DRIVER DISTRACTION DETECTION

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Abstract - Driving safety is a paramount concern in today's world, with road accidents claiming thousands of lives every year. Among the various factors contributing to these accidents, driver fatigue, distraction, and drowsiness stand out as significant threats to road safety. To address these challenges, this project presents a novel approach to real-time driver state detection using advanced computer vision techniques. Leveraging the capabilities of the MediaPipe library, the system analyzes 68 facial keypoints to compute essential metrics such as Eye Aspect Ratio (EAR), Gaze Score, and Head Pose. These metrics serve as indicators of the driver's state, allowing for the classification of normal, tired, drowsy, distracted, or potentially asleep conditions. By continuously monitoring these parameters, the system alerts the driver to take necessary actions, thereby enhancing road safety and reducing the risk of accidents.

1. INTRODUCTION

Drowsy driving has become a serious issue in our society not only because it affects those who are driving, but also all other road users in danger. Accidents due to sleep deprivation is a common problem all around the world. According to a database study conducted by the Australian Transport Bureau in 2002 about fatality crashes it is found that 16.6% of fatal crashes were caused by sleep deprivation and based on the report submitted by Ministry of Transportation of Ontario in 2004, 25.5% of injury causing crashes and 17.8% of crashes with fatality related to sleep deprivation. All of the above statistics is an estimate because in several cases the drivers will not admit the real cause to the Police. The aim of this project is to develop a prototype for detecting drowsiness called drowsiness detection system. The focus will be placed on designing a system that will accurately monitor the driver's facial expressions in real-time. Our first challenge is how to define fatigue exactly and how to measure it. Despite the progress of science, there is still no precise definition for fatigue. Certainly, due to the lack of precise definition of fatigue, there is not any measurable criterion or tool. However, a precise definition for fatigue is not defined yet, but there is a relationship between fatigue and some symptoms including body temperature, eye movement, heart rate. One of the most important symptoms of fatigue appears in the eye. This project helps drivers to get prevented from drastic accidents and the loss of life and property can be saved.

2. RELATED WORK

A literature review discusses published information in a particular subject within a certain time period. A literarture review can be just a simple summary and synthesis, it describes about the literature survey on various journals and explored mobile communication followed by existing for a digital mobile telephony system to display the message using wireless networks.

According to the Survey on Driver Fatigue-Drowsiness Detection System, the detection system includes the processes of face image extraction, yawning tendency, blink of eyes detection, eye area extraction etc.

Tuncer et al. [1] proposed an assistant system to track a lane, which will be activated for those drivers who are not able to perform a good job of lane keeping. Another method of face detection based on locating facial features is developed by Graf et al. [2].this method states that the morphological operations will be applied to find the areas that have high intensity with certain shapes. In the drowsiness detection method proposed by Pilutti et al, [3] driver assessment is determined in the context of a road departure warning and intervention system. This method states that the vehicle lateral position is used as the input and steering wheel position as the output in order to develop a system that will be updated during driving. Craw et al. [4] proposed the following method: the frontal view face is detected based on template matching. The edges extracted from Sobel filtering will be grouped together to locate the face.

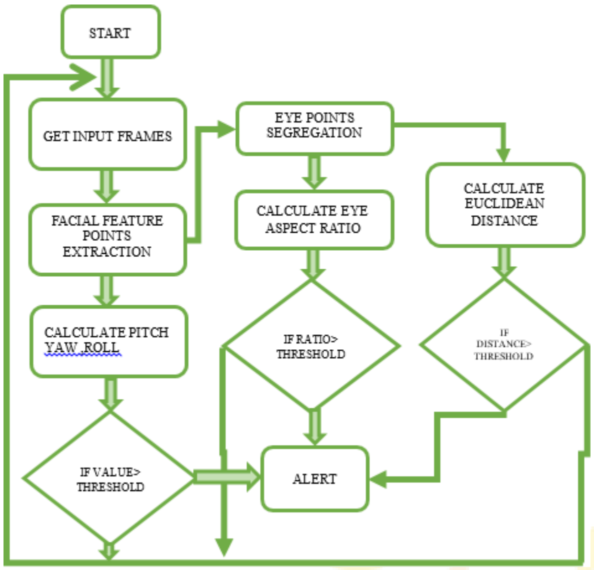
The same procedure has to be repeated for finding other facial features such as eyes, mouth and nose in the candidate face. Sigary, [5] proposed a method for hypo vigilance detection by processing of the eye region and without an explicit eye detection stage.

