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Driver Drowsiness Detection System

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***Abstract*— Road traffic accidents and other types of accidents are a common source of injury and death among the general population. The drivers are frequently exhausted and on the edge of becoming fatigued. This causes individuals to have bursts of microsleep, which is a brief bout of tiredness that can last anywhere from a fraction of a second to 30 seconds in which the victim fails to react to a stimulus in the surroundings and falls unconscious. According to current figures, India's traffic accidents claimed the lives of over 151 thousand people. The World Health Organization's (WHO) worldwide status statement on road safety noted that carelessness and tiredness of the driver are the leading causes of road accidents.We have offered a review of the Driver Drowsiness System in this work based on several reference papers that we have read. In this paper, we have provided a brief synopsis of a few reference publications.**

***Keywords*— Driver drowsiness, Opencv with dlib, Driver fatigue, drowsy detection, yawning and eye detection, drowsiness**

I. Introduction

Various studies have shown that about 20% of all road accidents are related to fatigue, up to 50% on some roads, with driver fatigue being a factor. significantly in a large number of vehicular accidents. Recent statistics estimate that every year 1,200 deaths and 76,000 injuries can be attributed to fatigue-related accidents. The development of technology to detect or prevent drowsiness while driving is a major challenge in the field of crash prevention systems. Because of the danger that drowsiness presents on the road, methods must be developed to counteract its effects.

Driver Doze is an automotive safety technology that helps prevent accidents caused by drowsy driving. Drowsy drivers can cause serious accidents on the highway. Warning and accident prevention systems are tough work, and controlling sleepiness during long-distance travel is also difficult. But our target is to prevent and recommend them.

Various technologies can be used to try to detect drowsy drivers.

1) Directional monitoring
2) Vehicle lane position monitoring
3) Driver eye/face monitoring
4) Physiological measurements.

It focuses specifically on technology that monitors the driver's eyes and face. Reading different articles, I found several different ways to implement this technique. In this article, I have tried to briefly explain the outline of each research paper.

The application was implemented using OpenCV and different libraries and dlib.

II. Literature Review

Dr. Jagendra Singh in his paper "Learning based Driver Drowsiness Detection Model(2020)"discussed about a model with 92.5% accuracy. His research paper includes a model to detect driver drowsiness using face recognition. It basically uses Common Object Context(COCO) dataset to recognize an object(person's face) firstly. Then it applies algorithm on consecutive frames for calculation of time that an eye takes to close. By general logic, the time taken by a drowsy driver to close the eyes will be greater than the time taken by the driver who is generally blinking. If the time is effectively longer it could result in a dangerous crash as a result of fatigue and sleepiness.

if EAR is less than 0.3(threshold) for at least 20 consecutive frames then driver has drowsy eyes[1].

"Driver Drowsiness Detecting using Percentage Eye Closure Method(2020)" is given by K.S.Sankaran and others presenting a method to classify eyes and detect eye closure levels based on the concept of the Viola-Jones method. By using this method, it detects the face of the person and if it detects the face means the PERCLOS is used to find eye closure. The eye closure is having three states open, closed and partially closed. According to the required state of the driver, the system works. If the driver's eye is closed means the alarm/ warning signal is given to the driver. The computed results which are given describes the comparison for HMM and SVM models[2].

L.Shang and others focused on implementing detection system using OpenCV. The paper " Eye Focus Detection Based on OpenCV "includes design based on OpenCV to detect the attention and attention time of people in the real-time video images, and judge the attention and attention time of users based on this information. This design USES OpenCV's own haar-like classifier for video stream face and eye recognition. The system includes image acquisition, face detection, eye detection, image pre-processing, pupil positioning and attention detection. Therefore, the system shall be composed of the following modules: 1) image acquisition module: real-time acquisition of video through the camera. 2) face recognition module: use haar-like classifier to recognize and locate each frame of image, and intercept the face image. 3) human eye recognition module: use haar-like classifier to recognize and locate human eyes on face images, and capture left and right eye images respectively 4) Averaging, gaussian filtering, binarization, and other image pre-processing modules are included. 5) pupil positioning module: use Hough transform circle detection on left and right eye images respectively to detect the pupil position. 6) attention detection module: determine attention and attention time according to the coordinates of pupil centre.[3].

"Detecting Drowsy Drivers Based on Eye Movement and Yawning Using Facial Signal Analysis" is once again an impressive research paper aimed at maintaining driver awareness and detecting somnolence using a 300 W dataset with the application of an API-based histogram of directional gradients and linear support vector mechanics. This enables face detection and classification, random forest regression with 2 split nodes per tree for facial landmarks, and Euclidean distance point extraction for eyes and mouth for sleep detection based on eyesight and yawning.

results achieved by the model:

i) 91.67% accuracy speed performance at camera angles 0% and , ii) 93.33% accuracy when detecting sleepy activity at both camera angles from +45° to 45°, both with 85% Accuracy leads to simultaneous detection of eyes and mouth. Continuous eye closure provided 100% protection in two different camera angle configurations in this study. However, yawning and the combination of visual and oral somnolence suffer from limitations in detection and recognition. So, for further improvement, the study recommends providing different calculations for aspect ratio and eyes so that a more flexible and efficient sleep detection model can be created.[4].

