A Vision-Based Driver Languor Identification Framework Using Eye Aspect Ratio and Mouth Landmark Points to Mitigate Driver Mishaps

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ABSTRACT

A computer vision based thoughts has been used to create the driver drowsiness detection system. The camera has been utilized as the structure which focuses on the driver's embodiment and check the sleepiness of the driver with some specific proportion to see shortcoming. A voice caution is given to alarm the driver, in such condition when weariness is seen using the method eye aspect ratio (EAR) and mouth aspect ratio (MAR). The system here administers utilizing data found by the image to locate the facial marks, which gets the zone where the eyes of some individual can exist. At some point the eyes of the driver are closed for some particular proportion of housings, the proposed system acknowledges that driver is nodding off and the alert will imply the driver. Furthermore, the proposed system identify the tiredness when dirver wears a glass and and works in light conditions as well.

KEYWORD

Driver Drowsiness, Eye detection, Blink pattern, Fatigue, Yawn detection.

1. INTRODUCTION

Driver's fatigue is a significant factor in endless mishaps. Driver fatigue and drowsiness is a serious problem that can lead to accidents and fatalities. It is estimated that driver fatigue is a factor in up to 20% of all road traffic accidents. It is caused by a lack of sleep, which can impair a driver's attention, alertness, and reaction time. It can also be caused by long periods of driving, especially at night or in monotonous conditions. Drowsiness is a state of sleepiness that can occur at any time, even if a driver has had enough sleep. It can be caused by factors such as stress, boredom, or medication. According to the Ministry of Road Transport and Highways, India recorded 1,53,972 road traffic deaths in 2021. Of these, 23,491 deaths were caused by accidents involving heavy goods vehicles (HGVs). It is estimated that driver fatigue is a factor in up to 30% of HGV accidents. Driver depletion and exhaustion is the central point and it results into various mishaps. Building up the innovations and keep up it proficiently which can forestall oridentify languor in the driver's seat and caution the driver before a mishap is a significant test in mishap counteraction frameworks. Threats of sleepiness can be resulted on the streets a few strategies should be made for forestalling neutralizing its belongings. There has been a significant amount of research carried out on driver fatigue and drowsiness, both in India and around the world. This research has focused on developing methods to detect and prevent driver fatigue, as well as on understanding the impact of driver fatigue on road safety.

A study by the National Institute of Road Safety and Research found that driver fatigue is a major factor in accidents involving heavy goods vehicles (HGVs). The study found that 43% of HGV drivers reported feeling drowsy while driving. All India Institute of Medical Sciences found that driver fatigue is a major factor in accidents involving young drivers. The study found that 35% of young drivers .reported falling asleep while driving. A study by the Indian Institute of Technology Delhi is developing a new system to detect driver fatigue using artificial intelligence. The system is currently being tested in real-world conditions. The appearance of current innovation and constant checking framework utilizing cameras can forestall significant mishaps out and about by alarming the driver who is in fatigue stage through a tiredness recognition framework. The fundamental target is to develop a model sleepiness identification framework. The target will be put on arranging a system that will precisely screen the open or shut state of the person eye who is driving constantly and the sleepy state, for example, yawning will likewise be thought of and the alarm will be given. By seeing the eyes and mouth, it is realized that it was the manifestations of driver weariness can be recognized right on time to dodge an auto collision.

