Real Time Driver Drowsiness Detection System Using OpenCV and Python

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Abstract: **Millions of people worldwide grapple with the serious issue of driving while experiencing exhaustion. According to the National Highway Traffic Safety Administration (NHTSA), close to 100k incidents arise every year in the INDIA due to drowsiness/fatigued driving - out of which around 1550 are fatal accidents. The issue particularly impacts commercial drivers, shift workers, or those who suffer from sleep conditions as they are at a higher risk of meeting with such incidents related to tiredness. Consequently, addressing this concern becomes all too important within our preview where we have proposed an innovative real-time driver drowsiness detector using OpenCV and Python technologies The focus of this project is heavily based on the facial detection with the ROI of both eyes instead of the whole face. Our project is designed for identifying any indications that hint at slackening focus thus reminding drivers about taking timely breaks or stopping over until they feel rested enough.**

Keywords—Drowsiness, OpenCV, Python, ROI (Region of Interest)

INTRODUCTION

Drowsiness can be described as a biological state where the body is in transition from awake state to a sleeping state. Drowsiness is intermediate stage between wakefulness and sleep that has been defined as the state of progressive impaired awareness associate with the desire or inclination to sleep.1 in 4 vehicle accidents are caused by drowsy driving and 1 in 25 adult drivers report that they have fallen asleep at the wheel in the past 30 days. The scariest part is that drowsy driving is not just falling asleep while driving. Drowsy driving can be as small as a brief state of unconsciousness when the driver is not paying full attention to the road. Drowsy driving results in over 71,000 injuries, 1,500 deaths, and $ 12.5 billion in monetary losses per year. Due to the relevance of this problem, we believe it is important to develop a solution for drowsiness detection, especially in the early stages to prevent accidents. Many of the road accidents will occur due to drowsiness of the driver. Drowsiness can be detected by monitoring the driver through continuous video stream with a mobile or camera. The general objective is to create a model that will indicate whether a person is feeling drowsy or

LITERATURE REVIEW

There have been several literature surveys conducted on driver drowsiness detection systems using OpenCV and Python. Some of the key surveys are discussed below:

1)"Driver drowsiness recognition based on computer vision technology" In this paper a non-profit drowsiness

detection technique with the use of eye monitoring and photograph processing, added a strong eye detection set of rules to solve issues as a result of modifications in brightness and motive force posture. The six measurements are calculated as the proportion of eyelid closure, maximum final period, frequency of eyelid frequency, average eye level opening, eye velocity beginning, and eye pace. those movements are completed collectively the usage of Fisher's linear discrimination features to limit co-approaches and to acquire an impartial index. The outcomes from the six contributors within the riding simulator experiments show the feasibility of this video-primarily based drowsiness detection approach imparting 86% accuracy.

2)**"Digital camera-primarily based drowsiness reference for driving force kingdom classification underneath actual driving conditions"**

it's proposed that driving force eye measures be initiated to come across drowsiness under the simulator or experiment conditions. Ultra-modern eye tracking overall performance automobile fatigue is classed supported assessment measures. These measures are statistically and a category technique supported 90 hours big dataset of drives on the essential avenue. The consequences show eye-tracking consequences detecting drowsiness works longer for some drivers. Blink detection works simply high-quality with a number of the proposed improvements still have problems for humans with terrible lighting fixtures conditions and sporting glasses. In precis, digital camera-based totally sleep measurements provide treasured support for drowsiness, but having suggestions by myself is not reliable enough.

OBJECTIVE

- The principal objective is to design or develop Drowsiness Detection Model which detects the eye movements of the driver to acknowledge the sleepy

pattern and generate the Sound Alarm whenever the driver feels drowsy.

- The secondary objective of this project is to make the model platform independent, computationally less efficient devices and cheap for the low-end spec platform. Also, to make detection algorithm accurate in terms of sensing the face.

RESEARCH METHODOLOGY

In the past, the facial detection was not prominent and if it was carried out, it was not accurate. So, the previous model of drowsiness detection was of average performance. At that time multiple problems were loaded these systems, one of the most important was the accuracy of the facial detection algorithm. Because of which the performance of the system was heavily compromised.

So now in this model, the facial detection process is carried out by the facial detection algorithm, [4]***shape_predictor_68_face_landmarks.dat*** which is pre-trained by the *Dlib* model for face landmark detection. Dlib has excellent Face Detection and Face Landmarks algorithms built in. Also, it provides pre- trained model for facial landmark detection. The ROI (Region of Interest), that is the eyes of driver is created using the face_utils of the *imutils* module of Python. The *Euclidean distance* for eye ratio is calculated using the distance of the *scipy.spatial* module. The alarm sound is carried out by the *pygame* module which is initiated when driver is detected to be drowsy or sleepy.

