Smart System for Driver Drowsiness and Alerting

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***Abstract*- Driver drowsiness has been one of the major causes of road accidents and can lead to severe physical injuries, deaths and significant economic losses. We decided to take a step towards safety and reduce accidents due to drowsiness by developing a prototype drowsiness detection system. By this prototype we intend to reduce accidents caused due to drowsiness. Our System is based on capturing real time video analysis and by using image processing those images will be scanned and based upon certain threshold results the drowsy condition will be detected. Using all these algorithms, the data obtained will be compared and if the drowsy condition is detected; the alarm will alert the driver and also text message related to drowsy condition will be sent to respective family members of the driver at the same time. By integrating such onboard system in every driving vehicle will definitely lead to 75% reduce in road accidents due to drowsy condition of a driver.**

***Index terms*- Driver fatigue, Drowsiness detection techniques, Image processing, Facial expressions, Eye states, Head poses, Algorithm matching**

I.INTRODUCTION

Nowadays, fatigue condition is increasing in this fast growing world. Fatigue is such a condition in which a person has loss of concentration for 1-30 seconds or even more. Also drowsiness has lead to one of major causes of road accidents.

Driving for a long period of time causes excessive fatigue and tiredness which in turn makes the driver sleepy or loose awareness. Driver drowsiness can be caused due to two factors i.e. either by drinking alcohol or due to fatigue condition. Fatigue can also lead to microsleep for a driver. Drowsiness detection involves many methods such as using EEG or ECG sensors, using steering movements or by capturing eye movements.

Devices to detect when drivers are falling asleep and to provide warnings to alert them of the risk, or even control the vehicle's movement, have been the subject to much research and development. Our system is based on capturing real time video analysis and by using image processing those images will be scanned and based upon certain results the drowsy condition will be detected. Also there will be alerting system which will alert the driver. In this paper the algorithms for face detection and eye tracking have been developed on frontal faces with no restrictions on the background .The proposed method for eye tracking is built into five stages. Using frontal images obtained from a database, the probability maps for the eyes region are built etc.

II. TECHNIQUES FOR DETECTING DROWSINESS STATE

Techniques can be divided into following categories

1 Sensing of physiological characteristics
2 Sensing of driver operation
3 Sensing of vehicle response
4 Monitoring the response of driver

The technique of sensing of vehicle operation is well suited for real world driving conditions since it can be non-intrusive by using optical sensors of video cameras to detect changes. Above mentioned first technique is not realistic since the sensing electrodes would have to be attached directly to the driver which will distract the driver.

Driver operation and vehicle behavior 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 monitoring the response of driver which included periodically requesting the driver to send a response to the system. Among the techniques mentioned above, the best one is sensing of physiological characteristics phenomena.
This technique will be implemented by measuring changes in physiological signals, such as brain waves, heart rates and eye blinking.

III. TECHNIQUE TO BE USED

A real time monitoring system in detecting drowsiness (using image processing)
Our system captures real time images. By using image processing those images will be compared with given threshold value algorithm. The alarm will alert the driver if drowsy state is detected.

IV. IMPLEMENTATION

The proposed method is built in four stages :

- Localization of Face
- Localization of the Eyes
- Tracking the eyes in the given frames.
- Capturing of image
- Detection of drowsy state
- Alerting the driver (By alarm and sending text message to respective family members)

Localization of Face: Since the Face is symmetric, we use a symmetry-based approach. The face detection method used in OpenCv is developed in 2001 by Paul Viola and Michael Jones, very well referred to as the Viola-Jones method. Though this method can be used for several objects but most specifically here it is used for face and eye detection in real time.

Location of Eyes: A raster scan algorithm is used for the exact location of the eyes and extracts that vertical location of eyes. This algorithm gives us the threshold value required to detect the condition.

Tracking of the eyes: We track the eye by looking for the darkest pixel in the predicted region. We first compare the six points of our eye. This points covers our entire eye and pupil. The result obtained is compared with respect to other frames obtained. To find the best match for the eye template, we initially center it at the darkest pixel, and then perform a gradient descent in order to find a local minimum.

Image Capture:
Utilizing a web camera introduced inside the automobile we can get the picture of the driver.
Despite the fact that the camera creates a video clip, we have to apply the developed algorithm on each edge of the video stream. This paper is only focused on the applying the proposed mechanism only on single frame. The used camera is a low cost web camera with a frame rate of 30 fps in VGA mode. Logitech Camera is used for this process is shown in figure.

