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Driver Safety System Using Machine Learning

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Abstract
The main idea behind the implementation of this project is to prevent vehicle accidents which is common occurrence in today's world. The goal of this paper is to design a non intrusive system which detects lethargy (drowsiness) in the driver using the latest technology and to overcome the electrode system which was attached to the drivers in earlier days to detect drowsiness state in driver's eyes. The earlier technology would irritate, annoy and would disturb drivers while driving. So as to eliminate this method, a new friendly method is being implemented. This vision based non intrusive system is developed for detecting whether the driver's eyes are open or closed in real time. If the driver's eyes stay closed for a thresholded time, then the sound module alerts driver's as well as any possible passengers to prevent possible accidents. The project is developed using OpenCV, Dlib ML algorithm, and python programming language.

Keywords: *Dlib, Lethargy, Non-Intrusive System, Open CV, Python Sound Module*

1. Introduction

In today's world, most houses own more than two vehicles. These days vehicle accidents are common and every day these incidents are rising rapidly. According to the research, every year 135,000 deaths happen due to vehicle accidents. The survey of National Highway Traffic Administration System reports 70,000 injuries and 76,000 crashes. The main reason for the vehicle accidents is the drowsiness of the driver. Drowsiness occurs due to lack of sleep in a driver and the symptoms of drowsiness are redness of eye, yawning and closing of eyes for a small period of time.

The earlier technique involved attaching highly positive electrodes directly to the driver's which would disturb them and disarray their concentration while driving and this would also lead to accidents and the driver's face wouldn't be captured on camera properly. To overcome this problem, a non intrusive system is designed to detect the drowsiness in the driver and the eye region of the driver is captured in the camera and the sound module would alert the driver when he is found to be dozy. This paper mainly depends on recognizing the state of doziness in driver's eyes.

2. Literature Survey

Many methods had been used till date for doziness recognition system.

[1] Roshan has described in his Technical paper that they have implemented drowsiness detection using haarcascade classifier and python programming language. The system is performed by capturing an image and it is segmented into frames and every frame is being examined. They have successfully detected the face and eye detection. They have stated if the driver is found to be lethargic, neither his or her eyes wouldn't be detected nor would the eye portion be circled. Infact they have deployed web technology in which the driver needs to manually login and the EAR value is calculated automatically and the message would popup on driver's smartphone to alert him and gain his attention. The limitation of this paper is that they have tested eye detection using without spectacles.

[2] The author Richard Grace has said in their Technical paper that they have put an effort in performing drowsiness detection method by using PERCLOS which is totally dependant on vehicle performance data. Perclos estimates the energy consumption, acceleration rate and steering angle.

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[3] Jian Da Wu et has researched and performed the driver drowsiness detection by implementing image processing method interfacing with fuzzy logic. The system was developed to analysis the level of drivers doziness. The level of drivers doziness was computed by the period and mode of the closing of the eyes of the driver. Their system is a great help for preventing traffic accidents.

[4]The author Manu BN specified in their paper that they have performed the eye detection using haarcascade classifier which distinguishes positive and negative images which is embedded with adaboost classifier. Adaboost classifier analysis the face region and the alternative image is marked in rectangular shape and is compared with the real image. They have made the comparison of real image to that of alternative image. They have performed the computation of rectangular portion varied with pixels allowing the positive images and removing the negative images.

In our proposed system, We overcame the limitation of one of the paper mentioned above and hence we successfully got the positive outcome of detecting the drivers eyes in the state of drowsiness by using the spectacles and we are using sound module to alert the driver and gain his or her attention to concentrate in driving.

3. Objective

Lethargy in drivers is a serious life threatening activity in transportation system. Drowsiness symptoms are redness of an eye, nodding head, abnormal activities of brain which would desire strong excess sleep. By using opencv, dlib in machine learning we have developed a non intrusive system for doziness detection in drivers and the sound module would alert the driver when he or she is found to be lethargic. This project would turn out to be a community based project after improvising iot based arduino technology and gsm technology.

4. Methodology

Requirements

1. 32 or 64 bit system
2. Anaconda software
3. Web Cam(External or PC)
4. OpenCV(Software)

We are using OpenCV with python along with DLib. We are using OpenCV because it's open source and provides us so many options for working on machine learning. Apart from that one of the key reasons for using it is, it can be easily implemented with python. Python is one of the high level languages which is portable and have extensive features. DLib is an open source library which provides us with a convenient environment for developing machine learning based applications. Dlib basically has linear algebra with basic linear algebra subprograms(BLAS). We mainly used it for the implementation of Bayesian network and Kernel based algorithms for classification, clustering, anomaly detection, regression and feature ranking. This library has basically two components, Linear Algebra and Machine Learning tools. We are using few of the Machine Learning tools from DLib in our project.

