Real Time Drowsiness Detection To Reduce Major Road Accidents

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Abstract: The car population is growing exponentially in the country. The drowsiness of the driver, alcoholism and neglect are the main reasons in an accident scenario. In India, no measuring device is used to measure the drowsiness of the driver. Detecting drowsiness of the driver is a safety technology for vehicles that saves the driver's life by preventing accidents when the driver starts to sleep. The main objective is first to develop a system for detecting the fatigue of the driver by constantly monitoring the retina of the eye. The system works despite wearing glasses and in different lighting conditions. Make the driver aware of the drowsiness detected by a buzzer or alarm. A message is sent to the owner if the detected drowsiness exceeds the set limit.

Keywords- *Accidents, Alarm, Driver Drowsiness Message sent.*

I. INTRODUCTION

Detecting drowsiness of the driver is a safety technology for vehicles that prevents accidents when the driver starts to sleep. Various studies suggest that about 20% of all traffic accidents are due to fatigue, up to 50% on some roads. The fatigue of the driver is an important factor in a large number of traffic accidents. According to recent statistics, 1,200 deaths and 76,000 injuries a year are attributable to fatigue accidents [1].

The development of technologies for detecting or preventing drowsiness at the wheel is a major challenge in the field of accident avoidance systems [3]. Because of the hazard that drowsiness presents on the road, methods need to be developed for counteracting its affects. Driver inattention might be the result of a lack of alertness when driving due to driver drowsiness and distraction [2].

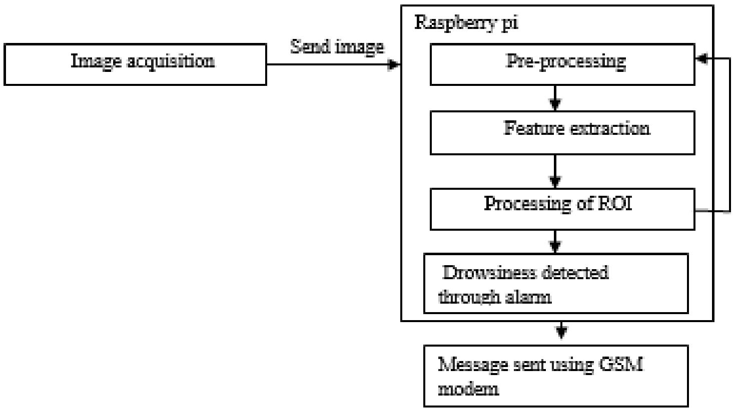
Driver distraction occurs when an object or event draws a person's attention away from the driving task [4]. Unlike driver distraction, driver drowsiness involves no triggering event but, instead, is characterized by a progressive withdrawal of attention from the road and traffic demands. Both driver drowsiness and distraction, however, might have the same effects, i.e., decreased driving performance, longer reaction time, and an increased risk of crash involvement [5].

Based on Acquisition of video from the camera that is in front of driver perform real-time processing of an incoming video stream in order to infer the driver's level of fatigue if the drowsiness is Estimated then the output is send to the alarm system and alarm is activated [6][7][8]. In this system, we have introduced message sending module to the owner when drowsiness detected.

II. SYSTEM DESIGN

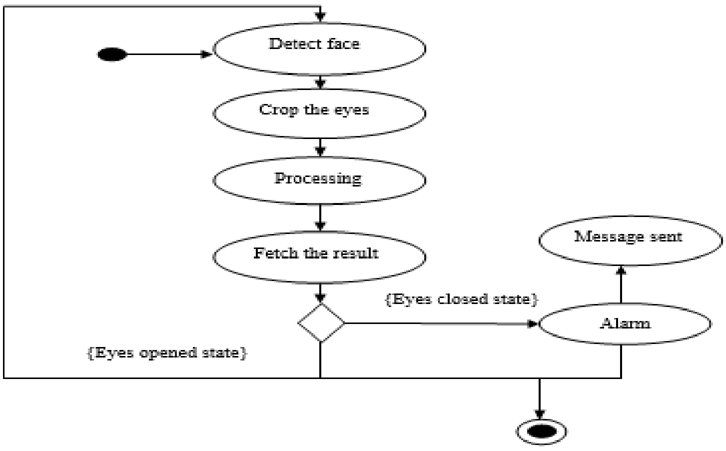
The design of a system is perhaps the most critical factor affecting the quality of the software, and has a major impact on the later phases, particularly testing and maintenance. The design activity is often divided into two separate phases. They are system design and detailed design.