Dr. D. Rosy Salomi Victoria and others in their paper "Driver Drowsiness Monitoring using CNN" presented a model on effective CNN architecture, planned to observe drowsiness based on eye closure. The implementation started preparing image datasets for both open and closed eyes. 75% of the data set is used for the custom-designed CNN training and the balance 25% of the dataset is utilized for test purposes. The proposed CNN gives a training accuracy of 97% and a testing accuracy of 67%. For future works, extra face characteristics can be added to give more accuracy in detection[5].

Another impressive paper is " Eyes Closure and Yawning Detection for Drowsiness Analysis by Infrared Camera" which presented a method to detect driver's eyes Closure and yawning for drowsiness analysis by infrared Camera. There are four methods, namely, face Detection, eye detection, mouth detection, and eyes closure and yawning detection. Four experiments, namely 1) face Detection, 2) eyes detection, 3) mouth detection, and 4) eyes Closure and yawning detection, were used to test the Performance of the system. The accuracy rate of 1) face Detection, 2) eyes detection, 3) mouth detection, and 4) eyes Closure and yawning detection were 99.47%, 94.33%, 99.80%, and 92.5%, respectively. Errors occurred when a Face is occluded such as hand. For future work, the method Should be performed effectively, although capture angle of Camera is varied in width range [6].

Dr. S. Kailasam in his paper "Accident Alert System for Driver Using Face Recognition" discussed about how they used a night vision camera for the eye detection. In this they connect a night vision camera with drowsiness detection system and that is connected to the speedometer. It will monitor the eye blinking for few seconds. If the condition is YES, then it goes to control system and the speed of the car. If the condition is NO then the night vision camera will continue the monitoring process. Night vision camera totally screens and after that sends the data to the control system. Then, control system successfully sends information to speedometer and thus it reduces to the random speed [7].

Dr. A. Uppal in his paper "Emotion recognition and drowsiness detection using Python" discussed that how they used Computer vision for emotion recognition and drowsiness detection using Python as python gives high accuracy on face or emotion recognition. dlib which is a opencv library is use to detect the face using the get_frontal_face_detector() function, further on the shape_ predictor function is used to find the facial landmarks. The indexes for left and the right eye are found which are used are to extract eye region from the frame. The eye aspect ratio for the left and the right eye are calculated. The final eye aspect ratio is the average of both of these values.

The results, to see the eye area it looks for the outline of the frame and we do this through a convex shell to find if a curve is convex. For each frame we calculate eye aspect ratio and check whether it is less than the given threshold value, if its more it saves the result. If the eye aspect ratio is more than threshold value for consecutive three frames, the person is declared to be drowsy and a warning signal is generated.[8].

Dr. G. Salizillo in his paper "Evaluation of Driver Drowsiness based on Real-Time Face Analysis" discussed about the algorithm implemented in python libraries using dlib, skfuzzy. The framework developed consists of five main steps. First, there is a face detection stage. Secondly,a set of facial landmarks locations are determined. Then, the facial landmarks are obtained, the orientation of the driver head is estimated, and any possible blink is detected. Eventually, with the monitoring of some ocular variables, the degree of driver drowsiness is detected through a Fuzzy Inference System (FIS).

A pre-trained facial landmark detector has been used to estimate the location of 68 (x, y)-coordinates that identify the characteristic regions of the face. The indexes of the 68 coordinates can be viewed. To build the blink detector, a metric called the Eye Aspect Ratio (EAR) has been selected. The EAR metric is a relationship between the width and the height of these coordinates, i.e.,

$$EAR = \frac{||p2 - p6|| + ||p3 - p5||}{2||p1 - p4||}$$

the EAR calculated for the left and the right eye, respectively. The total EAR metric taking into account both eyes is simply the average value

$$EARtot = \frac{EARl + EARr}{2}$$

This system does not require intrusive acquisition systems, therefore it could be easily adopted in a real-world driving scenario. [9].

The goal of this work is to extend the driver drowsiness detection in vehicles utilising signals from a driver monitoring camera, according to Dr. Mariella DreiBig's publication "Driver Drowsiness Classification Based on Eye Blink and Head Movement Features Using the k-NN Algorithm." In driving simulator tests, 35 features relating to the driver's eye blinking habit and head motions are retrieved for this purpose.

We designed and tested a feature selection method for the driver's state categorization based on the k-Nearest Neighbor algorithm using that enormous dataset[10].

