IMAGE PROCESSING

J COMPONENT PROJECT REPORT

Drowsy Driver Detection System for Vehicle Safety

Under the Guidance of,

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DECLARATION BY THE CANDIDATE

We hereby declare that the project report entitled **“Drowsy Driver Detection”** submitted by us to Vellore Institute of Technology. Vellore in partial fulfilment of the requirement for the award of the degree of **B. Tech (CSE)** is a record of J- component of project work carried out by me/us under the guidance of **Prof.** V Santhi

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1) ABSTRACT

Safety comes first when we think about travelling or driving. Mistakes of the driver can lead to severe injuries and deaths. Recently market has introduced there many systems like navigation systems, back mirror, various sensors etc. to reduce the burden of the driver. One of the most common mistake is that human errors which increases the probability of road accidents. The main reason occurring from the highway accidents are the drowsiness and sluggishness of driver while driving. It is important to come with an optimistic algorithm to detect drowsiness as soon as driver feels sleepy. This could ameliorate the negative effects of human errors.

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2) INTRODUCTION

Drowsiness or sluggishness is a process in which one have reduced consciousness due to inadequate of sleep or fatigue and it may cause the driver fall into sleep quietly. When the driver endore drowsiness he will lose his consciousness and probably the control of the car, so he might be suddenly deviated from the road and hit an obstacle or a car to overturn. Considering the available statistics, drowsiness detection systems is must required. The important objective of this paper is the design and implementation of a system that is able to detect drowsiness of drivers using image processing techniques especially those diagnosed at the right time to alert. This will decrease the number of accidents and save their precious lives and reduces the high cost damages caused by accidents.

A computer vision based ideas has been utilized for the development of a Drowsy Driver Detection System. The small camera (our laptop camera for this project) has been used by system that focuses straight towards the face of driver and checks the driver's eyes and his mouth with a specific end goal to recognize fatigue. A warning sign is issued to caution the driver, in such situation when fatigue is recognized. Our project will illustrates the process of locate the eyes of driver and his mouth, and to decide whether the eyes of driver and his mouth are open or close. The system manages utilizing data gained for the image which is in binary form to locate the face edges, which gets the location where the eyes of a person may exist.

If the eyes of driver are identified as close and his mouth for few iterative frames, the proposed system assumes that the driver is nodding off and a signal of warning will be issued. The framework is also capable to recognize in such situation when the eyes can't be discovered, and works in sensible lighting circumstances. Through this project we will demonstrate that eye-tracking drowsiness functions admirably for a few drivers the length of the squint acknowledgment works appropriately. The camera based drowsiness measures give an appreciated contribution.

3) LITERATURE REVIEW

Techniques that is used to detect the drowsiness can be divided into following categories

1. Analysis of physiological characteristics

2. Sensing of driver operation

3. Sensing of vehicle response

4. Monitoring the response of driver

The main strategy that is pointed above isn't efficient since the electrodes that are used to sense should be placed straightforwardly to the driver which will reduce the concentration of the driver. Indeed, even long time driving during summer might result in perspiration on sensors, weakening their capacity to monitor precisely. Driver activity and behaviour of the vehicle can be implemented by monitoring the steering wheel movement, accelerator or brake patterns, vehicles speed, lateral acceleration and lateral displacement which is also non-intrusive ways. The last one is by observing the reaction of driver which included occasionally mentioning the driver to send a response to the system. Among the strategies referenced above, the best one is detecting of physiological characteristics phenomena.This procedures can be implemented in two different ways.