Fig 1: Block Diagram Driver Drowsiness Detection System



The camera module is used for image acquisition and in the first step it is taking input form of snapshots and in the next step it senses the signal to the raspberry-pi which execute three main operations i.e., pre-processing, feature extraction and fetching the results. In pre-processing stage first frame of the snap shots is taken, using that the frame face is detected using Haar cascade algorithm and the eyes are cropped from the frame using certain calculations and then the cropped eyes are converted into binarization form. Same process continues for the next inputs. In feature extraction stage the eye percentage of each binarized frames are calculated and is compared with each other and final results are computed. If the driver closes his eyes for more than three seconds in the final stage, he is considered asleep and the alarm is triggered. If drowsiness is detected, a message appears on the screen. When the number of alarms reaches three, the message is automatically displayed sent via GSM modem to the registered phone number. Otherwise it will not remain idle and return to the original state of the camera.

Fig 2: Activity Diagram of Driver Drowsiness Detection System Activity Diagram of Driver Drowsiness Detection System



The camera gives input to the raspberry-pi by observing the eyes**.** The proper processing takes place in raspberry-pi for final result. If the driver closes his eyes for more than three seconds, the condition is met and the alarm sounds for five seconds. The message is sent to the registered mobile phone number through GSM modem. Otherwise, the process will return to the initial state to continue the process.

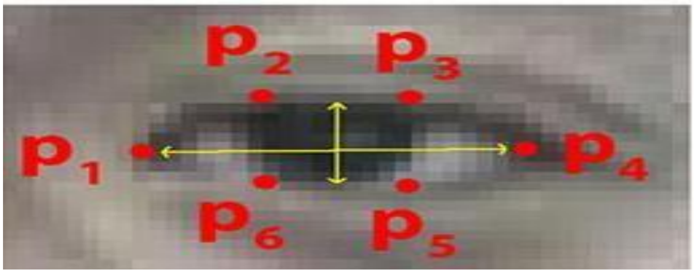
III. SYSTEM IMPLEMENTATION

4.1 Video Capture

First, set up the webcam in the car so that the face is easily recognizable and the facial mark position can monitor the eyes. The web camera mounted on the dashboard of a car captures the driver's images for video capture. Raspberry Pi is a single board computer the size of a control card and a sound alarm system for the detection of drowsiness.

4.2 Face Detection

The proposed system begins by recording the video images one after the other. OpenCV provides extensive support for live video processing. The system will detect the face in the frame image for each frame. This is achieved by using the Haar algorithm for face detection. The built-in OpenCV XML file "haarcascade_frontalface_alt2.xml" allows searching and recognizing the face in



individual images. This file contains a number of facial features consisting of a number of positive and negative samples. Start by loading the file cascading and pass the captured frame to an edge detection function that detects all objects of different sizes in the frame. As the driver's face occupies a large part of the image, instead of detecting objects of all possible sizes, specify the edge detector to detect only objects of a particular size i.e. for face region. Then the output of the edge detector is stored and this output is compared to the cascaded file to identify the face in the image. The output of this module is a frame with a recognized face.