III. PROPOSED METHOD

A. *Facial Landmark Detection*

Individual frames are extracted from the input video stream and converted from RGB to grayscale using openCV. Then the individual images are extracted and converted from RGB to grayscale using openCV. From then on, the dlib is used to identify faces and draw sights. This is accomplished using a dlib form flag record with an id and a flag. The indicator is used to distinguish the face and the indicator is used to plan the facial attractions, e.g. eyes, mouth, nose, eyebrows, jaw from the edge. At this step, the dlib library's facial landmarks finder is used to draw 68 points on the face instructing various facial structures such as the eyes, lips, nose, eyebrows, and jaws, as shown in Fig. 1 Then we use the face utilities from the imutils library to delete the necessary face landmark files. Using these lists or facial focus we can define Eye Angle Ratio (EAR) and Lip Distance.

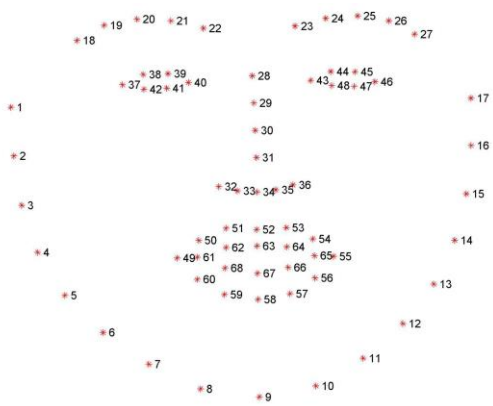

Fig.1 68 Facial Landmarks

B. *Eye Blink Detection*

Face and eye identities are localized by opencv and dlib. We can practice the milestone areas of the face to narrow down large areas of the face such as eyes, eyebrows, nose, ears, and mouth. When it comes to identifying flickers, we're just interested in two face structures: the eyes and the mouth. After identifying the location of eyes, the state of eye is measured. that is whether the eye is closed or open. The eye aspect ratio (EAR) is used to measure the state of the eye.

As shown in Figure 1, each eye is represented by 6 (x, y) - coordinates, starting at the attention angle on the left and proceeding clockwise from that location for the rest. increase. Based on this image, we need to eliminate important points. There is a relationship between the latitude and peak of these coordinates.We can then derive an equation that reflects this relation called the eye aspect ratio (EAR):

$$EAR = \frac{|| p2 - p6 || + || p3 - p5 ||}{2 || p1 - p4 ||}$$

Where p1 to p6 are the position of the 2D face markers. The numerator of this expression calculates the space between the vertical landmarks. The denominator calculates the location between the horizontal eye landmarks. A high EAR value means that the numerator is higher than the denominator. This indicates that eyes are open because the average vertical distance is greater than the horizontal distance as shown in FIG. 2A. When the EAR value is zero, the numerator is less than the denominator, which indicates that the normal distance of the vertical distance is lower than the horizontal distance, and as a result, the eyes are closed. FIG 2B. This technique is used to measure the state of the eyes.

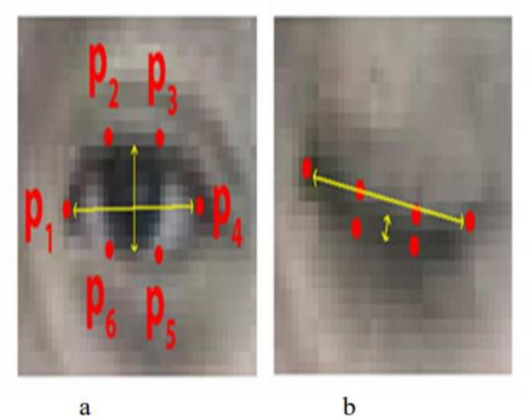

Fig 2.

C. *Yawn detection*

Mouth region captured by dlib. Facial feature detection is applied to find important areas of the face. To detect yawning, the upper lip and lower lip are first located with full face recognition via dlib. The average of the upper lip is calculated and the same is calculated for the lower lip. The absolute distance is calculated from the upper lip to the lower lip.

IV. IMPLEMENTATION

As seen in Figure 3, the webcam starts up and begins taking live video as an input. It then extracts the image frames from the given input video using OpenCV. Once the face is detected, the 68 landmarks are annotated on the face using dlib.

At this point, we separate the list of critical points on the face, in this case the eyes and mouth, using the face utilities from the imutils package. After eyes and mouth are detected they are taken as an input and converted into grayscale image.

Once this is done the EAR and lip distance are calculated and compared with the threshold values. And based on the results, it will give an alert to the driver.

