Drowsy Driver Warning System Using Image Processing

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Abstract: Driver in-alertness is an important cause for most accident related to the vehicles crashes. Driver fatigue resulting from sleep deprivation or sleep disorders is an important factor in the increasing number of the accidents on today's roads. Drowsy driver warning system can form the basis of the system to possibly reduce the accidents related to driver's drowsiness. The purpose of such a system is to perform detection of driver fatigue. By placing the camera inside the car, we can monitor the face of the driver and look for the eye-movements which indicate that the driver is no longer in condition to driver is no longer in condition to drive. In such a case, a warning signal should be issued. This paper describes how to find and track the eyes. We also describe a method that can determine if the eyes are open or closed. The main criterion of this system is that it must be highly non-intrusive and it should start when the ignition is turned on without having at the driver initiate the system. Nor should the driver be responsible for providing any feedback to the system. The system must also operate regardless of the texture and the color of the face. It must also be able to handle diverse condition such as changes in light, shadows, reflections etc. In given paper a drowsy driver warning system using image processing as well as accelerometer is proposed.

Key words: Drowsy, system, fatigue, template matching

I.INTRODUCTION
1.1 Overview

The innovations in the automobile industry over the last hundred years have made our vehicles more powerful, easier to drive and control safer more energy efficient, and more environmentally friendly. Majority of the accidents caused today by cars are mainly due to the driver fatigue. Driving for a long period of time causes excessive fatigue and tiredness which in turn makes the driver sleepy or loose awareness. With the rapid increase in the number of accidents seems to be increasing day to day. Therefore a need arises to design a system that keeps the driver focused on the road. Data on road accidents in India are collected by Transport Research Wing of Ministry of Road Transport & Highways.

The aim of this paper is to develop a prototype of drowsy driver warning system. Our whole focus and concentration will be placed on designing the system that will accurately monitor the open and closed state of the driver's eye in real time. By constantly monitoring the eyes, it can be seen that the symptoms of driver fatigue can be detected early enough to avoid an accident. This detection can be done using a sequence of images of eyes as well as face and head movement. The observation of eye movements and its edges for the detection will be used. 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. Driver fatigue is a serious problem resulting in many thousands of road accidents each year. It is not currently possible to calculate the exact number of sleep related accidents because of the difficulties in detecting whether fatigue was a factor and in assessing the level of fatigue. However research suggests that up to 25% of accidents on monotonous roads in India are fatigue related. Research in other countries also indicates that driver fatigue is a serious problem.

Young male drivers, truck drivers, company car drivers and shift workers are the most at risk of falling asleep while driving. However any driver travelling long distances or when they are tired, it is at the risk of a sleep related accidents. The early hours of the morning and the middle of the afternoon are the peak times for fatigue accidents and long journeys on monotonous roads, particularly motor-ways, are the most likely to result in a driver falling asleep. 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.

1.2 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. Even long time driving in summer may lead to perspiration on sensors, diminishing their ability to monitor accurately.

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 in two ways.
1.   Measuring changes in physiological signals, such as brain waves, heart rates and eye blinking.
2.   Measuring physical changes such as sagging posture, leaning of the driver's head and open/closed state of the drivers

II. LITERATURE SURVEY

1.   Hong Su published a paper on Partial Least Squares Regression-Based Fusion Model for Predicting the Trend in Drowsiness. The major observation was They proposed a new technique of modeling driver drowsiness with multiple eyelid movement features based on an information fusion technique—partial least squares regression (PLSR), with which to cope with the problem of strong collinear relations among eyelid movement features and, thus, predicting the tendency of the drowsiness.

2.   Bin Yang published a paper on Camera- based drowsiness reference for driver state classification under real driving. The major observation was they proposed that measures of the driver's eyes are capable to detect drowsiness under simulator or experiment conditions. The performance of the latest eye tracking. Based in-vehicle fatigue prediction measures are evaluated.

3.   A. Cheng published paper on 'Driver Drowsiness Recognition Based on Computer Vision Technology. The major observation was they presented a nonintrusive drowsiness recognition method using eye-tracking and image processing. A robust eye detection algorithm is introduced to address the problems caused by changes in illumination and driver posture.

4.   G. Kong published a paper on Visual Analysis of Eye State and Head Pose for Driver Alertness Monitoring. The major observation was they presented visual analysis of eye state and head pose (HP) for continuous monitoring of alertness of a vehicle driver.
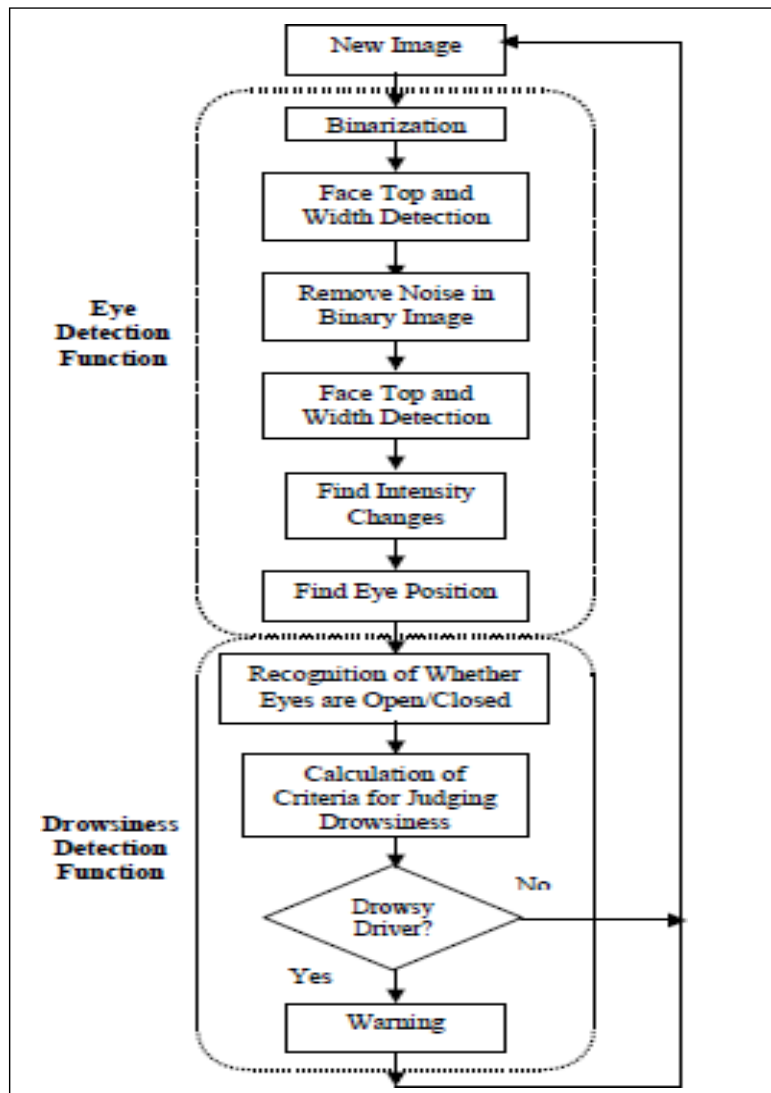
III. METHODOLOGY