2. LITERATURE SURVEY

Yong Du et al (2008) Successful vision based driver weakness location strategy. At that point we mimic the technique for crystallization to get the circumstance of eyes inside face zone. Afterward, eye region, normal stature of the student and width to tallness proportion are wont to dissect the eye's status. The test results show legitimacy of our proposed strategy [1]. Asjidtanveer.Metal (2019) Driver sluggishness recognition for cerebrum PC interface (BCI) utilizing useful close infrared spectroscopy (fNIRS) is explored. The uninvolved mind signals from sleepiness have been got from 13 solid subjects while driving vehicle test system profound neural organizations has been wont to characterize the languid and ready states [2]. Younes Ed-Doughmiet al (2020) This paper proposesthe most effective method to examine and foresee driver sleepiness by applying a Recurrent Neural Network over an arrangement outline driver's face. We utilized a dataset to shape and favor our model and actualized dull neural organization engineering multi-layer model-based 3D CNN to identify Driver laziness [3]. Qaisai Abbas et al (2020) This Hybrid Fatigue framework depends on incorporating visual highlights through PERCLOS measure and non-visual highlights by heart-beat (ECG) sensors A multilayer based exchange learning approach by utilizing a convolutional neural organization (CNN) and profound conviction organization (DBN) was utilized to identify driver weariness from half and half highlights [4]. Wanghua Deng et al (2017) the recurrence ofblinking and yawning, aredifferent from those inside thenormal state.Owing to the shortcomings ofpreviousalgorithms, we introduce a substitution face-trackingalgorithm to improve thetrackingaccuracy. Thenwe use thesefacial locales toevaluate thedrivers' state [5]. Kartik Dwivedi et al (2018) the aim of the paper is to propose a dream based clever calculation to identify driver sleepiness. A delicate max layer is utilized to characterize the driver as sleepy or non-lazy. This framework is henceforth utilized for notice the driver of sleepiness or in consideration regarding forestalls auto collisions [6]. Bhargava Reddyet al (2017) this paper proposes, a novel methodology towards constant tiredness identification dependent on profound realizing which can be executed on an ease installed board and performs with a high precision is proposed. In addition, Minimized organization structure was planned dependent on facial milestone contribution to perceive if driver is sleepy [7].

Bergasa et al. proposes a non-intrusive driver drowsiness recognition method using eye-tracking and image processing. The system extracts six features from the driver's eyes: percentage of eyelid closure, maximum closure duration, blink frequency, average opening level of the eyes, opening velocity of the eyes, and closing velocity of the eyes. These features are then combined using Fisher's linear discriminant functions to predict whether the driver is drowsy[8]. Ashquir et al. provides a comprehensive overview of various face and eye detection algorithms that can be used for driver fatigue monitoring systems. The authors evaluate the performance of several algorithms on a publicly available dataset of driver images and videos[9]. Elena et al. proposes a deep learning-based approach for driver drowsiness detection. The system uses a convolutional neural network to extract features from sequences of driver images. These features are then used to train a support vector machine classifier to predict whether the driver is drowsy[10]. Sojung et al. proposes a real-time driver drowsiness detection system using deep learning. The system uses a YOLOv3 network to detect the driver's face in each frame of a video stream. Once the face is detected, the system extracts features from the eyes and mouth using a ResNet50 network. These features are then used to train a support vector machine classifier to predict whether the driver is drowsy[11]. Sukrit et al. proposes a vision-based driver drowsiness detection system using eyelid closure and head pose estimation. The system uses a Lucas-Kanade optical flow tracker to track the driver's eyes and head. The eyelid closure is then estimated by calculating the percentage of the eye that is covered by the eyelid. The head pose is estimated using a geometric model of the human face. The eyelid closure and head pose features are then used to train a support vector machine classifier to predict whether the driver is drowsy[12]. Khan et al. proposes a real-time driver drowsiness detection system using eye blinking and head movement. The system uses a Viola-Jones algorithm to detect the driver's face in each frame of a video stream. Once the face is detected, the system extracts features from the eyes and head using a histogram of oriented gradients (HOG) descriptor. The eye blinking features are extracted by calculating the blink frequency and blink duration. The head movement features are extracted by calculating the head pitch, roll, and yaw angles. The eye blinking and head movement features are then used to train a support vector machine classifier to predict whether the driver is drowsy[13].