Detection of Drowsiness: And in this type of system uses a remotely placed camera to acquire video and computer vision methods are then applied to sequentially localize face, eyes and eyelids positions to measure ratio of closure. We count the number of consecutive frames that the eyes are closed in order to decide the condition of the driver.

We have implemented Face detection with the help of

1 Raspberry pi.
2 Web Cam.
3 Raspbian operating system.
4 Python IDLE.
5 OpenCv (Open source Computer Vision) for python with Harr object detection trainer.
6 Program code for face detection written in Python Programming language.

V. EXPERIMENTAL SET-UP

Process flow:
The camera is to be mounted on the dashboard inside the vehicle.
The grabbed frames are represented in RGB-space with 8-bit pixels (256 colors). We will not be using any specialized hardware for image processing. Given below is the block system configuration.

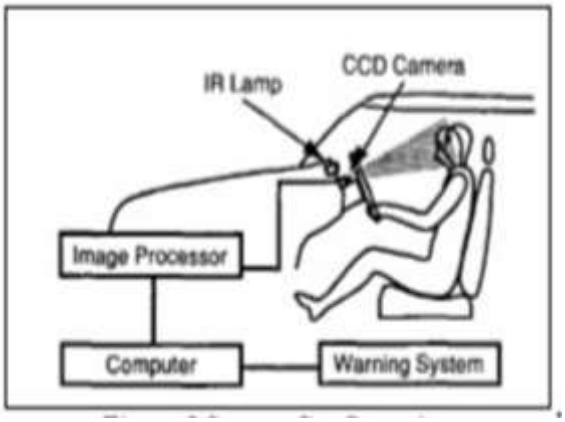

Figure1. System Configuration

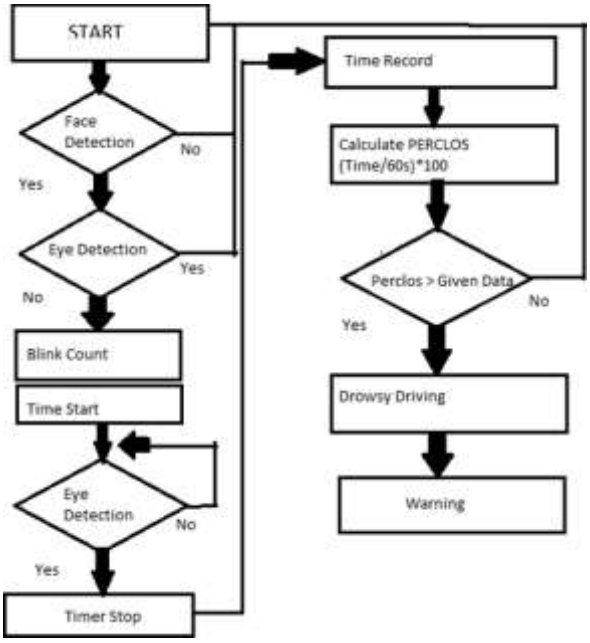

Figure2. Flowchart of given system

The function of the system can be broadly divided into eye detection function, comprising the first half of the preprocessing routine, and a drowsiness detection function, comprising the second half.

After inputting a facial image, preprocessing is performed to binarize the image and remove noise, which makes it possible for the image to be accepted by the image processor. The maximum width of the face is then detected so that the right and left edges of the face can be identified. After that the vertical position of each eye is detected independently within an area defined by the center line of the face width and lines running through the outermost points of the face. This parameter gives idea about the entire algorithm for identifying eye aspect ratio is given as:

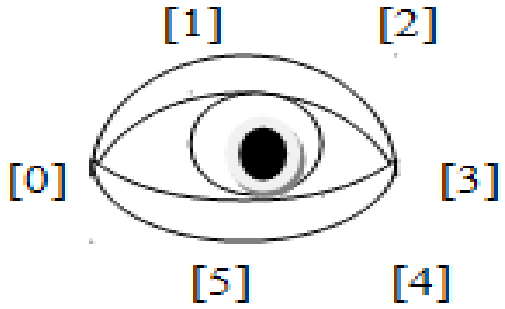

Figure 3 Eye

A = dist.euclidean(eye[1],eye[5])
B = dist.euclidean(eye[2],eye[4])
C= dist.euclidean(eye[0],eye[3])
Ear = (A+ B)/(2 *C)

If particular value exceeds more than 0.25 by observing 20 frames consequently, then the system detects person as a drowsy.