1. Calculating the changes in physiological signals, such as heart rates , brain waves and eye blinking.

2. Calculating physical changes such as sagging posture, learning of the drivers head and open or closed state of the drivers

To check driver’s sluggishness several systems have been built. They usually requires simplifying the problem to work partially or under special environments. This system works on several stages to be fully automatic. In addition, the goal of the algorithm is to identify and to trace the face and the eyes to calculate the drowsiness index. It works in a automatic and robust way, without prior calibration. The presented system is made up of 3 stages. The first one is pre-processing the image, which includes face and eye detection and its normalization. The second stage will performs pupil location detection and characterization, combining it with an adaptive sharpening filtering to make the system capable of dealing with illumination conditions. The final stage computes PERCLOS from eyes closure information. In order to evaluate this system, an outdoor database was generated, consisting of several experiments carried out during more than 25 driving hours. In the r system using a small camera that captures directly towards the driver's face, an image is obtained. From that image, skin region i.e. face is segmented out using YCbCr colour space. Finally localization of eyes is done with fuzzy logic application to determine the level of drowsiness and then warn the driver immediately.

1) Automatic Driver Drowsiness Detection and Accident Prevention System using Image Processing

This System has been developed using the non-intrusive machine based concepts. The system is made up with a camera that is placed facing driver which calculates drivers head movements to detect drowsiness or sluggishness of driver when drowsiness is detected warning sign is used to alert drivers from drowsiness. System numerous ways and algorithms for facial and eye monitoring are used to assess that they are efficient for use in a very driver fatigue monitoring system. Within the case of facial detection, the quality Viola-Jones face detector is used, whereas the technique of finding the attention centers exploitation gradients has been elite within the case of eye detection. The system has the ability to gather prerequisite parameters required to determine driver sluggishness. The System is divided into three methods Behavioral -based, Vehicle based, and Physiological based. These will work on the basis of vehicle deviations from the lane, movement of steering and pressure used on the accelerator, Driver behavioral can be equilized to yawning, eyeclosure, eye blinking, and head posture and psychologically based are the interaction between the Electrocardiogram and the Electrooculogram physiological signals. Tiredness is measured from pulse rate, heartbeat, etc. Model detects the driver drowsiness using Matlab and image processing algorithms. Its detection process is done in two different steps

(1) The reason for the driver drowsiness

(2) The patterns of drowsiness in the first step it evaluates the causes for the drowsiness of driver like work schedule, less hours of sleep and his sleeping environment.

In second step system uses patterns of drowsiness which are the frequent flicker of eyes,Moving the head from one side to other, yawning. The system uses Matlab algorithm to determine the frames cut from the image of camera present before the driver and using patterns of drowsiness if any one of them is detected system shows signs used to alert the driver to get back to a normal state. This, develop a drowsiness detection system that will accurately monitor driver drowsiness. This system has many advantages other than many existing systems.

2)Yawning detection by the analysis of variational descriptor for monitoring driver drowsiness

The destination of our approach is to carry out the localization and then segmentation of the interest zone in order to extract a signal who describes various states of the mouth and consequently to identify the states of driver yawn. We have the stages of tiredness detection states based on the the techniques of the spatiotemporal descriptors.

Localization of the face and the mouth As already mentioned previously, we propose to exploit the technique of Viola and Jones for the stage of the localization of the face and the mouth. It is a largely exploited classifier who based on the Haar descriptors. This procedure has the advantage of being very quick and the results which it reaches are satisfactory . This illustrates an example of face and mouth detection. In fact, the technique of Viola and Jones is based on a fast stage extraction of certain descriptors while making use of an integral image and a classifier based on Adaboost implemented according to a structure of cascade for a training supervised through several examples of objects analysed and classified in advance. Thereafter, the analysis and the classification of these objects are made by boosting in order to separate the positive examples from the negative examples according to the principle cascades of a decision. The figure 3 presents a diagram describing the various stages of this technique.

