COMPUTER VISION

MINI PROJECT REPORT

Group 5

Roll Number	Name	Batch	Contribution
101803654	Manan Kapila	COE 29	Implementation and Experimental Result
101803665	Akhil Rana	COE 3	Documentation

Real Time Classification for Autonomous Drowsiness Detection using Eye and Mouth Aspect Ratio

Manan Kapila[1] and Akhil Rana[2]

[1]Manan Kapila, 101803654, COE-29, manankapila2000@gmail.com

[2]Akhil Rana, 101803665, COE-3, akhilrana2000@gmail.com

ABSTRACT

Driver drowsiness is one of the major factor for road accidents. The research work about driving drowsiness detection algorithm has great significance to improve traffic safety. The development in technology over the years bring the support to drivers using smart vehicle systems. In a country like India where there is high percentage of road accidents, drowsiness and fatigue detection system can help prevent a large number of sleep induced road accidents. Around 20% of accidents are caused due to drowsy drivers. That's why a driver alert system is the need of the hour. Considering this problem this article proposes a Real Time Classification Drowsiness Detection System using Eye Aspect Ratio. The system employed various Computer Vision applications using eye closure(aspect) ratio, yawning to effectively and quickly identify the drowsiness of a driver during driving the vehicle and alter the driver accordingly. The proposed work tried to contribute in reducing the increased number of road accidents while keeping the methodologies simple and intact. **Keywords/Index Terms**— Eye Detection, Face Detection, Facial Landmarks,,Real-Time Detection, Drowsiness Detection, Computer Vision, Road Accidents

INTRODUCTION

Drowsiness is an intermediate state between wakefulness and sleep that may be defined as the progressive loss of cortical processing efficiency. It is also associated to a desire or inclination to sleep [1]. The significant increase in the percentage of accidents due to drowsiness and fatigue attracted the researcher's attention. It has been observed that the driver's performance also deteriorates with increase in drowsiness [2]. The statistical data on car crashes available at the national highway and traffic safety departments of many countries shows the alarming figures of 1.4 million deaths and up to 50 million minor or serious injuries [3]. According to NHAI the mid 90% accidents are due to the driver's drowsiness and fatigue. With this view, the creation of intelligent vehicles has been exponentially increased. Autonomous cars can prove to be a great way to deal with drowsy driving [4].

In this paper, CV tools are used to determine and identify signals of abnormal states (i.e., drowsiness) observed in operator images/ videos sensors. The goal is not to detect aspects and status after the failure happens but rather to proactively identify behaviors performed by the operator before it actually takes place avoiding all consequences of the error. Specifically, the detection of eye blinks has an important role in systems that monitor human operator's vigilance.

RELATED WORK

In order to detect drowsiness of drivers, numerous approaches have been proposed. This section summarizes the existing approaches to detect drowsiness.

In view of vision, Malla et al. [5] proposed a light-harsh framework utilizing Haar calculations [6] to recognize items and face. The level of eye conclusion was taken as a measure to identify the sleepiness of the driver. Afterward, Vitabile et al. [7] introduced a drowsiness discovery framework which perceived the indications of a sluggish driver utilizing an infrared camera. The analysts utilized the idea of splendid students to derive a calculation for eye discovery and following. The framework used to alert the driver after recognizing the languor. On the comparable grounds, Bhowmick et al. [8] utilized the traditional Otsu limit technique [9]. The total discovery model utilized the eye confinement and division as the center ideas. Eventually, a non-direct Support Vector Machine (SVM) was utilized to prepare the model to recognize the languid eyes. Considering, transport as an indispensable business as usual exercises, Alshaqaqi et al. [10] proposed a driver sluggishness recognition framework known as Advanced Driver Assistance Framework (ADAS). They proposed a calculation which made a difference in finding, following, and examining both the drivers face and eyes to quantify PERCLOS, an experimentally upheld measure of languor related with moderate eye conclusion.

Rateb et al. [11] detected real-time driver drowsiness using deep neural networks. They developed an Android application. Tereza Soukupova et al. [12] used EAR (Eye Aspect Ratio) as a standard measure to compute drowsiness of a person. They also detailed the types of systems used for detecting drowsiness of driver. For example, Active Systems (considered as reliable, but use special hardware that are expensive and intrusive like infrared cameras etc.) and Passive Systems (are inexpensive and rely on Standard cameras). There are several other research works that have been conducted to determine vision based drowsiness detection (I. García, S. Bronte, L. M. Bergasa, J. Almazán, and J. Yebes,2012) [13] –(K. Srijayathi and M. Vedachary,2013) [14], fatigue detection(A.Chellappa, M. S. Reddy, R. Ezhilarasie, S. Kanimozhi Suguna, and A. Umamakeswari,2015) [15] discusses about method of driver eyes closure and yawning detection for drowsiness.