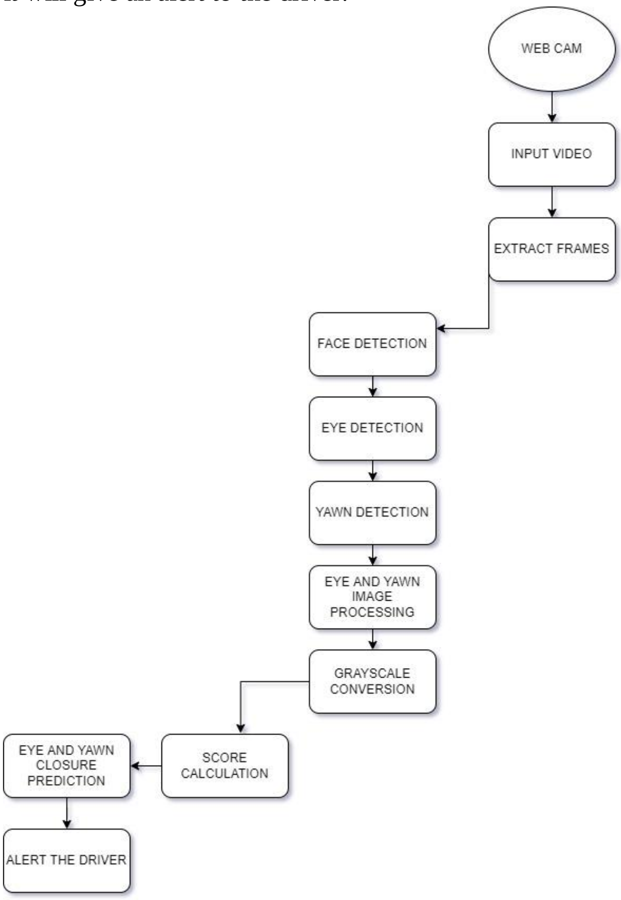

Fig3: System Architecture

V. RESULTS AND TABLE

A. Results

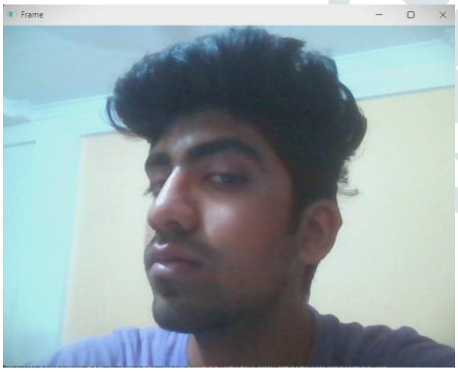

Fig 4: Face improperly aligned

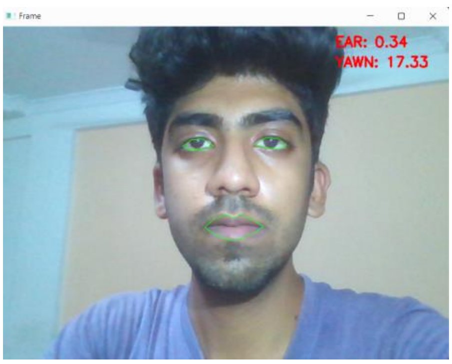

Fig 5: Face properly aligned

Fig 6: Drowsiness Alert when Eyes are closed

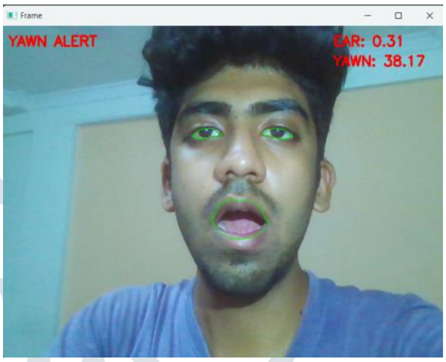

Fig 7: Yawn Alert

B. Table: System Testing

Test Cases	Eyes detected	Eyes closed?	Yawn Detected	Results
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

The given table shows the 5 sample test cases that were performed during this project Driver Drowsiness Detection System.When the driver's eyes are closed for more than the defined threshold number of frames or when the driver yawns (threshold value for eye aspect ratio is 0.25 and lip distance is 30), the system determines that the driver is drowsy. Each time one of these notable situations appears, the associated effect occurs. When the face is perfectly oriented and no wearable barrier is present, the accuracy measured during the performance analysis phase is almost 100 %. When an obstruction is present, accuracy suffers slightly. For good outcomes, the ambient lighting conditions are critical. When the user's eyes close and yawn at the same time, a voice alert is sounded, but the system behaves incorrectly and unsynchronizedly.

VI. CONCLUSION

As we go through all these research papers, we realize that there is quite a bit work going on in this field which is actually the need of hour and yet a lot more work still has to be done. We see that different model using different technologies have different limitations. We aim to implement a detection system using OpenCV which will include eye detection along with the yawn detection to check the drowsiness of driver. These systems should be able to identify the driver needs some help to concentrate on driving again instead of feeling fatigue or fall victim to drowsiness

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