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Fatigue Detection System Based on Eye Blinks of Drivers

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Abstract- In recent years, road accidents have increased significantly. One of the major reasons for the accidents as reported is driver fatigue. Therefore, there is a need for a system to measure the fatigue level of the driver and alert the driver when he/she feels drowsy to avoid accidents. So, in this paper we propose a system which comprises of a camera installed in the car dashboard. It will continuously monitor the blink pattern of driver and detect whether he is feeling drowsy or not. If the system finds the driver is feeling drowsy then an alert will be generated to avoid accident. This project attempts to contribute towards the exercise of analyzing driver behavior-based Eye Aspect Ratio (EAR) in order to reduce preventable road accidents.

Keywords- Blink pattern, Camera, Car dashboard, Driver fatigue, Drowsy, Eye Aspect Ratio (EAR)

I. INTRODUCTION

Cars play an important role, as it's a convenient way to travel**.** People drive cars so that they would be able to travel where ever they want to and whenever they want to and they would be able to save a great deal of time in covering long distances without any problem.

Driving a car is not difficult and gives everyone the ability to travel from one place to another place covering large or small distance much quicker than walking. First of all, Individuals must obtain a driver's license to drive a vehicle. In order to get a license, drivers must pass a written test to show that they know the rules of the road and what to do in different types of situations. They must then pass adriving test. The examiner has drivers drive to show their abilities.Passing a driving test and having a driver's license does not make anyone a great driver. While driving a car, it is important for drivers to stayalert at all times. This means paying attention to the road instead of phones, passengers and music player.

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And the most important reason for accidents is drowsiness of the drivers as they totally lose track of the road and lose complete control of the car. Researchers have identified various signs or symptom that determine the drowsiness of a person and they are as follows:

- Daydreaming and lack of focusing.
- Blinking frequently and partially closed eye.
- Not able to remember the traveled path.
- Yawning after every small period.
- Drifting or maybe move out from the lane.
- Head nodding.
- Poor Concentration
- Slow reactions.

The main focus of this project is to reduce accidents that are caused by the drowsiness of the driver. And we intend to do that by placing a camera in the dashboard of the car and record the eyeblinking pattern of the driver if he is blinking faster than usual to detect whether the driver is feeling sleepy or not and alert the driver with an alarm to get some rest to avoid accidents

II. LITERATURE SURVEY

In previous years a lot of studies have been done on the determining the fatigue level of the driver and also certain researches have been done for the available system [7]. **"Demo: Vision based smart in-car camera system for driver yawning detection"** [1]This paper was presented **B. Hariri, S. Abtahi, S. Shirmohammadi and L. Martel** which detects the yawning pattern of the driver using live video capturing. But it has a disadvantage that if a person is speaking or keeping its mouth open for a longer period of time even then also it will find it as feeling drowsy.

"Predicting driver drowsiness using vehicle measures: Recent insights and future challenges" [2]is a paper presented by **Charles C.Liu, Simon G.Hosking, Michael G.Lenné**which uses various sensors to detect the vehicle movement to judge the drowsiness of the driver which do have certain drawbacks that can be avoided by using the behavioral characteristics of the driver.
Certain researchers have also tried to test the physiological signal such as electroencephalogram (EEG), electromyogram (EMG), electrooculogram (EOG), electrocardiogram (ECG) is used to detect the fatigue level. Physiological signal-based system is the most promising fatigue detection system but they require sensor attached to the skin which may affect the user by causing skin irritation, revulsion, loathing, repulsion, etc.

"A Hybrid Approach to Detect Driver Drowsiness Utilizing Physiological Signals to Improve System Performance and Wearability" [3]this one such system proposed that uses the EEG and ECG to check the drowsy level of the driver. Such system is proved to be very accurate but the feasibility of such system in day to day life is questionable. **"One Millisecond Face Alignment with an Ensemble of Regression Trees"** [4]by VahidKazemi and Josephine Sullivan their paper addresses the problem of Face Alignment for a single image. Using the Dlib library of python they were able to detect the face from the frame.

So, there is a need of such a system that can monitor the driver's real time behavior to judge the drowsy level of it and eye blink are best way of detecting the drowsiness of driver.

III. METHODOLOGY

The process of losing alertness at the wheel due to fatigue can be characterized by a gradual progression of facial features: Changes relating to the direction of the gaze of the driver, Changes in the position of the eyelids or the size of the eyes, Rapid changes in rate of blinking and orientation and position of the head.

The approach presented in this project can be saliently encapsulated as follows:

Step1: Find the face and eye region

- We utilized a pre-trained frontal face detector from Dlib's library which is based on a modification to the Histogram of Oriented Gradients in combination with Linear SVM for classification.
- This pre-trained facial landmark inside the dlib library is used to estimate the location of 70(x,y)- coordinates that map to facial structures on the face.Figure 1 is a 68 facial landmark modelbut by adding 2 more points or pupil we will get 70 landmark model.

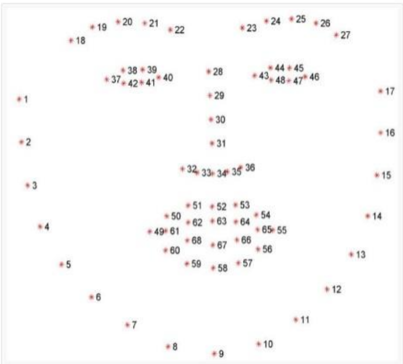

Figure 1. 68 facial landmark model

- After starting the video stream, we have to eliminate the lightning effects using the histogram equalization[5] and Gamma Correction[6]

Histogram Equalization:

It involves correcting image intensities to enhance contrast

Gamma Correction:

This involves enhancing contrast by using a non-linear transformation between input and output mapped values.

