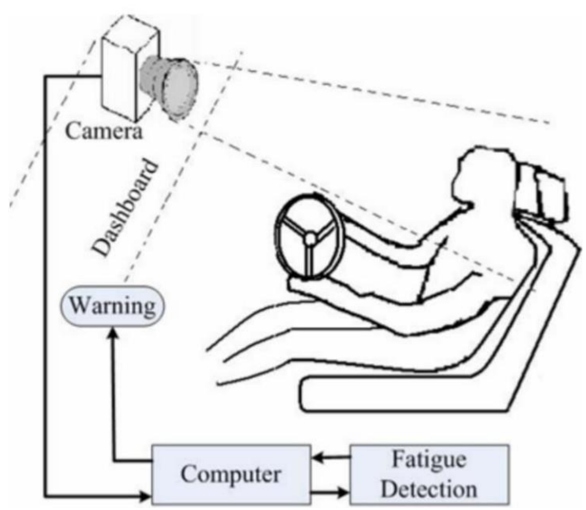


Fig. 2: Detailed Design

V. EXPERIMENTAL RESULTS

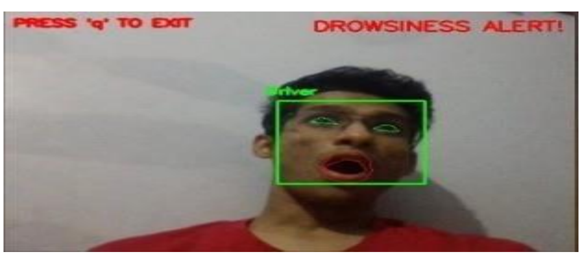
A. *Experimental Dataset*

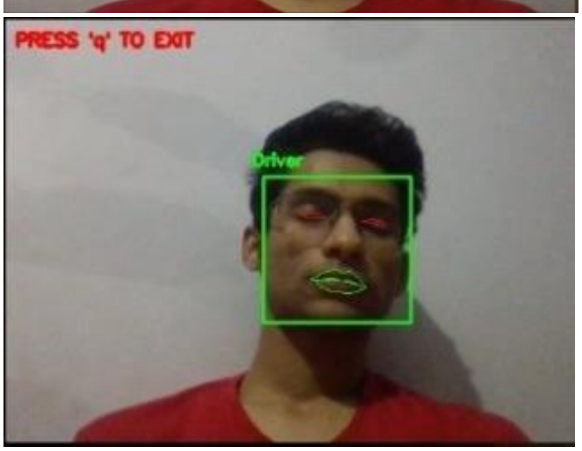
The experimental dataset used in our project is the iBUG-300w Dataset, which consists of 300 indoor and as many outdoor images. The dataset covers a large variety of identities, face size, lighting conditions, pose, etc. The images in the 300-W dataset cover more expressions than the common neutral smile 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.

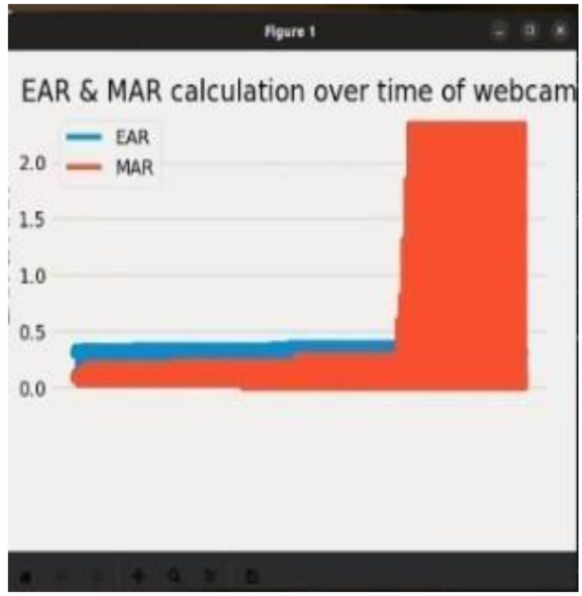
Total Images	Number of Annotated faces involved
293	1
53	2
53	[3,7]

B. *Performance Analysis*

To achieve the expected results, a large number of pictures were taken and their accuracy in drowsiness (using EAR calculation) and yawn detection was analyzed.







CONCLUSION

The model is capable of detecting drowsiness by monitoring the eyes and mouth. Shape prediction methods are used to detect important features on the face. The inputs given to these methods are facial landmarks which are obtained from facial landmark detection. This module deals with the EAR function which computes the ratio of distances between the horizontal and vertical eye landmarks. An eSpeak module (text to speech synthesizer) is also deployed which is used for giving appropriate voice alerts when the driver is feeling drowsy or is yawning. The whole project 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. The future work of this paper can be focused on the use of outer factors for measuring fatigue and drowsiness.

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