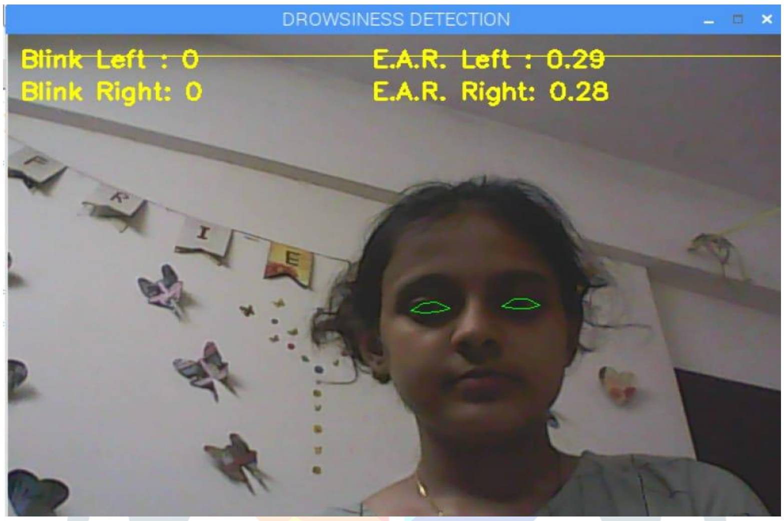


Fig 3: Detection of eye

4.3 Alert Unit

The warning unit is modelled when the driver is sleepy. An audible signal sounds when the driver is asleep. The representation of the classification output is +1 or -1 and this number is used by the warning unit as follows. In particular, the classification output is the input of a running sum that adds the successive output values and has a minimum value of zero. This device uses two thresholds. First, it is determined whether there is little or no fatigue. The second threshold is the difference between low and high fatigue levels. If the value obtained exceeds a specified threshold, this means that the fatigue is detected and that the alarm system becomes active and becomes active according to the degree of fatigue detected. When the fatigue level is low, the alarm sounds for 5 seconds and after 5 seconds the system checks the value again and runs the alarm accordingly. For a high level of fatigue, we can apply more effective accident prevention measures, such as automatic speed reduction and, finally, stopping the vehicle and the water jet. This system can be used to monitor the driver's fatigue level and to detect the onset of sleep with a safe distance.

4.4 Aspect Ratio of eye

It also means that we can extract some facial structures by knowing the indices of each facial area. With regard to the detection of the eyes, we are only interested in two groups of facial structures: the eyes. Each eye is represented by 6 coordinates (x, y), starting from the left corner of the eye (as if you were looking at the person), then clockwise around the rest of the area: each video image, the ocular characteristics are detected. The eye ratio (EAR) between the eye size and the eye width is calculated.

$$\text{EAR}=\frac{||p_2-p_6||-||p_3-p_5||}{2||p_1-p_4||} \qquad (1)$$

Here in equation (1) p1, . . ., p6 are the 2D landmark locations.

Fig 4: Eye Aspect Ratio

The EAR is generally constant when an eye is open and close to zero when closing an eye. It is partly insensitive to people and the posture of the head. The aspect ratio of the open eye has little variation between individuals and is totally invariable for uniform scaling of the image and rotation of the face in the plane. The blinking of the eyes being done synchronously by the two eyes, the average of the EAR of the two eyes is calculated. The numerator of this equation calculates the distance between the landmarks of the vertical eye, while the denominator calculates the distance between the landmarks of the horizontal eye, the denominator being weighted accordingly, because there is only one set of horizontal dots, but two sets of dots, the eye ratio is constant, then quickly falls to zero and rises, indicating that only one blink has occurred.