Sarvas et al. proposes a driver drowsiness detection system using deep learning and eye tracking. The system uses a convolutional neural network to extract features from the driver's eyes. These features are then used to train a support vector machine classifier to predict whether the driver is drowsy. The eye tracking data is used to improve the accuracy of the system by filtering out false positives[14]. Li et al. proposes a vision-based driver drowsiness detection system using deep learning and facial landmarks. The system uses a convolutional neural network to extract features from the driver's face. These features are then used to train a support vector machine classifier to predict whether the driver is drowsy. The facial landmark data is used to improve the accuracy of the system by providing additional information about the driver's facial expressions . Also real-time driver drowsiness detection system is developed using deep learning and physiological signals. The system uses a convolutional neural network to extract features from the driver's eyes and physiological signals. The physiological signals are collected using a wearable device that measures the driver's heart rate, respiration rate, and skin conductance. The features from the eyes and physiological signals are then used to train a support vector machine classifier to predict whether the driver is in sleep mode or active[15].

3 METHODOLOGY

3.1 Motivation

As per the National Highway Traffic Safety Administration, per annum around 100,000 police-announced accidents include lazy driving. These accidents end in very 1,550 fatalities and 71,000 wounds. The significant number could likewise be a lot higher, be that as it may, on the grounds that it is hard to work out whether a driver was tired at the hour of an accident. Along these lines, in order to frame the main impetus mindful before any such mishap happens, we've made this procedure. It predicts the consideration and mouth milestones to spot if an individual is nodding off, by checking if his eyes are shut or if he/she's yawning.

3.2 Objective

Driver sleepiness recognition is a vehicle safety technology that can save the driver's life by preventing accidents when the driver is getting drowsy. The main goal is to develop a system to detect driver drowsiness by continuously monitoring the driver's eyes. The system works regardless of whether the driver is wearing glasses and in different lighting conditions. To alert the driver of drowsiness, the system uses an alert system. The speed of the vehicle is also automatically reduced to maintain traffic safety and reduce accidents.

3.3 Methodology

A driver's face is monitored continuously using a webcam to detect drowsiness. The first step is to identify the driver's face in the video stream. This is done by using a face detection algorithm to find the region of the image that contains the driver's face. Once the face has been detected, the system tracks the driver's eye movements and mouth shape using facial landmark detection. To detect drowsiness, the system calculates the Eye Aspect Ratio (EAR) and Mouth Aspect Ratio (MAR) for the driver's face. If the EAR or MAR falls below a certain threshold for a certain number of frames, the system triggers an alarm and automatically reduces the vehicle's speed. This is done to prevent the driver from falling asleep and causing an accident.

The different components of the system are as follows:

- **Webcam:** The webcam is used to capture a video stream of the driver's face.
- **Face detection algorithm:** The face detection algorithm is used to identify the region of the image that contains the driver's face.
- **Facial landmark detection:** The facial landmark detection algorithm is used to track the driver's eye movements and mouth shape.
- **Eye Aspect Ratio (EAR):** The EAR is a measure of how open the driver's eyes are. A lower EAR indicates that the driver's eyes are more closed, which is a sign of drowsiness.
- **Mouth Aspect Ratio (MAR):** The MAR is a measure of how wide the driver's mouth is. A higher MAR indicates that the driver's mouth is more open, which is a sign of yawning, which is another sign of drowsiness.
- **Threshold:** The threshold is a value that determines when the system should trigger an alarm. If the EAR or MAR falls below the threshold for a certain number of frames, the system triggers an alarm.
- **Alarm:** The alarm is a signal that is used to alert the driver that they are drowsy. The alarm can be a visual signal, such as a flashing light, or an audio signal, such as a siren.
- **Vehicle speed controller:** The vehicle speed controller is used to automatically reduce the vehicle's speed if the system triggers an alarm.