All the above existing methodologies utilized difficult techniques to recognize the tiredness of a driver. Among these methodologies EAR was one of the easiest to implement and effectively detect the drowsiness of a driver. This article proposed a simple technique for the equivalent. The proposed article is ordered as: Section-II, portrays the proposed strategy followed by Section-III in which test results are referenced. In the end at Section – IV portrays the future scope and drawbacks of the proposed work degree and impediment of the proposed work.

PROPOSED METHOD

3.1. Measure Used

Among all the strategies, the most precise technique depends on human physiological measures. Though this method gives the most accurate results regarding drowsiness. In the proposed work, the first step in constructing the real-time model for drowsiness classification is to locate the user's eye. Thus, a dlib library was used for facial landmark estimation based on, which adopts HOG and linear SVM. The 68-facial landmark predefined landmark helps in shape prediction to clearly identify the various regions of the face like eye brows, eye, mouth region etc.

3.2. Dlib brief working

Picture descriptor, Histogram of Oriented Gradient (HOG) alongside Linear Support Vector Machine (SVM) is utilized to set up profoundly precise item classifiers. From the outset include network is extricated utilizing HOG descriptor and afterward these highlights are utilized to prepare SVM classifier. The strategy includes events of angle direction in restricted bits of a picture. This strategy is like that of edge direction histograms, scale-invariant component change descriptors, and shape settings, yet varies in that it is processed on a thick network of consistently separated cells and utilizations covering neighborhood contrast standardization for improved precision. HOG and Haar-like features are complementary features; hence combining them might even result in better performance. HOG features are good at describing object shape hence good for pedestrian detection. Whereas Haar features are good at describing object shading hence good for frontal face detection. HAAR cascade classifier is affected by the varying light intensity. Also if an object has HAAR wavelets similar to that of a face it recognizes that object as a face. On the other hand these limitations are overcome by HOG classifier as it works on the principle of segmentation. Therefore, we are using HOG classifier in this system.

3.3 Workflow

Different change in boundaries of these recognized focuses reports different articulation of the individual. The facial landmark recognition is carrying out as:

I. Input the image and plainly recognize the face utilizing Viola-Jones Algorithm[reference].

II. Clearly detect 68 points to identify (x,y) coordinate various region of the face.

III. Localize the landmarks to detect eye, mouth region etc.

IV. Change in the shape of said region reports various expressions for drowsiness and fatigue.

Figure. 1. Visualizing the 68 facial landmark coordinates using Dlib Facial plot [16]

A. Frame Acquisition: In this research project we have used the inbuilt pc camera to capture the frames one by one and generate the alerts accordingly. (We can also use mobile camera using IP webcam).

B. Eye detection: The first step in constructing the real-time model for drowsiness classification is to locate the user’s eye, the eye is detected using Haar Cascade Classifier and EAR is used, Here, EAR – the proportion between width and height of the eye was used based on its landmarks; see Eq. (2) Figure-1 depicts all landmarks used in the EAR calculation. Unlike traditional CV methods for computing blinks – which normally imply searching for the whites of the eyes and determining if they disappear for a period it was possible here to easily (i.e., with low computational cost) extract an eye-based variable and make inference based on its value, when the value of EAR (Eye Aspect Raito) falls below its threshold value for 40 consecutive frames, the system alerts the driver by playing an alarm.

$$EAR = \frac{||P2 - P6|| + ||P3 - P5||}{2\,||P1 - P4||}] \quad (1$$

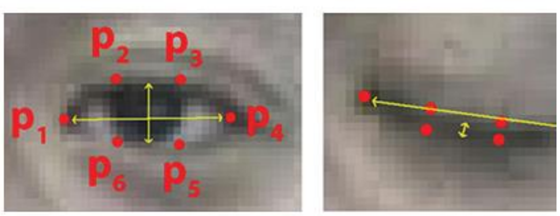

Figure 2: Coordinates to calculate EAR [16]

C. Yawn Counts: Mouth is represented by 8 - organizes in dlib landmarks predictor function The landmark spots are checked beginning from left corner of the mouth while moving in the clockwise heading as appeared in Figure-3, Eq. (2). It has been seen that the even and vertical co-ordinates share some connection with every others. The proportion of vertical distance among lower and upper lips to the level distance between the lip corners is determined to decide MAR. At the point when an individual opens his mouth to yawn, the distance among lower and upper lips increments.