SOFTWARE REQUIREMENTS SPECIFICATION

The presented model's performance will be based on quality of the camera. The Graphical User Interface is provided so the user can easily interact with model by just clicking on the interface provided. The front end is made user-friendly so that it isn't too complex for the non-technical user. The model requires a web-cam (camera) & a speaker as its basic entity. The complete model is built on Python 3 and is implemented alongwith the necessary peripheral devices.

DROWSINESS DETECTION DESIGN

System Architecture

During the driving of heavy vehicle (including car), this model uses web-cam to take live video feed as input. Thisfeed will be used as an input for the detection of drowsiness in the driver. The feed will be processed by the OpenCV module and with the help of Dlib the landmarks are established, which in this case are eyes. The calculation of eye aspect ratio is calculated by the Euclidean distance formula which is used to measure the eye closure and generate warning if the value is decreased than the defined threshold value and ultimately the alarm will set off.

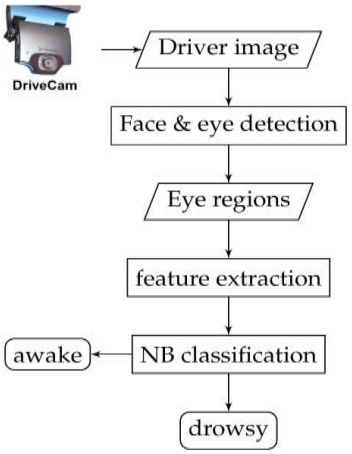


Figure 1. Flow chart of DDM.

Detailed Design

➢ Take Image as Input from a Camera: With a webcam, we will take images as input. We use the method provided by OpenCV, cv2.VideoCapture(0) to access the camera and set the capture object cap.read() will read each frame and we store the image in a framevariable.

➢ Detect Face in the Image and Create a Region of Interest (ROI):OpenCV algorithm for object detection takes grey images in the input. face_utils.FACIAL_LANDMARKS_68_IDXS["EYE _L/ R"] is used to define eyes from the Model itself.

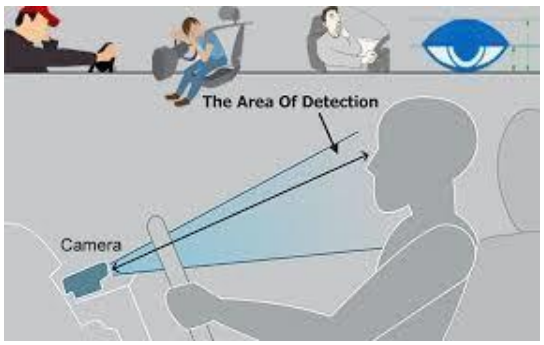


Figure 2. Eye Detection.

➢ Detect the eyes from ROI and feed it to the classifier: The same procedure to detect faces is used to detect eyes. We can use an OpenCV Cascade Classifier to detect a face and eye and use it to get the face bounding box.

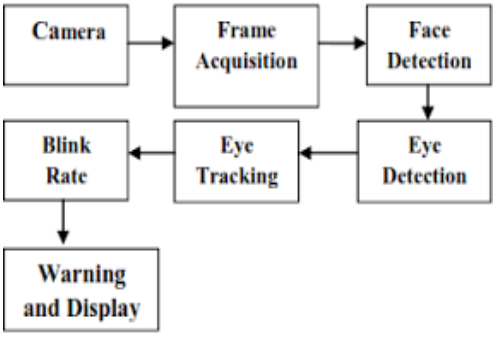


Figure 3. Flow of Detection Process.

- Classifier will Categorize whether Eyes are Open or Closed: The Classifier will detect the eye aspect ratio to whether the eyes are open or not.This is done by a simple Euclidean formula. Calculate Score to Check whether Person is Drowsy: The score is basically a value we will use to determine how long the person has closedhis eyes. We are drawing the result on the screen using cv2.putText() function which will display real time status of the person.

$$EAR = \frac{\|p_2 - p_6\| + \|p_3 - p_5\|}{2\|p_1 - p_4\|}$$

RESULT AND DISCUSSION

In this project, there is no dataset training as the model used for facial recognition is pre trained. The [4]**shape_predictor_68_face_landmarks.dat** is used todetect the face in a frame or image. The output is based on status of the object created for the algorithm (i.e.,driver's eyes). The following result is generated as per the positioning of the eyes:

Table I: Model Testing

Test Case	Eye Status	Eye-lid Position	Result
Case 1	Not detected	Open	No Alarm
Case 2	Detected	Open	No Alarm
Case 3	Not detected	Close	No Alarm
Case 4	Detected	Close	Alarm