3.4 Architectural Diagram

The architecture diagram for a vision-based driver languor identification framework using Eye Aspect Ratio (EAR) and Mouth Landmark Points (MLP) to mitigate driver mishaps is shown in Figure 1 and it can be divided into various phases like Data acquisition, Face detection, Eye aspect ratio (EAR) calculation, Mouth landmark points (MLP) extraction, Drowsiness detection and finally Alert and mitigation system . The proposed system work as follows and the flowchart is depicted in Fig.2.

- A webcam captures a video stream of the driver's face.
- A face detection algorithm is used to identify the driver's face in the video stream.
- Once the face is detected, the facial landmarks are extracted.
- The EAR and MLP features are calculated from the facial landmarks.

- A machine learning algorithm is used to classify the driver's state as drowsy or not drowsy based on the EAR and MLP features.
- If the driver is classified as drowsy, an alarm is triggered to alert the driver.

The EAR is a measure of how open the eyes are. A lower EAR indicates that the eyes are more closed, which is a sign of drowsiness. The MLPs are used to track the movement of the mouth and detect yawning, another sign of drowsiness. The system is designed to work in real time, so that the driver can be alerted to their state of drowsiness as soon as possible. This can help to prevent accidents caused by drowsy driving. Here are some of the advantages of using a vision-based driver languor identification system:

- It is non-invasive and does not require any special sensors to be worn by the driver.
- It can be used in a variety of lighting conditions.
- It is relatively inexpensive to implement.

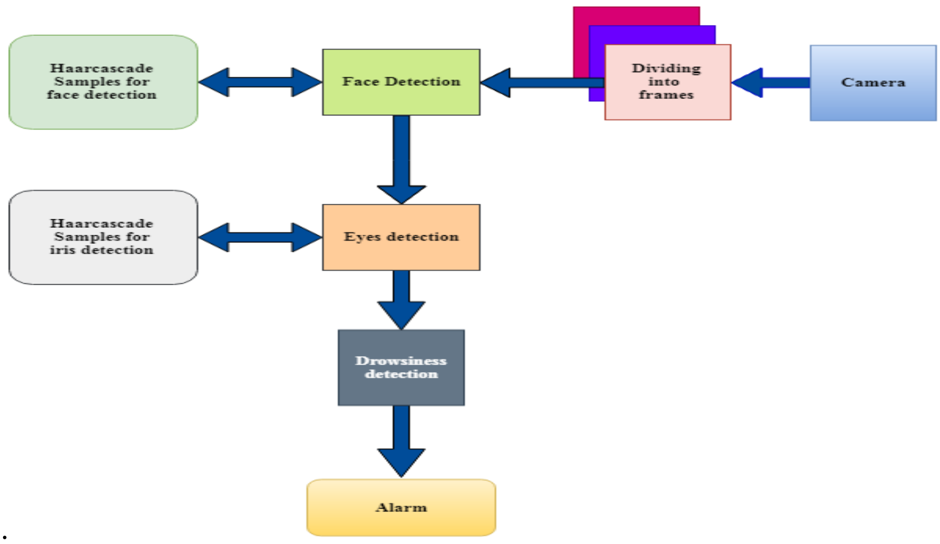

Figure 1 Architecture Framework for Vision-Based Driver Languor Identification Framework