The procedure flow

1) Experimental Setup

2) Face Detection

3) Eye Area

4) Circularity

5) Fourier Coefficients

6) Wavelet Coefficents

7) Discrete Cosine Transform Coefficients

3) Driver Drowsiness Detection System Based on Binary Eyes Image Data

In this paper, the algorithm driver drowsiness detection is used. The algorithm is based on the state of eyes of the driver. This is determined by the visibility of iris and it has been implemented. If the eyes remains in same state either in open or closed for a longer time than the expected time then it is one of the indication that the driver is feeling sleepy. And also if the driver is not looking front for a while then also it is an indication that the driver is feeling sleepy. Whenever the driver feels drowsy the system warns the driver that u r drowsy. The system which was developed can detect the state of eyes even though the driver wear the eye glasses. For processing the image that is provided by the camera, some image processing tools with Matlab is used. Matlab is used to create a system object using Viola-Jones Algorithm. It is used to detect the objects like mouth, nose , upper body. After capturing an image rectangular area of eyes is to adjust for noise reduction. First RGB image is converted into Gray scale and finally to Binary image. The conversion is with a suitable threshold value. A median filter was used to reduce the noise in the image and then the smoothening will applied on the image. The drowsiness detection is done based on some of the conditions like number of pixels in the column greater than the threshold value and eye's shape, black to white pixels ratio, light and position of the driver plays an important role. System is implemented in such a way that it can learn at from start stage to setup stage of threshold values by its own. The system may give inaccurate results in certain type of conditions due to the position of driver, effect of light etc.

4) Eye and mouth state detection algorithm based on contour feature extraction

In this paper they developed an algorithm which will analyze the state of both mouth and eyes by extracting some contour features. Here eyes and mouth are very much important in fatigue detection.

At first the face area is detected in the image database that has acquired previously. Then by using Eyemap algorithm the eyes were located. Here the clustering method is used to extract the sclera fitting eye contour and then contour aspect ratio is calculated. In addition to this, an effective algorithm has been proposed to solve the contour fitting problem that is when an human eye is affected by stabismus. At the same time in the Rgb space the value of chromatism is defined. And the mouth is accurately located by using lip segmentation method. Based on the color difference of the skin, lip and internal mouth, the internal mouth contour can be fitted to analyze the different states of mouth. Meanwhile another unique and effective yawning judgment mechanism is taken into the picture which is used to determine whether the driver is drowsy or not. This paper is based on the three different databases which is used in evaluating the performance of the proposed algorithm. And it doesnot required any training with high efficiency. The proposed algorithm can be used in future intelligent vehicles, energy vehicles and advanced driver assistant systems. And this can be further analyzed to determine whether the driver is fatigued by detecting the state of the mouth and eyes. When the driver drowsiness is detected, it will give a warning to remind the driver that he has to pay attention while driving in order to decrease traffic accidents. Their future work is to build a fatigue model, which was used to give a warning signal to remind the driver when he/she appears to be demonstrating fatigue symptoms.

4) PROPOSED METHODOLOGY

1) Face recognition:

Recognition of the face is accomplished by Viola Jones. The principle objective of face recognition is to decrease the identification of false facial expressions. The significance of this part is to precisely find the location of the eyes and the mouth.

2) Skin segmentation:

After the detection of the face, the segmentation of the skin is carried out by changing the image to YCbCr domain. The greatest advantage of this type of conversion is that, the impact of luminosity can be reduced by considering just the chromatic components.

3) Segmentation by K means:

K means segmentation of the objects into K no. of mutually exclusive clusters, so that objects in each cluster are nearest to each other, and farthest from objects in other clusters.

4) Recognition of Yawning:

Viola Jones is used to find the area of the mouth, the detected region will be segmented by using K means clustering and followed with tracking that uses correlation coefficient template matching.