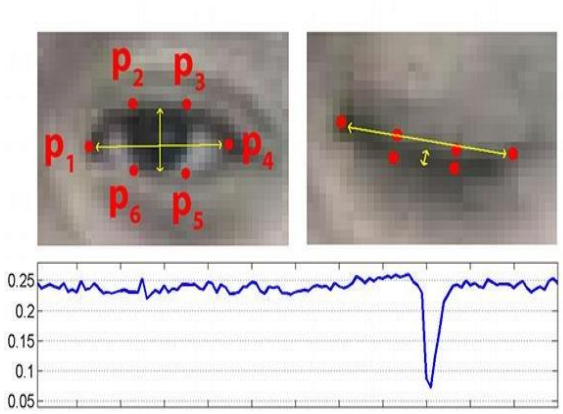


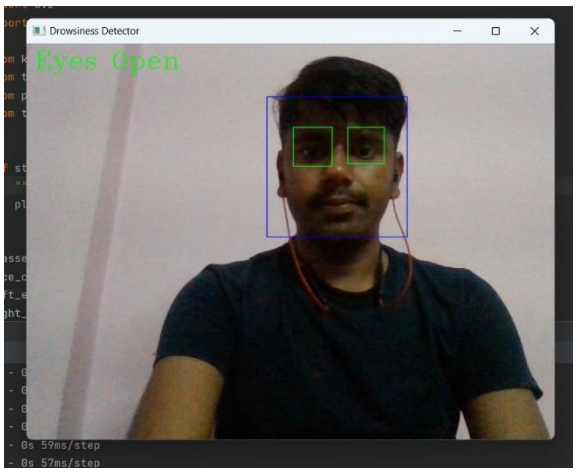
Figure 4. Region of Interest (ROI) & Euclidean Distance

According to the approach of the model, if the eye-lidsare closed for more than the pre-defined threshold value, the model will start to generate alert message with alarm. Subsequently, one of the different cases arises, theresult will be generated as per the above table.

The live testing of the model has shown the followingresults:

Figure 5. Ideal detection of eye.

The above image shows the ideal positioning of the face as well as the eyes. It defines the case in which the Eye Status is Detected and the Eye-lid Position is Open. The counter value is generated sidewise to the image frame and when the eyes are closed for more than 20 (i.e., the threshold value defined in the model), the alert message along with the alarm. The Fig. 2 shows the alert generation case as stated above.



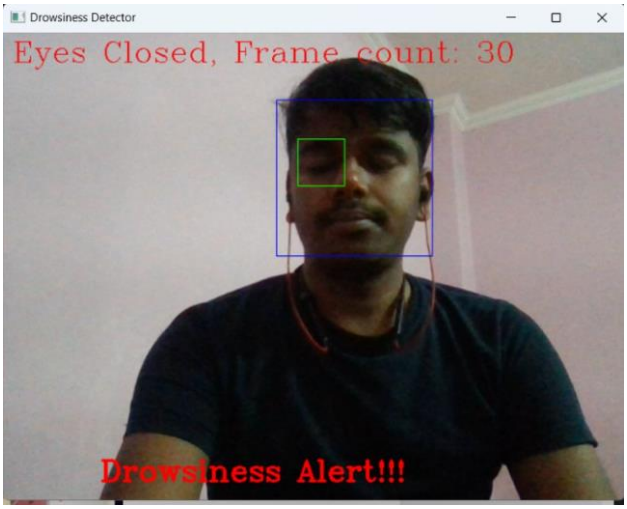


Figure 6. Detection and Alert Generation.

CONCLUSION

The Drowsiness Detection Model is competent of detecting the sleepiness by keeping track of the eye'smovement of the driver. The inputs are obtained from the facial detection algorithm which is pre trained by the haar-cascade model of facial recognition. The model deals withthe eye's aspect ratio to detect the region of interest. The eye's aspect ratio is calculated using the EAR function. The alert is generated if the value of the detection counter exceeds the threshold value defines inside the driver code. The main focus for developing this project isto reduce the number of accidents which occur due to the sleepiness of the drivers.

FUTURE SCOPE

The correctness of this model is hugely dependent on the quality of camera. The quality of detection degrades if the driver's eyes are not clearly visible for the detection. It can happen because of the Sunglasses or spectacles having light reflection or any other kind of obstacles between the eyes and the camera. Also, if the driver is not facing the camera properly, the accuracy is compromised.

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[4]. Shape_predictor_68_face_landmarks.dat, is a toolthat takes in an image containing some object and outputs a set of points location that define the pose of the object. It is also used in detecting the face in a frame or image.

BIOGRAPHIES

Nitish Kumar –He is currently student of B. Tech final year, Department of Computer Science, Global institute of technology & Management, Gurgaon, India. And working on Drowsiness Detection Model.

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