In contrast to EAR, the yawn threshold gets increased soon as MAR threshold increments surpass a limit esteem.

$$MAR = \frac{||P1 - P5|| + ||P2 - P4||}{2\,||P6 - P3||}] \quad (2)$$

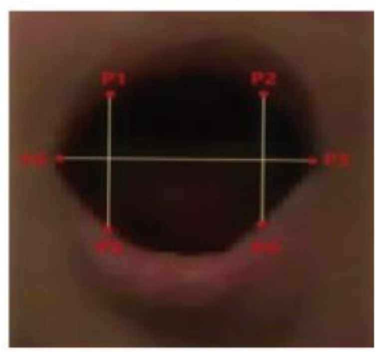

Figure 3: Coordinates to calculate MAR [16]

D. Alarm Activation: Blink rate and yawn checks surpass specified limit esteems separately for a specific number of continuous edges, the framework will accept that the driver is dozing off and will initiate a caution to alarm the driver until the driver awakens.

FLOW CHART:

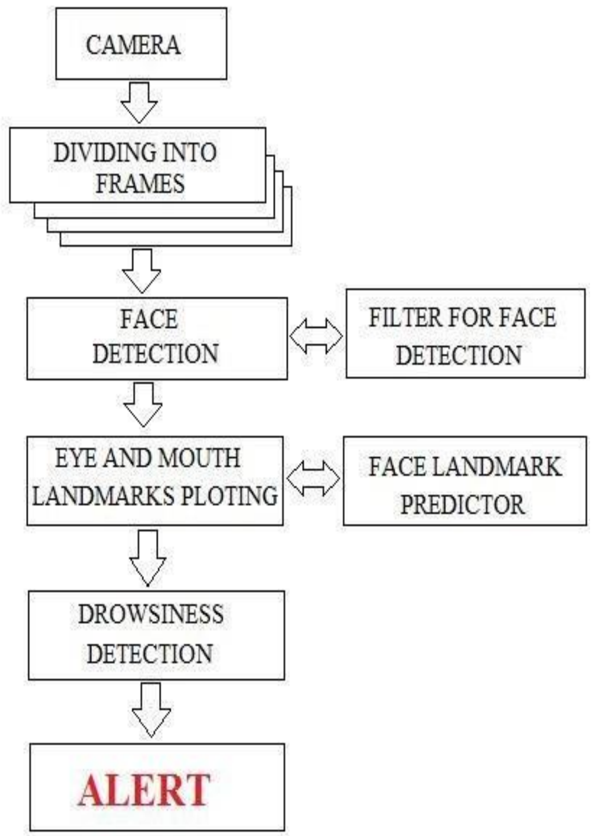

Figure 4: Flowchart [18]

EXPERIMENTAL RESULTS

Implementation of the project gives the following result

i) Drowsiness detection by EAR

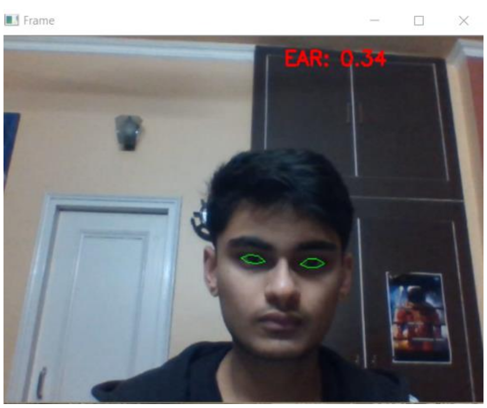

Figure 5: Subject with open eyes

The above frame (Fig 5) shows person with open eyes, the top right side of window shows the Eye Aspect Ratio, if the threshold value of the EAR falls below 0.23 alarm is signaled.

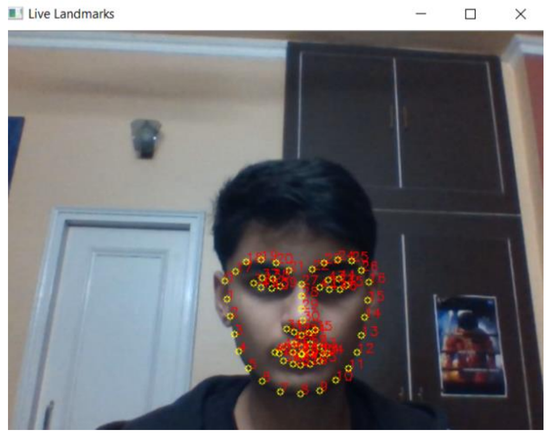

Figure 6: Live landmarks of the subject

The above frame (Fig 6) shows the live landmarks during the execution of the program.