5) PROPOSED ALGORITHMS AND FUNCTIONS

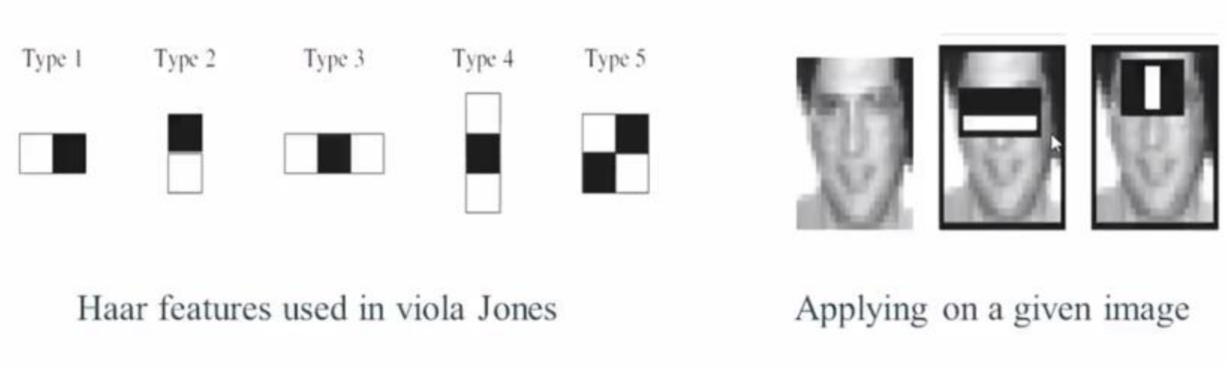
1) Viola Jones algorithm

The Viola–Jones object detection framework is the first object detection framework to provide competitive object detection rates in real-time proposed in 2001 by Paul Viola and Michael Jones. Although it can be trained to detect a variety of object classes, it was motivated primarily by the problem of face detection.

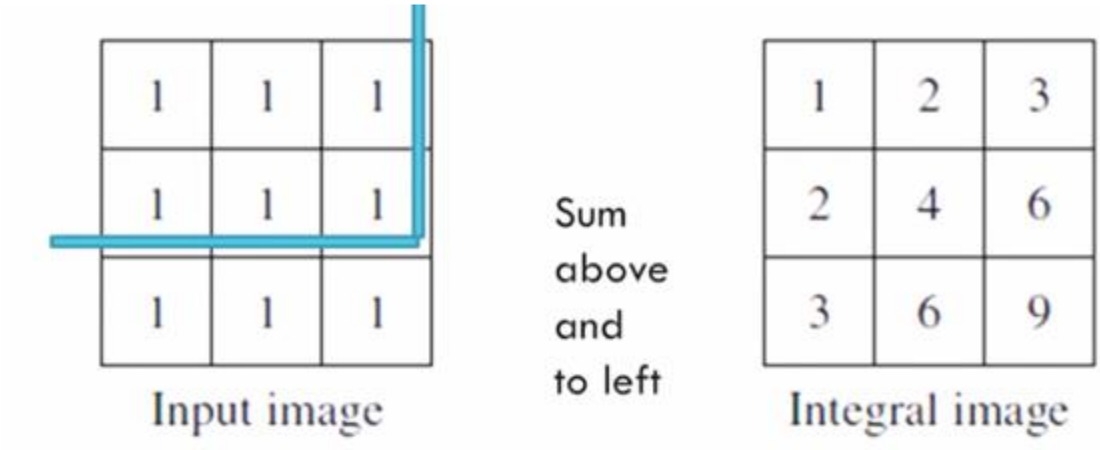
The algorithm has four stages:

1. Haar Feature Selection
2. Creating an Integral Image
3. Adaboost Training
4. Cascading Classifiers

a. Haar Feature selection

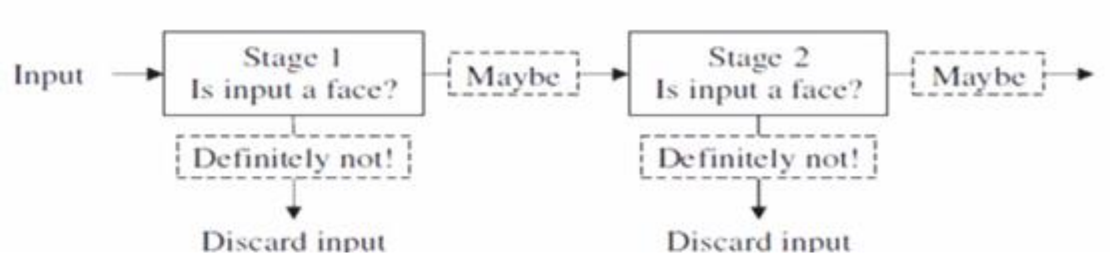


b. Creating an Integral Image



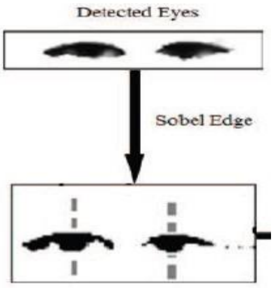
c. Adaboost Training

d. Cascading classifiers



2) Edge detection (Sobel edge operator):

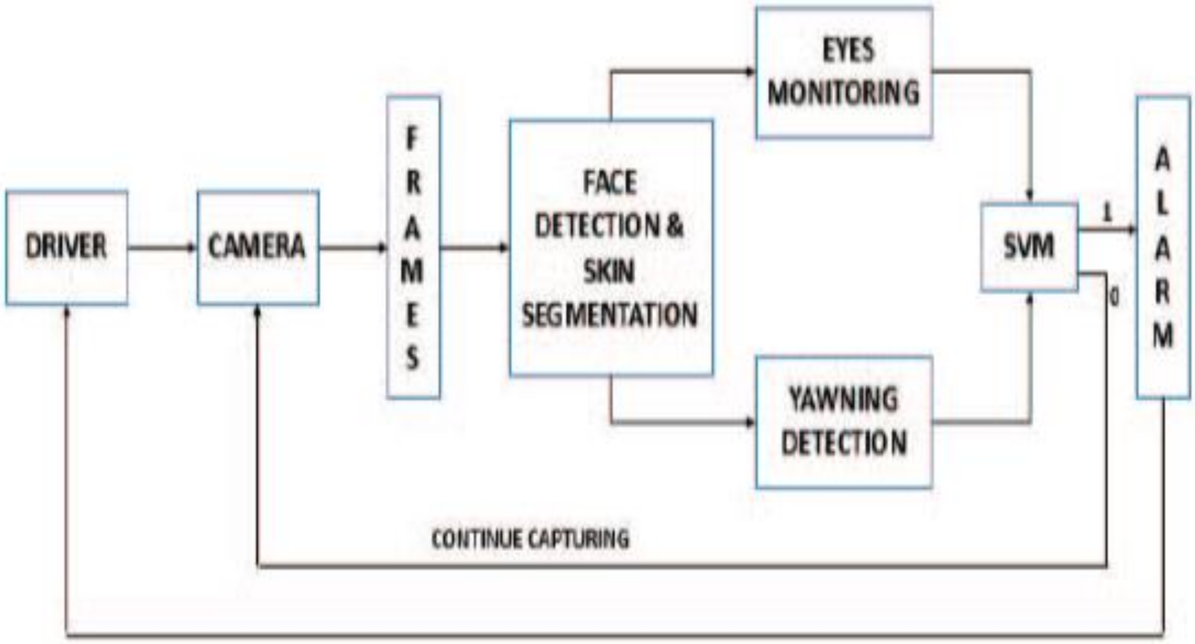
The Sobel detector convolves the image with a filter that has small, separable, and integer valued function in both horizontal and vertical directions



1) Segmentation by K means;

K means partitions the objects into K no. of mutually exclusive clusters, so that objects in each cluster are closest to each other, and farthest from objects in other clusters.

Proposed frame work



Hardware Requirements

The hardware requirements for an effective drowsy driver detection system are as follows:
• A non-intrusive monitoring system that will not distract the driver.
• A system that will work in both daytime and night time conditions.