The dataset we've used in this project is 'Real-Life Drowsiness Dataset (UTA-RLGD)'. The data set consisted of 280 images consisting of 170 men, 110 women of different ethnicity. Out of 280 images, 125 were present with spectacles and 50 with facial hair. Images were taken from roughly different angles and labelled drowsy or not.

Our first task was to make the system locate the face and it is done using HaarCascasdes Library which uses a set of positive and negative images to detect objects. We trained the classifier using the dataset images converted to grayscale marked as positive images consisting of the faces of the driver we want the classifier to recognise and a set of negative images which does not have the object we want to detect.

The next step is to find the eyes and mark it as a region of interest. Facial Landmarks such as ear, nose, lips and eyebrow are used to find eyes on the face. We decide based on the landmark we use , for example from the nose, eyes are located in the upper region on both sides. So we look for eyes in the upper part from the nose. For comparing the left and the right eye, we find the centre of the face referencing the sides of the face. A bounding box is drawn over the image.

Once the ROI is found, we use the shape predictor to obtain the (x,y) co-ordinates of the ROI. The Dlib library is pre-trained with detected facial landmarks manually mapped with the co-ordinates, with eyes marked from 37-42, 43-48. Hence, we extract the co-ordinates for each of the eye as below -

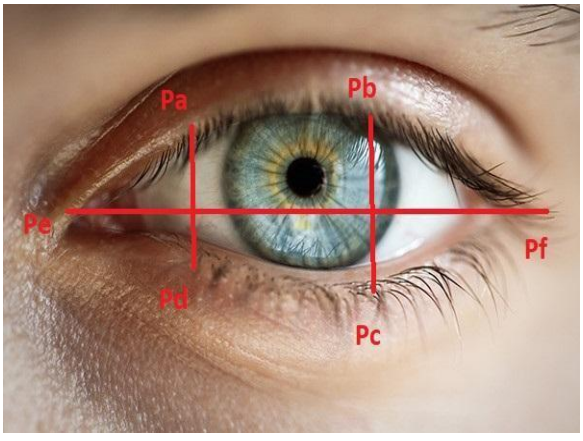

Figure 1: Computation of eye detection system

We then devise a simple formula to calculate the ratio of the euclidean distances between the eye. This method is faster in detection. We consider the co-ordinates Pa,Pb,Pc,Pd representing the horizontal distances and Pe,Pf representing the vertical co-ordinates.

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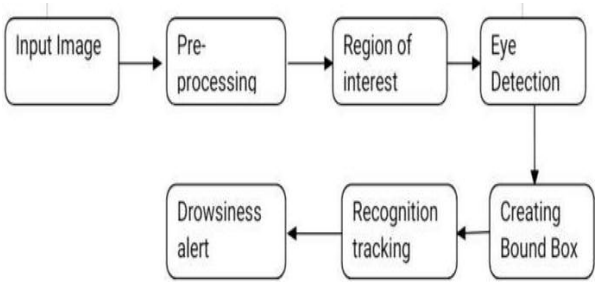

Figure 2: Block diagram of Eye Detection

The eye ratio can help predict whether the driver is drowsy or not. The ratio is given by-

EAR = (pa+pb) – (pc+pd)/ 2* (p+pf) (1)

The " Equation (1) is calculated for each frame, and then the average value is taken considering both eyes.

This average value is compared to the threshold value which we set for determining if the driver is dozy.