Tabrizi and Zoroofi [6] proposed a non-intrusive and simple way of fatigue detection by determining whether the eye is open or closed. The algorithm consist of three steps which were analyzed, such as determining eye regions by eye map and locating pupil center by the center of mass of the eye region image and the refining the pupil center and detecting the iris boundary. Omidyeganeh et al. [7] used a method of fatigue detection by applying the Structural Similarity Measure to find the eye location. In this method, the structural similarity value will be evaluated between -1 and 1. When images are the same, the max gained value will be 1 and when there are some differences, the result will be -1. Then the horizontal and vertical projection will be applied on the eye region to determine the amount of eye closure and align the detected eye region. M. Saradadevi and P.Bajaj,[8]propsed Driver Fatigue Detection Using Mouth and Yawning Analysis, IJCSNS International Journal of Computer Science and Network Security, vol. 8, no. 6, pp. 183-188, June 2008.

The robust and reliable method of face detection based on the Viola-Jones theory has been used by Wang and Shi [9] in order to limit the mouth search area to the face region. The mouth region is located based on multi-threshold binarization in intensity space and by using the Gaussian model in RGB color space. The lip corner will be found by calculating the integral projection of the mouth in the vertical direction. The two lines which are running through the lower and upper lip boundaries that is resulting from the integral projection which represents the mouth openness. In this method, the yawning will be determined by finding the degree of mouth opening in terms of the aspect ratio of the mouth bounding rectangle. A huge mouth opening over a predefined threshold for a continuous number of frames means that the driver is in a state of drowsiness.

A. Cheng et. al. [10] described 'Driver Drowsiness Recognition Based on Computer Vision Technology’. They presented an nonintrusive drowsiness recognition method using eye-tracking and image processing. Robust eye detection algorithm was introduced to address the problems caused by changes in illumination and driver posture.

3. PROPOSED METHODOLODY

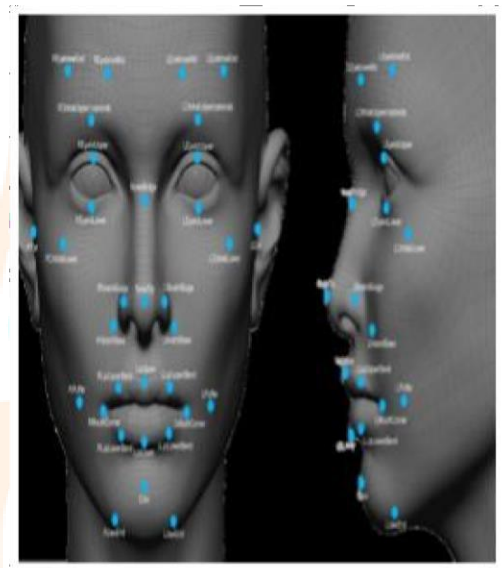


The depicted methodology focuses on monitoring the driver safety systems, where monitoring eye behavior and facial cues can help prevent accidents caused by inattentive drivers. By combining facial feature analysis with eye tracking, the system aims to enhance safety and alertness during critical tasks.

The process then splits into two parallel paths: one for facial feature points extraction (such as identifying landmarks like eyes, nose, and mouth) and calculating yaw and roll angles (indicating head orientation), and the other for eye segregation (isolating eye regions) and calculating eye aspect ratio (a measure of eye openness). These two paths converge at a decision point where the system checks if the eye aspect ratio falls below a predefined threshold. If it does, an “ALERT” is triggered, possibly indicating drowsiness or reduced attentiveness.

3.1 FACE DETECTION

For face detection itself, several approaches have been used in the related literature. Knowledge based methods try to encode human knowledge about the characteristics of a typical face, such as the relationships between facial features, and use them as a way to detect faces in an image.The goal of the feature invariant approaches is to find structural face features, such as eyebrows, eyes, nose, mouth and hairline, which persist under various poses, viewpoints or lighting and use those features to detect faces. Such features are mostly extracted using edge detectors.The video is obtained from a camera focused on the driver’s face. The Haar-based classifier contains several features such as heights, weights, face features, the threshold of face colours. It is constructed by

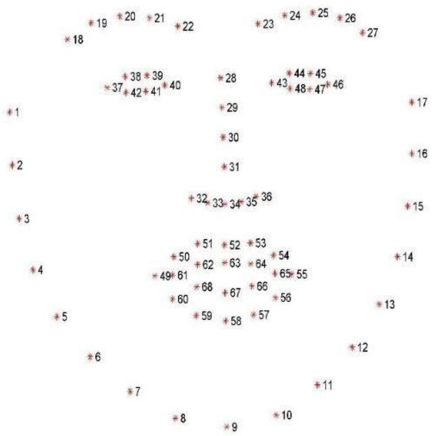


using a lot of positive and negative samples. The cascade consists both positive and negative samples. Eyes and mouth features are extracted and parallel processing is preceded by successful driver’s face detection.