Software Requirements

Operating system: windows 7,8,10
Software : Python Terminal
Ram : A minimum of 4GB is required.

6) IMPLEMENTATION

Code

```
from___future___import division

from imutils import face_utils
import dlib
import cv2
import numpy as np
from scipy.spatial import distance as dist
import threading
import pygame


def start_sound():
   pygame.mixer.init()
   pygame.mixer.music.load("Activated_fire_alarm_(sound).ogg")
#Enter the path where you have saved your fire_alarm sound
   pygame.mixer.music.play()


def resize(img, width=None, height=None,
interpolation=cv2.INTER_AREA):
    global ratio
    w, h = img.shape
    if width is None and height is None:
        return img
    elif width is None:
        ratio = height / h
        width = int(w * ratio)
        resized = cv2.resize(img, (height, width),
interpolation)
        return resized
    else:
        ratio = width / w
        height = int(h * ratio)
        resized = cv2.resize(img, (height, width),
interpolation)
        return resized


######
def shape_to_np(shape, dtype="int"):
    coords = np.zeros((68, 2), dtype=dtype)
```

```
    for i in range(36, 48) :
        coords[i] = (shape.part(i).x, shape.part(i).y)
    return coords


def eye_aspect_ratio(eye):
    A = dist.euclidean(eye[1], eye[5])
    B = dist.euclidean(eye[2], eye[4])

    # compute the euclidean distance between the horizontal
    # eye landmark (x, y)-coordinates
    C = dist.euclidean(eye[0], eye[3])

    # compute the eye aspect ratio
    ear = (A + B) / (2.0 * C)

    # return the eye aspect ratio
    return ear


camera = cv2.VideoCapture(0)

predictor_path = "shape_predictor_68_face_landmarks.dat"  #Enter
the path where you have saved your shape_predictor

detector = dlib.get_frontal_face_detector()
predictor = dlib.shape_predictor(predictor_path)
(lStart, lEnd) = face_utils.FACIAL_LANDMARKS_IDXS["left_eye"]
(rStart, rEnd) = face_utils.FACIAL_LANDMARKS_IDXS["right_eye"]
total = 0
alarm = False
while True:
    ret, frame = camera.read()
    if ret == False:
        print('Failed to capture frame from camera. Check camera
index in cv2.VideoCapture(0) \n')
        break

    frame_grey = cv2.cvtColor(frame, cv2.COLOR_BGR2GRAY)
    frame_resized = resize(frame_grey, width=120)

    # Ask the detector to find the bounding boxes of each face.
The 1 in the
    # second argument indicates that we should upsample the
image 1 time. This
    # will make everything bigger and allow us to detect more
faces.
    dets = detector(frame_resized, 1)

    if len(dets) > 0:
        for k, d in enumerate(dets):
            shape = predictor(frame_resized, d)
            shape = shape_to_np(shape)
            leftEye = shape[lStart:lEnd]
            rightEye = shape[rStart:rEnd]
            leftEAR = eye_aspect_ratio(leftEye)
```