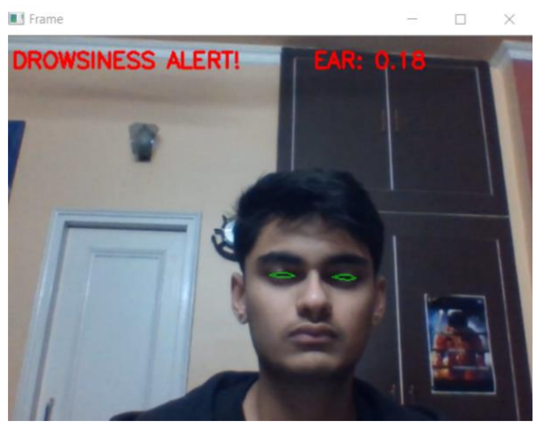

Figure 7: Drowsiness alert

When the EAR value falls below 0.23 for 40 consecutive frames the system signals the alarm and a notification is shown at the top left corner of the window.

i) Drowsiness detection using MAR

When the subject yawns continuously, it is a big sign of drowsiness, so we have set threshold to 5 i.e. when the yawn counts reach above 5 again the alarm is signaled with a notification on the screen, in the given frame (Fig 7), the notification of the yawn counts is shown at the bottom left corner of the window. In the frame (Fig 8) the yawn counts have hits the threshold level.

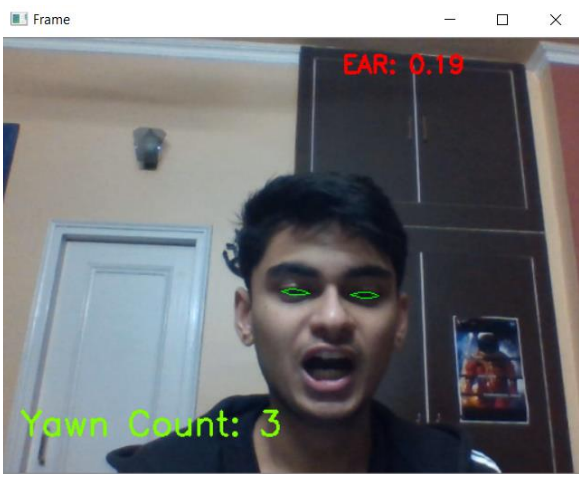

Figure 8: Subject Yawning

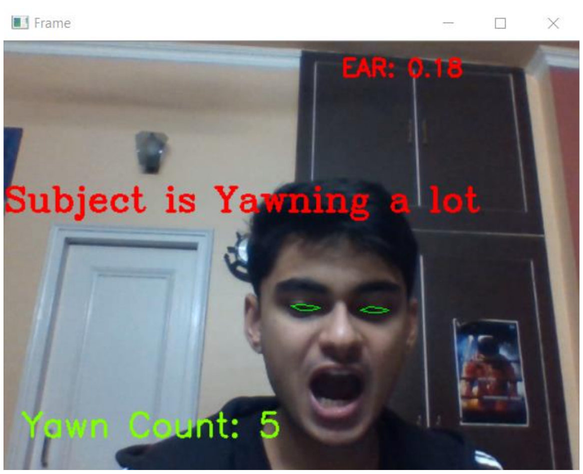

Figure 9: Drowsiness alert

Whenever the subjects yawn the EAR also falls down, so there is high chance of getting drowsiness alerts before the yawn count threshold is reached.

Figure 10: Variation in EAR with Eyes opening and closing [16]

Figure 11: Fig-: Variation of MAR with Mouth opening and closing [16]

CONCLUSION

In the proposed work, Drowsiness Detection is implemented to detect the drowsiness and fatigue of a driver in real-time based on the image captured. The work is based on behavior analysis, high end camera installation and conventional algorithm to detect the possible coordinate to identify eyes and mouth. Existing state of art methods are computationally complex as compare to our proposed method. Based on real time data capturing and analysis eye blinking and yawn detection are considered important parameters to detect drowsiness and fatigue of the drive and ring the alarm accordingly. In future, Machine Learning model along with the proposed work can be implemented to detect drowsiness of a person before it happens, it will be more efficient as the threshold for EAR and MAR are different for different people.

The future work can include integration of the proposed system with globally used applications like Uber and Ola. The system, if integrated, can reduce the number of casualties and injuries that happen regularly due to these drowsy states of the drivers. This experiment can run as a part of pilot plan i.e. for a few days/months in different regions of the world where such incidents occur regularly. Thus, our proposed approach also gives the same accuracy for the people wearing spectacles. Accuracy of our proposed system improves with the increase in brightness of the surrounding environment. The work can be extended for different types users such as bike riders or in different domains like railways, airlines etc.

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