The proposed method has been explained with the help of flow chart in Fig. 3

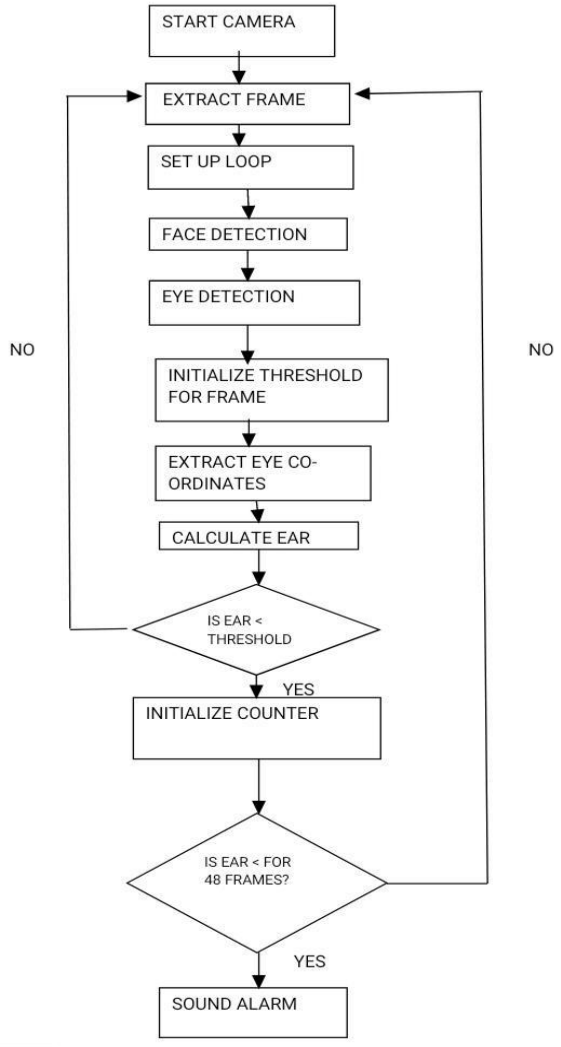

Figure 3: Workflow of the project

The EAR value is calculated for 48 frames. We set the threshold value of EAR as 0.3 which acts as a standard value of comparison in each frame.

If the value is less than or equal to the threshold value for 48 consecutive frames, then the person is drowsy otherwise not.

The eyes can be detected even with plain power glasses. As we know that people nowadays have powers in their eyes and therefore they will be using specs while driving. So it was very important for us to consider this point while working for the application. The model is trained to recognise eyes and calculate eye ratio for drivers wearing spectacles as well.

Based on the EAR value, if the person is found to be drowsy, action will be taken. We in our project have added a sound module to wake the driver and alarm the passengers.

For producing an alarm, we are using the "pygame" module. The "pygame" and "load music" is initialized and then when EAR value reaches the threshold value of drowsiness the alarm will initialize and it will produce the sound to wake the driver up.

The sound module is implemented as a separate thread so as to continue eye detection even while the alarm is sounding.

Algorithms Used

Step 1: Import required libraries

i. Scipy to calculate euclidean distance
ii. Face_utils making it easier to work with OpenCV
iii. Threading to run the sound module simultaneously
iv. Pyglet to initialize sound module
v. Dlib for facial co-ordinate prediction
vi. Cv2 to start video stream

Step2: Construct variable to pass argument for webcam

Step 3: Define a sound function specifying path in pyglet.resource.load() function.

Step 4: Define function to compute euclidean distances - horizontal and vertical for the set of eyes.

Step 5: Compute the eye ratio

Step 6: Define a threshold for eye ratio which indicates the eye is open and and variable for the number of frames the eye must be below the threshold to declare drive is dozy.

Step 7: Initialisefacial co-ordinate predictor

Step 8: Start the thread for streaming video, capturing the driver's face and start looping

Step 9: Pull the frame from the stream and convert to grayscale

Step 10: Draw a bounding box round the ROI recognised by the haar cascade algorithm.

Step 11: Apply facial landmark predictor to obtain co-ordinates of the eye.

Step 12: Convert the obtained co-ordinates to array

Step 13: Calculate average distances

Step 14: If the ratio is below threshold increment counter

Step 15: If ratio is less for sufficient number of frames, start the sound module

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If ratio above the threshold, reset the counter
Step 16: Print the eye ratio on frame, and the number of frames eyes are closed on console.

5. Results and Discussions

A real time eye drowsiness detection algorithm is implemented. We have completed our project and the system works precisely. For this project, we tried examining in both the conditions that is with and without spectacles. The driver face is captured if he or she is found to be lethargic and this sound module produces sound which alerts and gains the attention of the driver to become cautious .We have taken snaps of the real time eye detection.