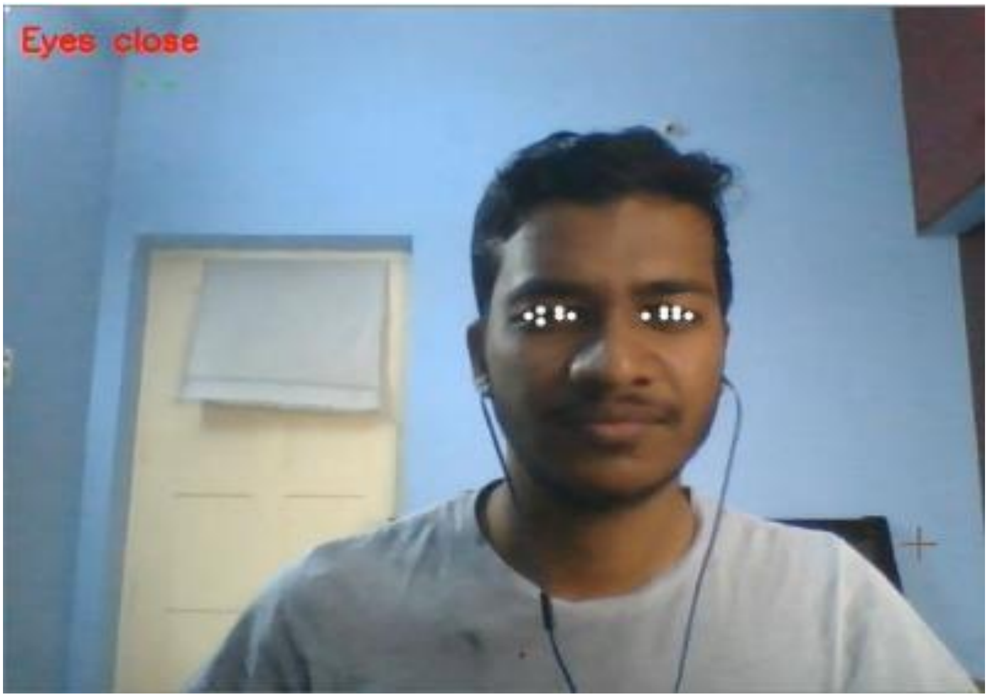
```
            rightEAR = eye_aspect_ratio(rightEye)
            ear = (leftEAR + rightEAR) / 2.0
            leftEyeHull = cv2.convexHull(leftEye)

            rightEyeHull = cv2.convexHull(rightEye)
            cv2.drawContours(frame, [leftEyeHull], -1, (0, 255,
0), 1)
            cv2.drawContours(frame, [rightEyeHull], -1, (0, 255,
0), 1)
            if ear > .25:
                print(ear)
                total = 0
                alarm = False
                cv2.putText(frame, "Eyes Open ", (10, 30),
cv2.FONT_HERSHEY_SIMPLEX, 0.7, (0, 0, 255), 2)
            else:
                total += 1
                if total > 20:
                    if not alarm:
                        alarm = True
                        d = threading.Thread(target=start_sound)
                        d.setDaemon(True)
                        d.start()
                        print("so jaaaaaaaaaa")
                        cv2.putText(frame, "drowsiness detect",
(250, 30), cv2.FONT_HERSHEY_SIMPLEX, 1.7, (0, 0, 0), 4)
                cv2.putText(frame, "Eyes close".format(total),
(10, 30), cv2.FONT_HERSHEY_SIMPLEX, 0.7, (0, 0, 255), 2)
            for (x, y) in shape:
                cv2.circle(frame, (int(x / ratio), int(y /
ratio)), 3, (255, 255, 255), -1)
    cv2.imshow("image", frame)

    if cv2.waitKey(1) & 0xFF == ord('q'):
        cv2.destroyAllWindows()
        camera.release()
        break
```

7) RESULTS

A fatigue and a non-fatigue frame



Driver would be hearing sound alarm when a fatigue frame is captured

8) FUTURE WORK

Work Head lowering prediction is also to be included with a threshold Efforts will be made to make the system rotation invariant. NIR camera is used to capture the driver’s facial images. With this we can capture images even in pitch black and hence does not depend on colour and lighting conditions and will have higher accuracy.

9) LIMITATONS

1) Accuracy drops when the lighting conditions are dropped.

2) Unable to predict drowsiness when the head was tilted towards left or right.

3) It is not very accurate when the person is wearing spects

10) CONCLUSION

This project presents the real time implementation of drowsiness detection which is invariant to illumination and performs well under various lighting conditions. Correlation coefficient template matching provides a fast way to track the eyes and mouth. Achieved good overall accuracy in four test cases. A high detection rate and reduced false alarms Can efficiently reduce the number of fatalities

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