- Now, out of 70 points we have to extract exactly 12 points 6 from left eye and 6 from right eye out of 70 points to get the exact position of eye.

Step 2: Find aspect ratio of eyes and check status

- We then calculate the aspect ratio using the Euclidean distances between the points of eye to check whether eyes are opened or closed.
- The eye is open if Eye Aspect Ratio is greater than threshold.
- For calculating the distances between two points we are using Euclidian's Formula

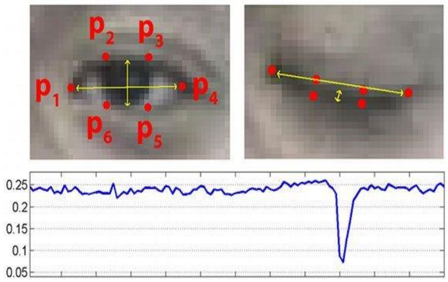

Figure 2. Figure showing the changes at open and closed eye Using Figure 2, we get the equation: -

EAR= (dist(P2,P6)+dist(P3,P5))/(dist(P1,P4))

Step 3: Decision on blink and Drowsiness

- A blink is supposed to last 200-300 milliseconds. A drowsy blink would last for 800-900 ms.
- Assume time between two frames is 100 ms (varies between computers)
- Blink will be valid if it lasts for 300 ms (3 frames). (Different for different people)
- Person is drowsy if eye remains closed for more than 900 ms (9 frames)

Step 4: Finally sound the alarm

- If the drowsy time increases the drowsy limit then the alert will be generated.

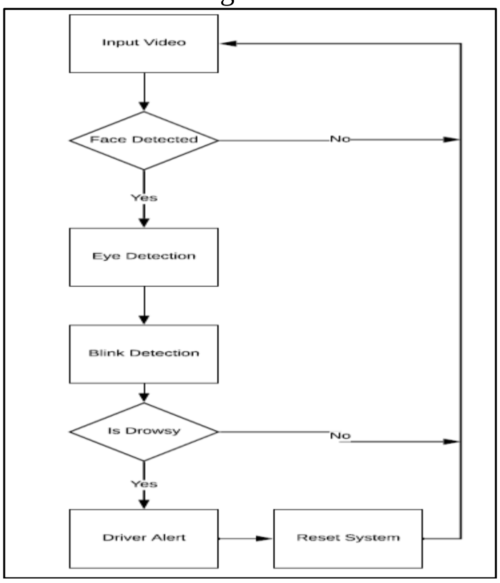

Figure 3. Flow Chart for the system

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IV. RESULTS AND DISSCUSSION

The system will be fully automated, reliable, transparent and convenient to use.This technology will be much more convenient compared to the physiological signals i.e. ECG, EOG etc. [3]The evaluation of drowsy state is based the comparison of the thresh value to the Eye Aspect Ratio (EAR). Once the EAR value becomes less then the thresh value the eye state will change to 1 to 0 i.e. 1 for eye open and 0 for eye closed and the blink count will be increased. Once the eye state become 0 a counter will be set which will keep track for the drowsy time if it increases the limit then a waring will be generated which will alert the driver.

Here are the screenshots of the project that shows how it works:

Figure 4. Reading the face and detecting eye regions and counting the blinks

In the above figure i.e., Figure 4 system is capturing the live video of the person and checking for blinks if he blinks the EAR value will become less then the thresh value then the blink_count value will be incremented by 1.

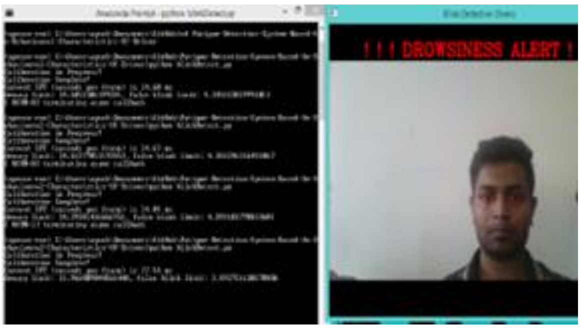

Figure 5. Generating an alert

If the person closes his eyes for more then the minimum limit time between two blinks then an alert will be issued to the driver that he is feeling sleepy (Figure 5).

Our system just uses only eye EAR values to detect the drowsiness of driver but there are certain researches done which derives accuracy of 95%[1,2,3]but these systems are not at all feasible in Realtime and our system works with an accuracy of 80% which is easy to be used and install in cars. It contains certain drawbacks because as per now it doesn't have any provision for other feature detection like yawn, head positions etc.

V. CONCLUSION

This project leads us to great shortfall of our car driving system i.e. drowsiness or fatigue experienced by the drivers. So, this project helped us to detect whether the driver is feeling drowsy or not. Still there are some limitations of our project as it won't be able to detect the drivers face in low light or during night, secondly if the driver turns his head then it won't be able to identify the face and eye points and also if driver wears a sunglass then also it won't be able to detect the eye blinks. But our system has successfully detected the eye blinks and drowsiness in suitable lightning and also if he wears a power glass.

Future Works

- Stabilize the landmark points by using k previous frames.
- Attempt to utilize the orientation of the head to add an additional layer of sophistication in the fatigue detection approach.
- To detect the stress level of the driver
- To detect the eye blinks during night time.

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