3.2 FACIAL MAPPING

The algorithm is implemented using a Dlib python library that contains a landmark’s facial detector with pre trained models. The 68-point shape predictor dataset was used to train the dlib facial landmark predictor and is the source of these marking.

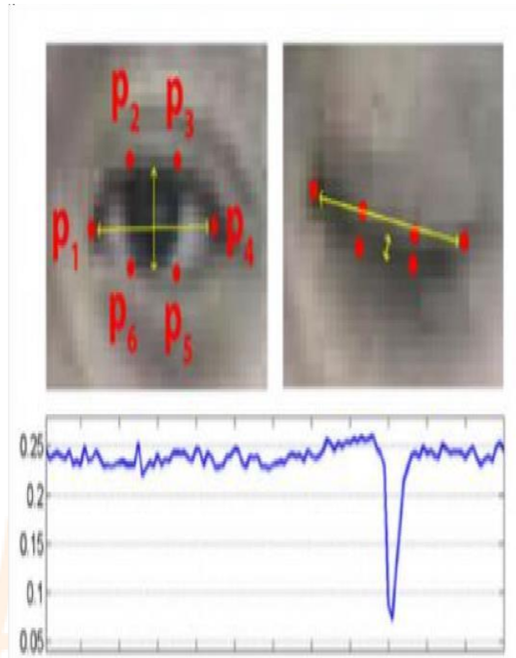
3.3 EYE DETECTION



Eye tracking is the process of measuring either the point of gaze (where one is looking) or the motion of an eye relative to the head. An eye tracker is a device for measuring eye positions and eye movement. Eye trackers are also being increasingly used for rehabilitative and assistive applications (related for instance to control of wheel chairs, robotic arms and prostheses). There are a number of methods for measuring eye movement. The most popular variant uses video images from which the eye position is extracted. We here are using eye tracking in detecting the drowsiness of the driver. Eye tracking is helping us to detect and sense the sleep of the driver, whether he is sleeping, wanting to sleep, getting exhausted while driving etc. We are first trying to generate a preview of the driver through the web camera of the laptop.The driver's preview image is being captured simultaneously by the web camera and the camera forms to give us a preview image. The camera now starts to record the video and automatically saves it in the backend so that it can be analyzed. After the images, videos, frames are being recorded and saved, the eyes are detected from them and then tracked.

3.4 EYE ASPECT RATIO (EAR)

The eye tracking involves to calculate the value for the eye aspect ratio. Eye aspect ratio (EAR) is a parameter that Determines eye state used to figure out if it is Open or closed. It can be



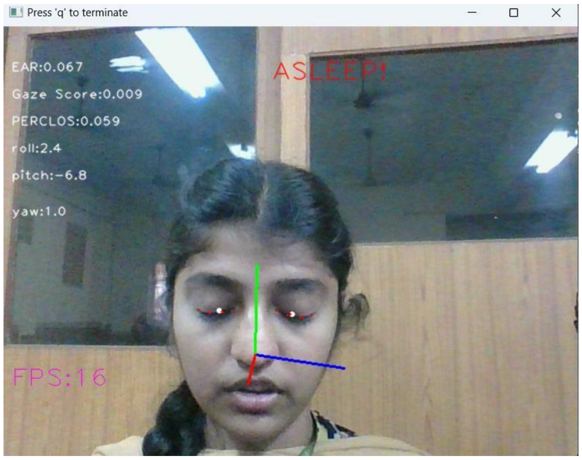
calculated using facial landmarks plotted by the 68 facial landmark point plot provided by python's dlib library. Once we get the eye region, we calculate the Eye Aspect Ratio to find out if the eye-lids are down for a substantial amount of time.Once we get the eye region, we calculate the Eye Aspect Ratio to find out if the eye-lids are down for a substantial amount of time.