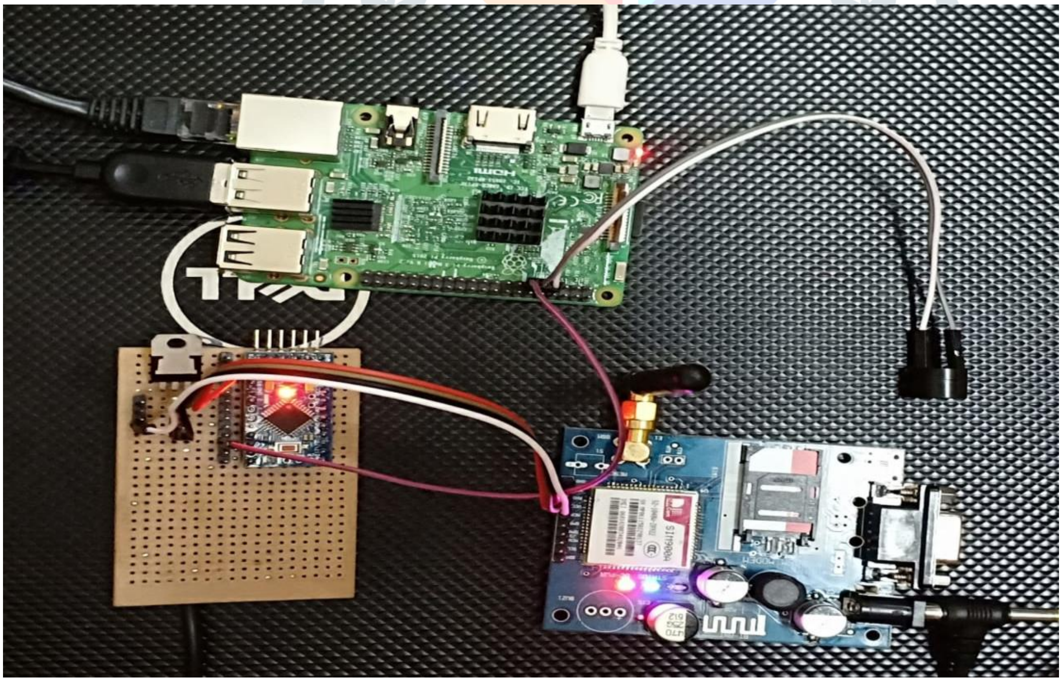
4.5 Message Sending

A GSM digitizes and reduces the data, then sends it on a channel with two different client data streams, each in a specific time window. The digital system can transfer data rates from 64 kbps to 120 Mbps. If Raspberry Pi needs to communicate with the outside world while it is not within reach of a Wi-Fi hotspot, a digital cellular network can be used. As for mobile phones, a SIM card and a subscription to any provider are required. On the hardware side, a GSM module, also called a GSM modem, can be connected to the Raspberry Pi. After three consecutive beeps, the detected drowsiness is displayed on the screen and the message is sent to the driver's registered cell phone number.

Fig 5**:** GSM Modem interfacing with Raspberry pi