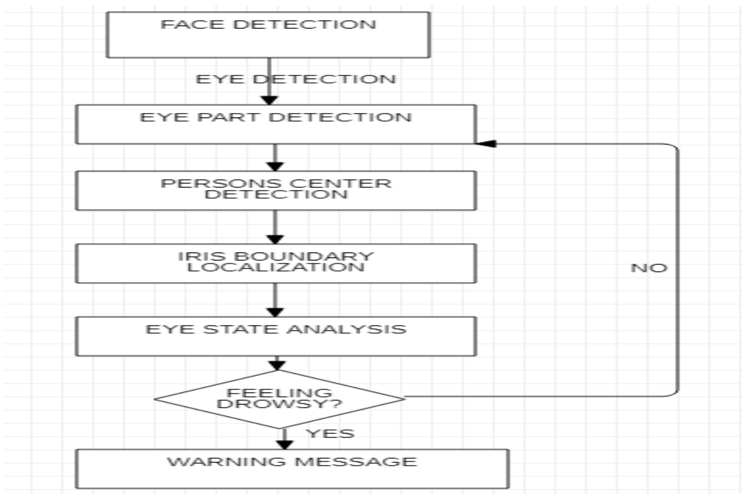

Figure 2 Stream outline of the framework

4 IMPLEMENTATION AND RECKONING ANALYSIS

The mounted camera has been utilized here to watch the eyes of the main thrust progressively to recognize languor. A camera arrangement that shows up for faces inside the info video transfer and screens edges of appearances. Inside the occasion that a face is distinguished, facial achievement ID is associated and hence the eye locale will be far away to the sides of video transfer.

4.1 Data Acquisition

Data acquisition is an important step in developing a driver drowsiness detection system. The quality and quantity of the data collected will have a direct impact on the performance of the system.

There are two main types of data that can be collected for driver drowsiness detection:

- Physiological data: This type of data measures the driver's physiological signals, such as heart rate, respiration rate, and eye movements. Physiological data can be collected using wearable sensors, such as an electrocardiogram (ECG) monitor or an eye tracker.
- Visual data: This type of data captures images or videos of the driver's face. Visual data can be collected using a webcam or a camera mounted in the vehicle.

Here, we are using a web camera to capture images or videos of the driver's face from inside the vehicle. The webcam will be continuously capturing video frames. OpenCV is a popular open-source computer vision library. The cv2.VideoCapture() function is used to access a video capture device, such as a webcam. The parameter (0) specifies that the first webcam connected to the computer should be used. The cap.read() function reads the next video frame from the capture device. The return value of cap.read() is a tuple containing a boolean value and a NumPy array representing the video frame. The boolean value indicates whether the frame was read successfully.

4. 2 RECOGONIZINGKEYFACIAL STRUCTURES IN THE FACE REGION:

4.2.1 EyeAspectRatio

EyeAspectRatio in light of the fact that the name recommends, is that the proportion of the length of eyes, width of eyes. The length of eyes is determined by averaging more than two particular vertical lines over the eyes as our speculation was that when an individual is languid, their eyes are probably going to encourage more modest and that they are probably going to flicker more. upheld this theory, we anticipated that our model should foresee the class as tired if the consideration proportion for a private over progressive edges started to decrease for example their eyes started to be more shut or they were flickering quicker. EAR is a simple and effective way to detect driver drowsiness because it is based on the observation that people's eyes tend to close more often and for longer periods of time when they are drowsy. This is because the muscles that control the eyelids become less active when we are drowsy. To calculate EAR, we first need to identify the two key landmarks of the eye: the inner corner (pupil) and the outer corner. Once we have identified these landmarks, we can calculate the EAR using the following formula:

$$EAR = (p2 - p6) / (2 * (p1 - p4))$$

where:

- p1 and p4 are the coordinates of the inner corners of the eyes
- p2 and p6 are the coordinates of the outer corners of the eyes

The proposed languor identification framework utilizes a stylish and solid arrangement of eye proportion which is predicated on separation proportion between facial milestones of the eyes. EyeAspectRatio. gives a straightforward, quick and proficient squint identification strategy. For flicker location, we work in files of two arrangements of facial structures for example the eyes. Each eye is portrayed by six (x, y) facilitates, starting with left corner of eye and plotting clockwise round the eye locale. The connection between the width and tallness of the plotted directions is named the EAR. The connection has six focuses spoke to by p1, p2, p3, p4, p5 and p6 which progressively are two-dimensional eye milestone areas. The landmark points of eye are shown in figure 3. The numerator of E.A.R. condition processes vertical eye milestone separation while the denominator figures flat eye milestone separation. There exist two arrangements of vertical and one bunch of level focuses. The EAR value will be higher when the eyes are more open and lower when the eyes are more closed. A typical EAR value for open eyes is around 0.3, while a typical EAR value for closed eyes is around 0.1. To use EAR to detect driver drowsiness, we can simply monitor the EAR value over time. If the EAR value starts to decrease, it is a sign that the driver is becoming drowsy. We can then trigger an alert to warn the driver to take a break. The framework is also constantly comparing the EAR values of the current frame to the EAR values of the previous frame. If the EAR value for either eye in the current frame differs from the EAR value for the same eye in the previous frame by more than a certain threshold, the framework triggers an alert to warn the driver that they are experiencing a flicker.