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

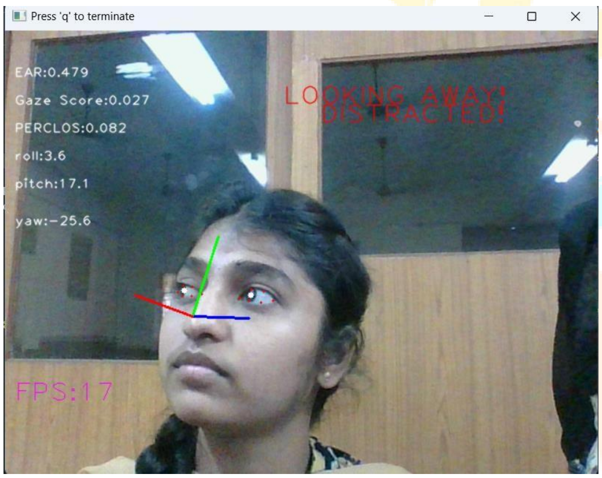
Where p1… p6 are 2D facial landmark location.

The numerator of this equation computes the distance between the vertical eye landmarks while the denominator computes the distance between horizontal eye landmarks, weighting the denominator appropriately since there is only one set of horizontal points but two sets of vertical points.

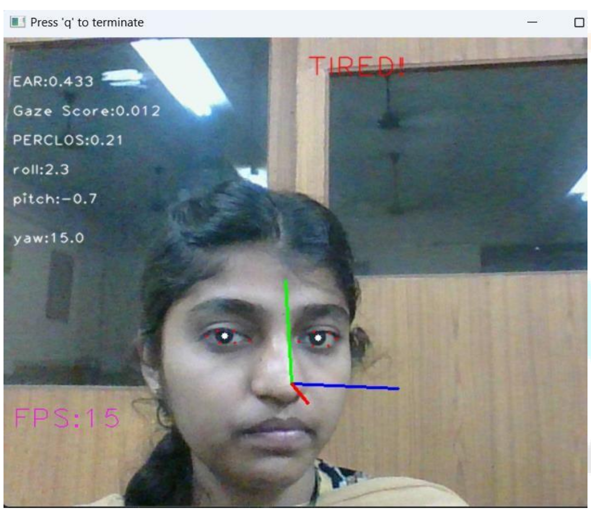
4. RESULTS AND DISCUSSIONS



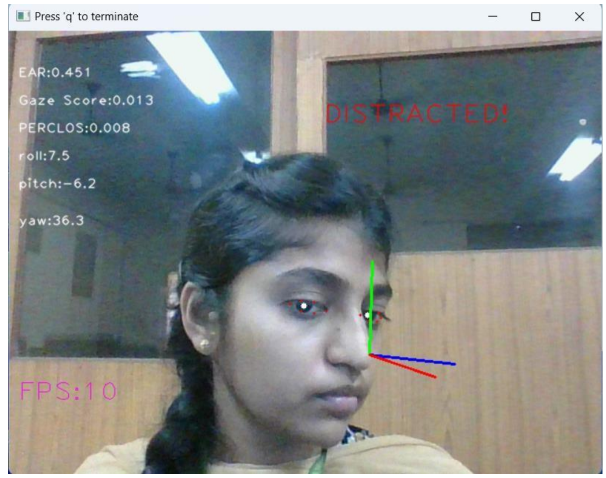
4.1 output Sample 1



4.2 output Sample 2



4.3 output Sample 3



4.4 output Sample 4

5. CONCLUSION

Hence driver state detection is a very important part for the driver while he drives the car. So every driver should have a state detection system in his vehicle so that he can be almost safe and secure from road accidents, deaths from road accidents. A distraction of even a second can take the life of the driver. Then why to take any risk? This risk can be prevented when the driver uses the driver state detection system. The truck drivers, car passengers, taxi drivers, all can be aware about this system. They can manage to get help through it. Also they must be tracked on every route where they are driving to prevent any mishappening. The fatigue detection system in drivers has thus been simulated in Open CV. The real time system has been successfully created to detect the face and hence the eyes and mouth of the driver to check whether he is blinking or yawning to acquire information about his level of alertness. The alarm that has been implemented is a pygame library which converts text to speech to alert the driver. To realize the fatigue detection on the real roads, the head posture is also a good choice in the future work.

6. FUTURE ENHANCEMENT

Some drivers cover their mouth while yawning or they have different signs of sleepiness like eye closure or falling head; in this case, future work may consist of combining the detection of different fatigue signs. When the driver wears glasses the system may not detect eyes which is the most noteworthy disadvantage of these systems. This issue has not yet been settled in near future it can be sorted out.

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