The overall connection of the system where GSM modem is interfaced with the RaspberryPi and alarm also connected to the RaspberryPi. The main characteristics of GSM modem SIM900A are:

Power Requirement: This board requires external power supply of ~12V and can draw up to ~2A of current at its peak.
Indicators: It has two LED indicators as,
ON: It shows that the Modem is getting powered and is switched on.
NET: This network LED blinks when the modem is communicating with the radio network.
Network LED: When modem is powered up, network LED blink every second and after network registration it will start to blink after every 3 seconds. This shows that the modem is registered with the network.



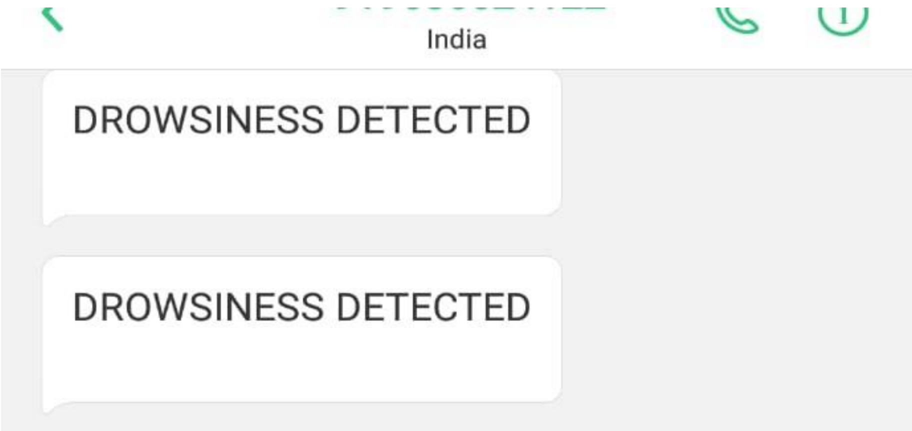
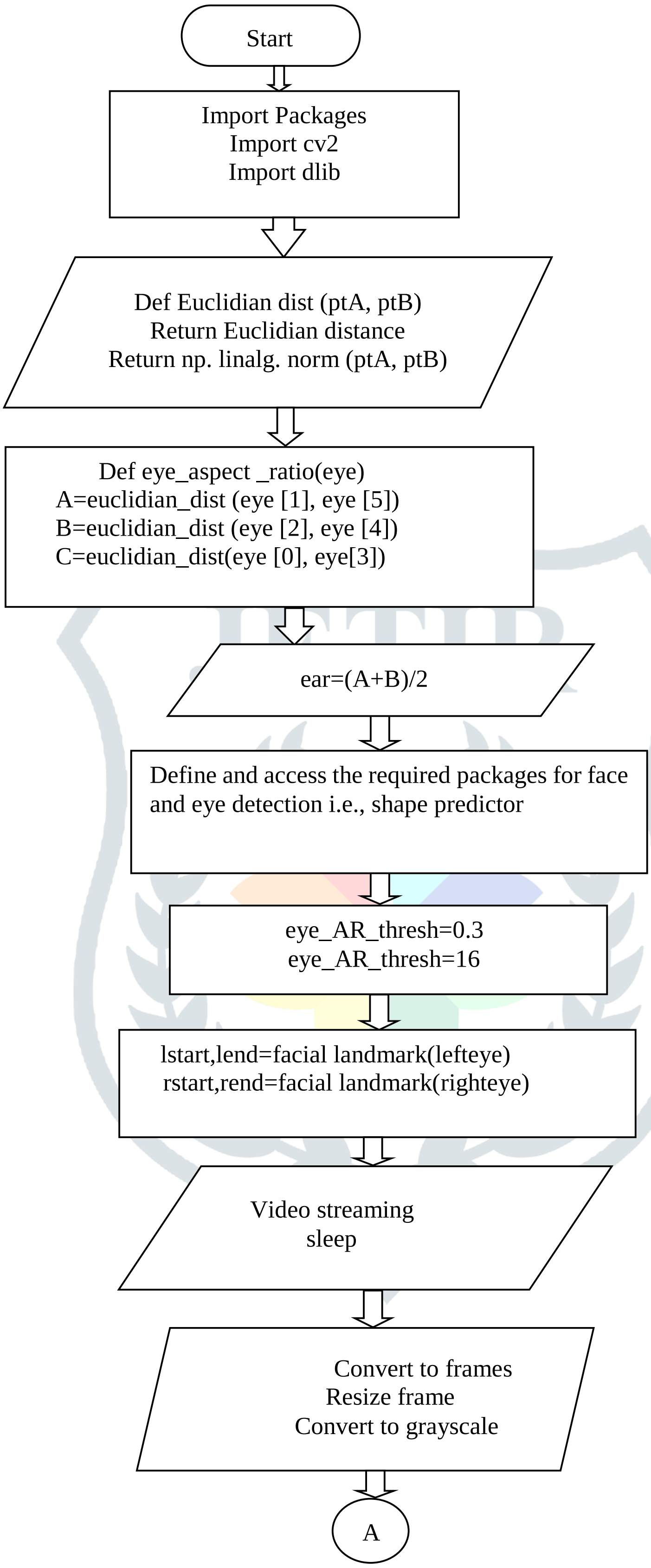