Judgment whether the eye are open/closed:

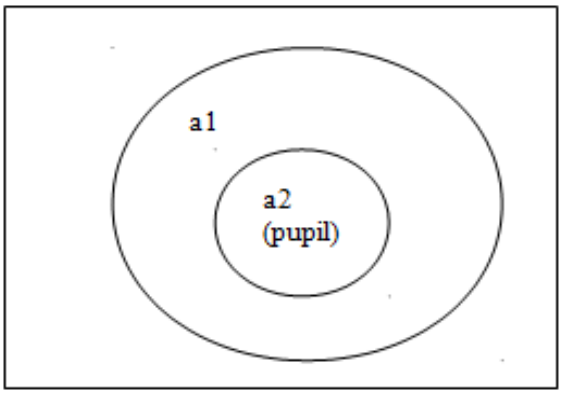

Figure4. Eye histogram

We constructed a template consisting of two circles, one inside the other. A good match would result in many dark pixels in the area inside the inner circle, and many bright pixels in the area between the two circles. This match occurs when the inner circle is centered on the iris and the outside circle covers the sclera. The match M (a1, a2) is computed as

$M(a1, a2) = \sum I(p, q) - \sum I(p, q)$.

A low value for M (a1, a2) corresponds to a good match. The template is matched across the predicted eye-region, and the best match is reported. We track the eye by looking for the darkest pixel in the predicted region.

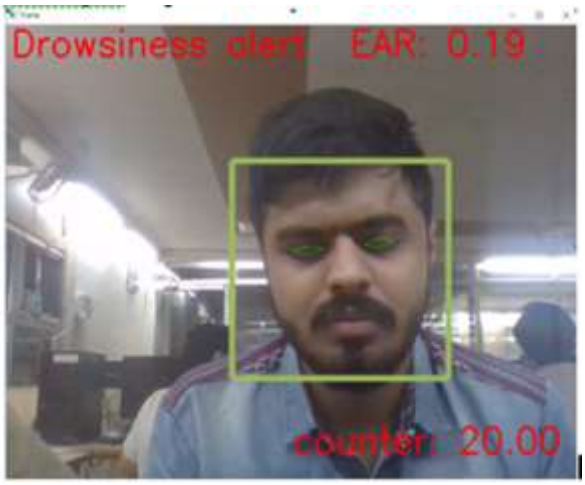

Figure5.Histogram corresponding to eye opened/closed.

Using all these algorithms, the data obtained will be compared and if the drowsy condition is detected the alarm will alert the driver. At the same time when drowsiness is detected the text message will be sent to respective family members.

By integrating such on board system in every driving vehicle will definitely lead to 75% reduce in road accidents due to drowsy condition of a driver.

VI. LIMITATIONS

Dependence on ambient light: The model developed for this purpose strongly depends on the ambient light condition. As our algorithm considers the eye sight as a dark region when it is closed and brighter region when it is open so if the ambient condition affects such that there may be possibility of brighter and darker condition depending on light source then it causes error in the result. Also this model depends on certain minimum level of light condition otherwise it becomes very difficult to detect. To avoid this error we can use either LED light for better detection or we can use an infrared camera.

Distance of camera from driver face: For best result we have assumed and designed the code according to the fact that the distance between camera and face should be nearly 100 cm. Hence the designed set up output may vary from vehicle to vehicle as different vehicle have different types of seat lengths.

Processor speed of hardware: We have used RaspberryPi for implementation. The processor speed of RaspberryPi is 700 MHz. So this speed of processor is not compete enough to do video processing. Hence processor with very high speed is needed which will ultimately increase the cost of the product.

Use of spectacles: In case the user uses spectacle then it is difficult to detect the state of the eye. As it hugely depends on light hence reflection of spectacles may give the output for a closed eye as opened eye. Hence for this purpose the closeness of eye to the camera is required to avoid light.

Multiple face problem: If multiple face arise in the window then the camera may detect more number of faces undesired output may appear. Because of different condition of different faces. So we need to make sure that only the driver face come within the range of the camera. Also the speed of detection reduces because of operation on multiple faces.

VII. CONCLUSION

We developed a system that localizes and track the eyes and head movements of the driver in order to detect drowsiness. Our System is based on capturing real time video analysis and by using image processing those images will be scanned and based upon certain threshold results the drowsy condition will be detected. A warning signal will be given in the form of buzzer or alarm author-kit message and also text message will be sent to family members.

VIII. ACKNOWLEDGMENT

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