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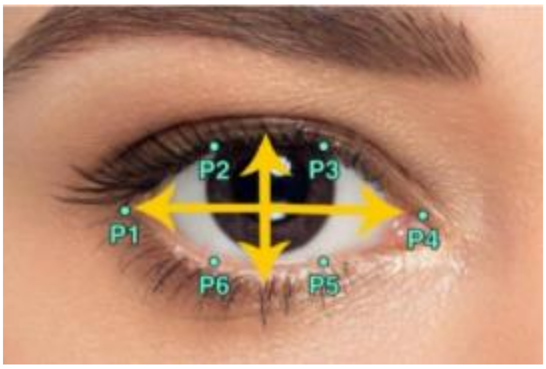

Figure 3 Eye Landmark points

4.2.2 MAR Equation:

The mouth landmark points are shown in the figure 4 and the MAR is a measure of how open the mouth is. A higher MAR indicates that the mouth is more open, while a lower MAR indicates that the mouth is more closed. The formula is as follows:

$$MAR = || P2-P8||+|P3-P7||+|P4-P6|| / 2||P1-P5||$$

where:

- P1-P5 are the coordinates of the five facial landmarks around the mouth:
  - P1: Upper lip center
  - P2: Right corner of mouth
  - P3: Lip corner at right edge of mouth
  - P4: Lip corner at left edge of mouth
  - P5: Left corner of mouth
- P6-P8 are the coordinates of the three facial landmarks on the nose:
  - P6: Nose tip
  - P7: Right nostril
  - P8: Left nostril

Computationally practically like EyeAspectRatio and MouthAspectRatio, we can expect the ratio of measures and the proportion of length of mouth, width of mouth. Our speculation was that as a private gets lazy, they will probably going to yawn and lose their power over mouth, now marking out their MouthAspectRatio to be regular on this particular state. Similarly to work out the yawning parameter the ratio of the mouth is calculated. it's calculated by the subsequent formula,

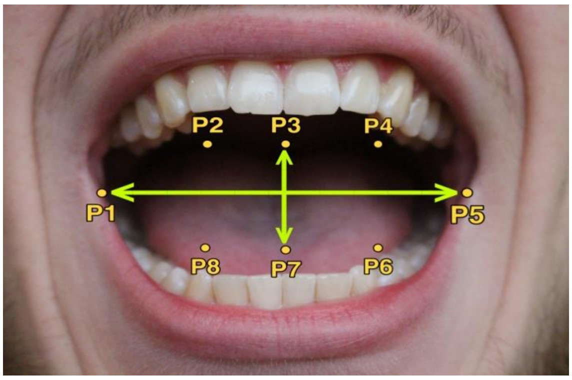

Figure 4 Mouth Landmark points

4.2.3 Algorithm

The proposed algorithm uses libraries such as dlib and OpenCV to implement the necessary functionality. Dlib provides a pre-trained model for facial landmark detection, and OpenCV provides a pre-trained model for drowsiness detection. This algorithm is a simple and effective way to detect driver drowsiness. It is non-invasive, requiring only a camera mounted in the vehicle. It is also robust to changes in lighting and facial expressions.