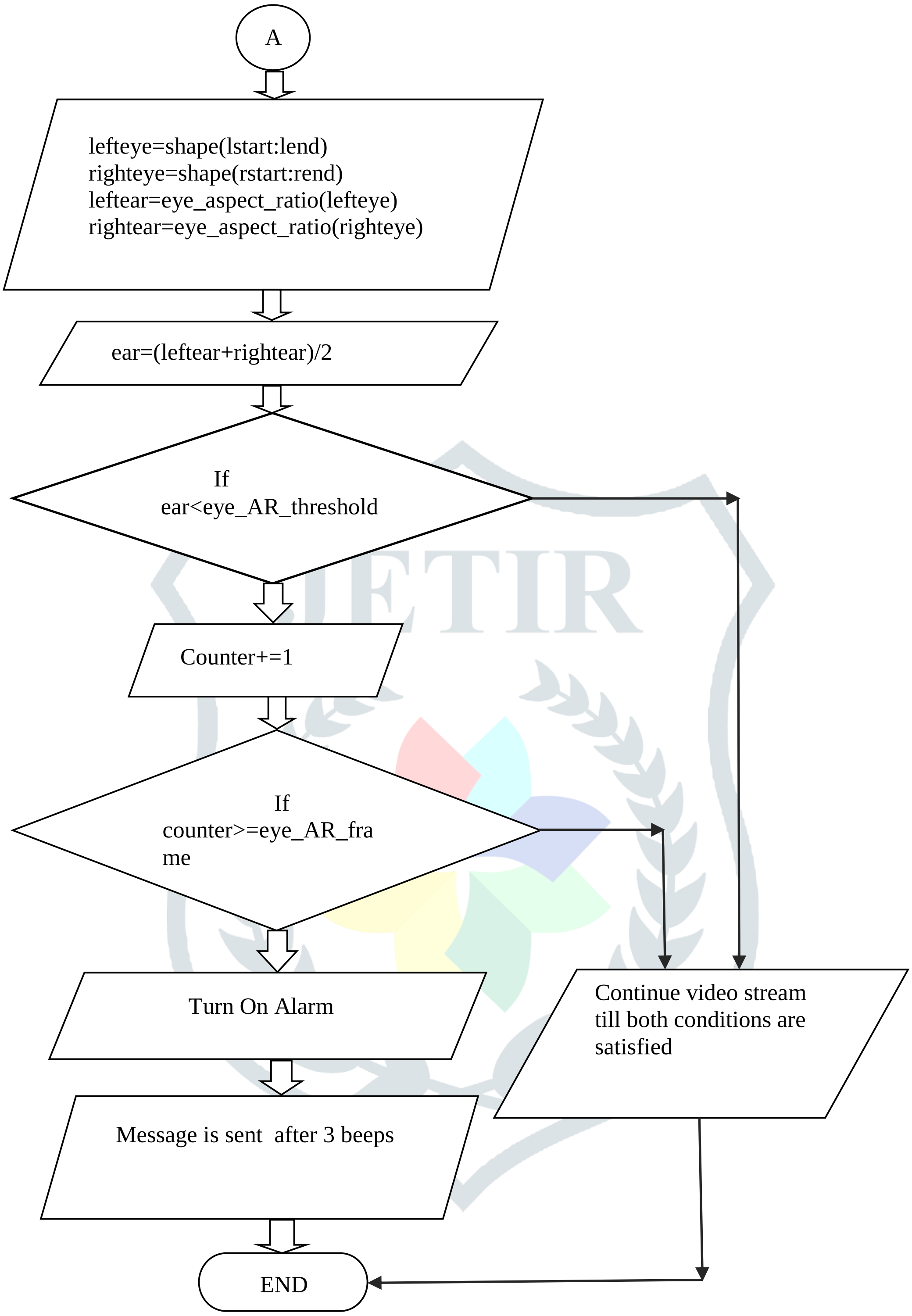
Fig 6: Received Message

4.6 Algorithm

1. Start
2.a. Define Euclidian distance as Euclidian dist (ptA, ptB).
  b. Find the Euclidian distance of points A, B, C as
    A=euclidian_dist (eye [1], eye [5])
    B=euclidian_dist (eye [2], eye [4])
    C=euclidian_dist (eye [0], eye [3])
    And then find the Eye Aspect Ratio (Ear) =(A+B)/2.
  c. Define and access the required packages for face and eye detection.
3.a. Set the threshold values: eye_AR_thresh=0.3. And Cover the eyes:
    lstart, lend=facial landmark(lefteye)
    rstart, rend=facial landmark(righteye).
  b. Capture the image and convert that to frames and then resize the frame and convert the frames to greyscale. And then calculate:
    lefteye=shape (lstart: lend)
    righteye=shape (rstart: rend)
    leftear=eye_aspect_ratio(lefteye)
    rightear=eye_aspect_ratio(righteye).
    Ear= (leftear+rightear)/2
4. If ear<eye_AR_threshold, then counter=counter+1.
  Else Continue video streaming.
  If counter>=eye_AR_frame, then Turn On Alarm. After 3 beeps of alarm message is Sent. Else Continue video stream till both conditions are satisfied.
5. End

4.7 Flowchart


Start
Import Packages
Import cv2
Import dlib
Def Euclidian dist (ptA, ptB)
Return Euclidian distance
Return np. linalg. norm (ptA, ptB)
Def eye_aspect _ratio(eye)
A=euclidian_dist (eye [1], eye [5])
B=euclidian_dist (eye [2], eye [4])
C=euclidian_dist(eye [0], eye[3])
ear=(A+B)/2
Define and access the required packages for face and eye detection i.e., shape predictor
eye_AR_thresh=0.3
eye_AR_thresh=16
lstart,lend=facial landmark(lefteye)
rstart,rend=facial landmark(righteye)
Video streaming
sleep
Convert to frames
Resize frame
Convert to grayscale
A



IV. CONCLUSION

Conclusion

This system works only on the required part of face image i.e. eyes and rejects the rest. This step decreases the unnecessary features in the feature set. Selecting only eye regions makes the system optimized in the context of time and accuracy. The two ways of alerting the driver about drowsiness: alarm and the message sent to the registered mobile number of the driver is an efficient way to alert the driver. It works in such a way that the driver is not subjected to sudden attack, which may lead to an accident.

Future Scope

- The system can be modified by including a calling feature instead of sending a message.

- Drivers mouth region can be detected so that their drowsiness state(yawning) can be found.
- When drowsiness is detected car speed can be reduced automatically.

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