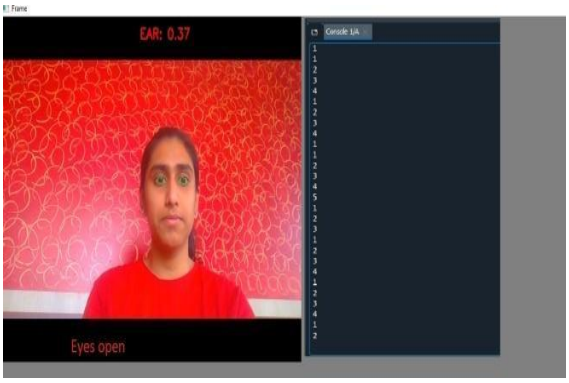

Figure 4: Open eyes detection without spectacles

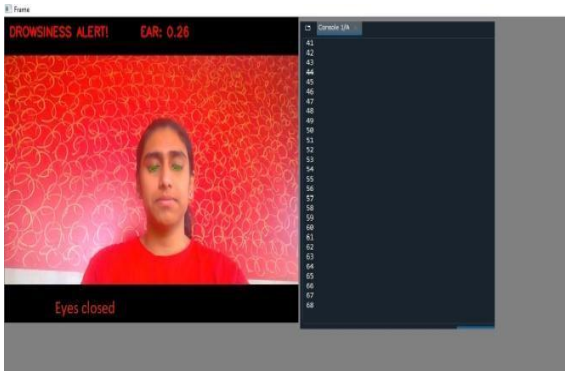

Figure 5: Closed eyes detection without spectacles

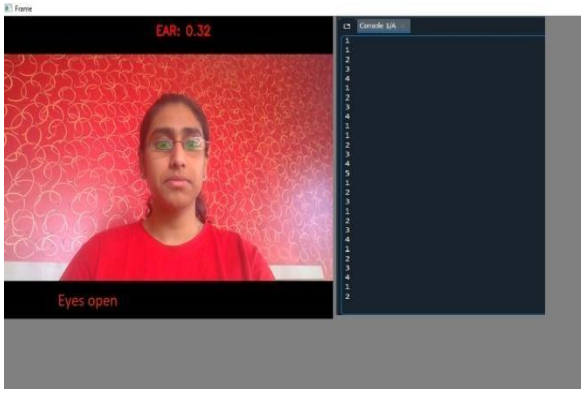

Figure 6: Open eyes detection with spectacles

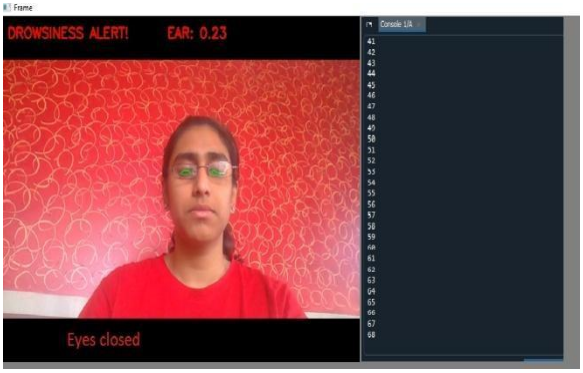

Figure 7: Closed eyes detection with spectacles

6. Conclusion

Life is important and saving it is our upmost duty. Doziness in a driver is a life threatening activity. This doziness happens passively without the intention and knowledge of the driver. Therefore we have looked at the problem from earlier technique of the positive electrodes attached directly to the drivers which would disturb and annoy drivers while driving. So as to avoid this problem and not lead any obstacle and be well focused on their driving ,We came up with an idea of implementing a new method by designing a Non Intrusive System of eyes detection in the driver's if he or she is found to be lethargic. The proposed system is not dependant on the distance between the driver and webcam. Irrespective of his or head tilting movements, the Non Intrusive System takes the driver's image to be still and does not vary nor show any error while capturing the driver's image. This project is being designed for observing the driver's cautious level depending on the driver's frequent eye closures for smaller period of time detecting doziness.

7. Future Work

To optimise our project, we have schemed such as:

1) By using GPS technology, we can inform nearby police stations to track the location of the vehicle so as to take immediate action and prevent the accidents.

2) To overcome the GSM technology ,we would be implementing a new technology such as obd-2, onboard diagnostics sensor which is currently loaded on vehicles and is self diagnostic and has the reporting capability to report the status of the vehicle by sending alert messages to nearby hospitals.Obd-2 has many parameters such as describing vehicle failure position, fuel efficiency, steering angle ratio and has a standard protocol which connects data lines to communication protocol to provide a connection for diagnostic device.

3) A brainwave hat which is also called as smart cap can be designed for drivers which would read impulses from the brain and would determine if the driver is exhaustive or not. The brainwave hat would be integrated with hardware and the buzzer would sound if the driver is found to be exhaustive which is a symptom of drowsiness.

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Therefore, by adopting these above methods this project would be of great help in the real time world and would turn out to be a community based project and would be reliable.

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ShoibaAzam

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