OPENCV (library used for real time computer vision):

main.py - E:\DROWSY DETECTION\main.py (3.6.4)

File Edit Format Run Options Window Help

```
from parameters import *
from scipy.spatial import distance
from imutils import face_utils as face
from pygame import mixer
import imutils
import time
import dlib
import cv2
```

Presently for ascertaining the eye-angle proportion we'd prefer to process the Euclidean separation between the facial milestones focuses which progressively needs SciPy bundle in python.It is not a severe prerequisite but rather SciPy is required if work related with PC Vision or picture preparing is intended. the bundle named imutils is needed for picture handling and PC vision capacities to assist the working with OpenCv library. The string class is imported all together that we will blare the caution during an alternate string from fundamental string all together that it's guaranteed that our content doesn't stop/delay executing while the alert signals. in order to play a document of the wav or mp3 design,then the sound library which is present will be played.

Library(dlib) for face recognition:

```
detector    = dlib.get_frontal_face_detector()
predictor   = dlib.shape_predictor(shape_predictor_path)

ls,le = face.FACIAL_LANDMARKS_IDXS["left_eye"]
rs,re = face.FACIAL_LANDMARKS_IDXS["right_eye"]
```

The dlib was considered as (face detection) library. By using this librarywe can mark out the specific regions.

4.2.4 Results and Discussion

Figures 5 and 6 depict normal operation (eyes open and moth closed) and drowsiness detection (eyes closed) respectively.

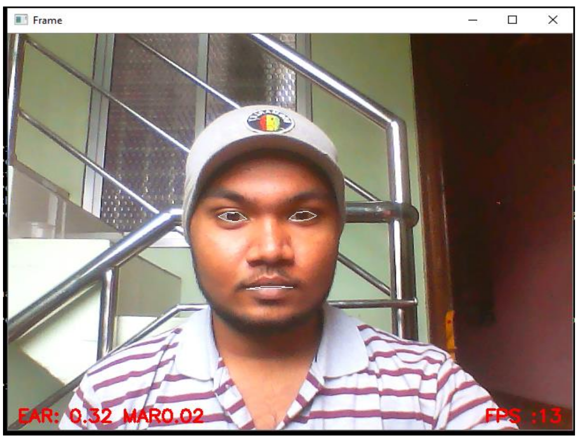

Figure 5 Proposed System Screenshots

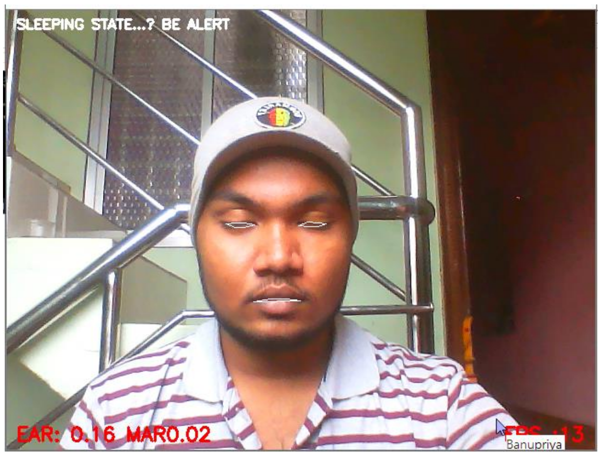

Figure 6 Drowsiness detected and alerted (Eyes are closed)

Figure 7 illustrates how tiredness can be recognized when the mouth is open widely and how the driver is warned.

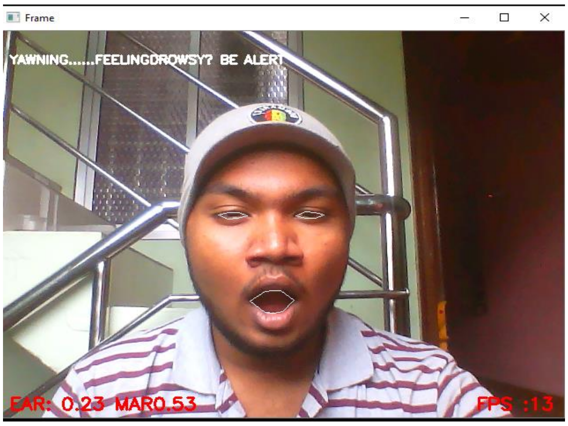

Figure 7 Yawning state detection

Figure 8 shows the driver is in active mode while wearing spectables. To identify the tiredness in a driver wearing glasses a combination of image processing and machine learning approaches are utilized . Using the OpenCV library, the face area must first be located. Once the facial region is identified,the researchers used a dataset of images of drivers wearing glasses and not wearing glasses. The eyeglasses are removed using eyeglasses are removed using morphological operations. Because eyeglasses might obstruct the detection of the eyes and eyelids, this is important. After taking off the glasses, the eye regions are identified. So our proposed model able to detect accurately drowsiness when the driver was wearing glasses. It also handles a variety of lighting conditions and head poses. It also helps to prevent accidents caused by drowsy driving. Figure 9 shows the drowsiness detected and alerted the driver while wearing spectacles

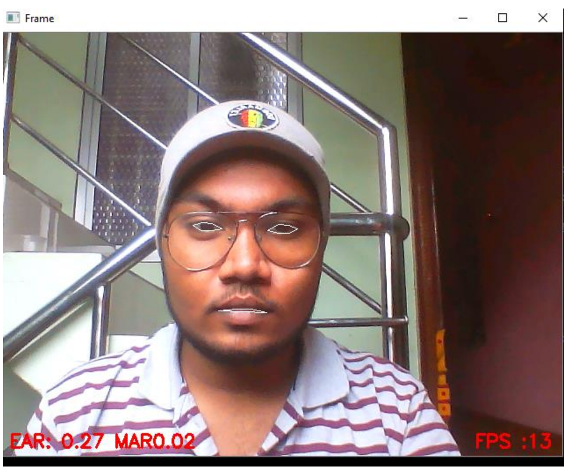

Figure 8 Normal operation (wearing spectacles)

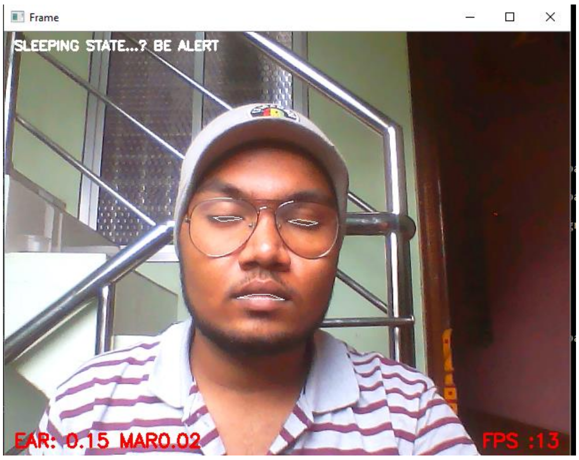

Figure 9 Drowsiness detected and alerted after wearing spectacles

5. Conclusion

The paper intends to present an answer to alert the driving force before a mishap happens. The proposed system captures the videos and, using image processing techniques, recognizes the driver's face in each case.The technology can recognize facial landmarks and calculates the Eye Aspect Ratio (EAR) and Mouth Aspect Ratio(MAR) to assess the driver's level of tiredness. The proposed system is simple, efficient, and robust to various environmental factors, such as lighting conditions and driver head poses. It can also detect drowsiness when the driver is wearing glasses. Detecting the fatigue of the driver, which is one among the main explanation for road accidents, will reduce deaths and injuries to an excellent extent. The system has been evaluated on a real-world dataset of driver images, and it has achieved high accuracy in detecting drowsiness. The system can be easily implemented in a real-time environment using a low-cost camera, making it a practical solution for driver drowsiness detection. The proposed system can be used to develop a variety of driver assistance systems to mitigate driver mishaps.

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