Figure: step by step process of the application

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. On that basis, the area in which each eye is present is determined. Once the areas of eye presence have been defined, they can be updated by tracking the movement of the eyes. The degree of eye openness is output simultaneously with the establishment or updating of the areas of eye presence. That value is used in judging whether the eyes are open or closed and also in judging whether the eyes have been detected correctly or not. If the system judges that the eyes have not been detected correctly, the routine returns to the detection of the entire face.

The following explains the eye detection procedure in the order of the processing operations.
a)Preprocessing
The preprocessing operations include the binarization of a facial image to increase the processing speed and conserve memory capacity and noise removal. The image processor developed for this drowsiness warning system performs the expansion and contraction operation on the white pixels and processing for noise removal is performed on the small black pixels of the facial images.
After the binarization, the noise removal procedure involves an expansion processing method combined with the use of a median filter. These preprocessing operations are sufficient to support detection of the vertical positions of the eyes.

However, following identification of the eye positions, the size of the eyes must be converted back to the original image format at the time the degree of eye openness is output. To facilitate that, data contraction is performed in the latter stage of preprocessing.

b)Face width detection

The maximum width of the driver's face must be detected in order to determine the lateral positions of the areas in which the eyes are present. Face width is detected by judging the continuity of white pixels and the pattern of change in pixel number. On that basis, the outer edges of the face are recognized and determined.

c) Detection of vertical eye position

Each vertical eye position is detected independently within an area demarcated by the center line of the face, which is found from the face width, and straight lines running through the right and left outer edges of the face. In a binary image, the eye becomes collection of black pixels, along with the eyebrows, nostrils, mouth and other facial features. These collections of black pixels are recognized on the basis of a labeling operation, and the position of each eye is extracted by judging the area of each label along with its aspect ratio and relative coordinate positions in the facial image. Through this process of detecting each vertical eye position, the central coordinates of each eye are recognized. The coordinates serve as references for defining the areas of eye presence.

d)Eye tracking

A function for tracking the positions of the eye is an important capability for achieving high-speed processing because it eliminates the need to process every frame in order to detect each eye position from the entire facial image.

This function consists of a subordinate for updating the areas of eye presence and recognizing when tracking becomes impossible. The basic concept of eye tracking is to update the area of eye presence, in which an eye search is made in the following frame, according to the central coordinates of the eye in the previous frame. The updating process involves defining an arc of eye presence on the basis of the coordinates (x_k, y_k) at the point of intersection of center lines running through the Feret's diameter of the detected eye. The area thus becomes the area of eye presence in which the system searches for the eye in the image data of the next frame.

This process of using information on eye position to define the eye position for obtaining the next facial image data makes it possible to track the position of the eye. As it is clear from this description, the size of the area of eye position changes. If the eyes are tracked correctly, their degree of openness will always vary within certain Specified range for each individual driver. Consequently, if the value found by the system falls outside the range, it judges that the eyes are not being tracked correctly. The process of detecting the position of each eye from the entire facial image is then executed once more.

a)   Judgment whether the eye are open/closed:

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.

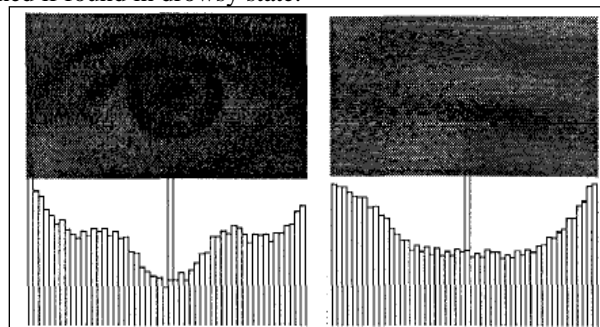And thus the driver can be warned if found in drowsy state.

Figure:.Histogram corresponding to eye opened/closed.

IV. CONCLUSION

We developed a system that localizes and track the eyes and head movements of the driver in order to detect drowsiness. The system uses a combination of template – based matching and feature based matching in order to localize the eyes. During tracking, system will be able to decide if the eyes are open or closed and whether the driver is looking in front. When the eyes will be closed for too long, a warning signal will be given in the form of buzzer or alarm author-kit message.

V.RESULTS
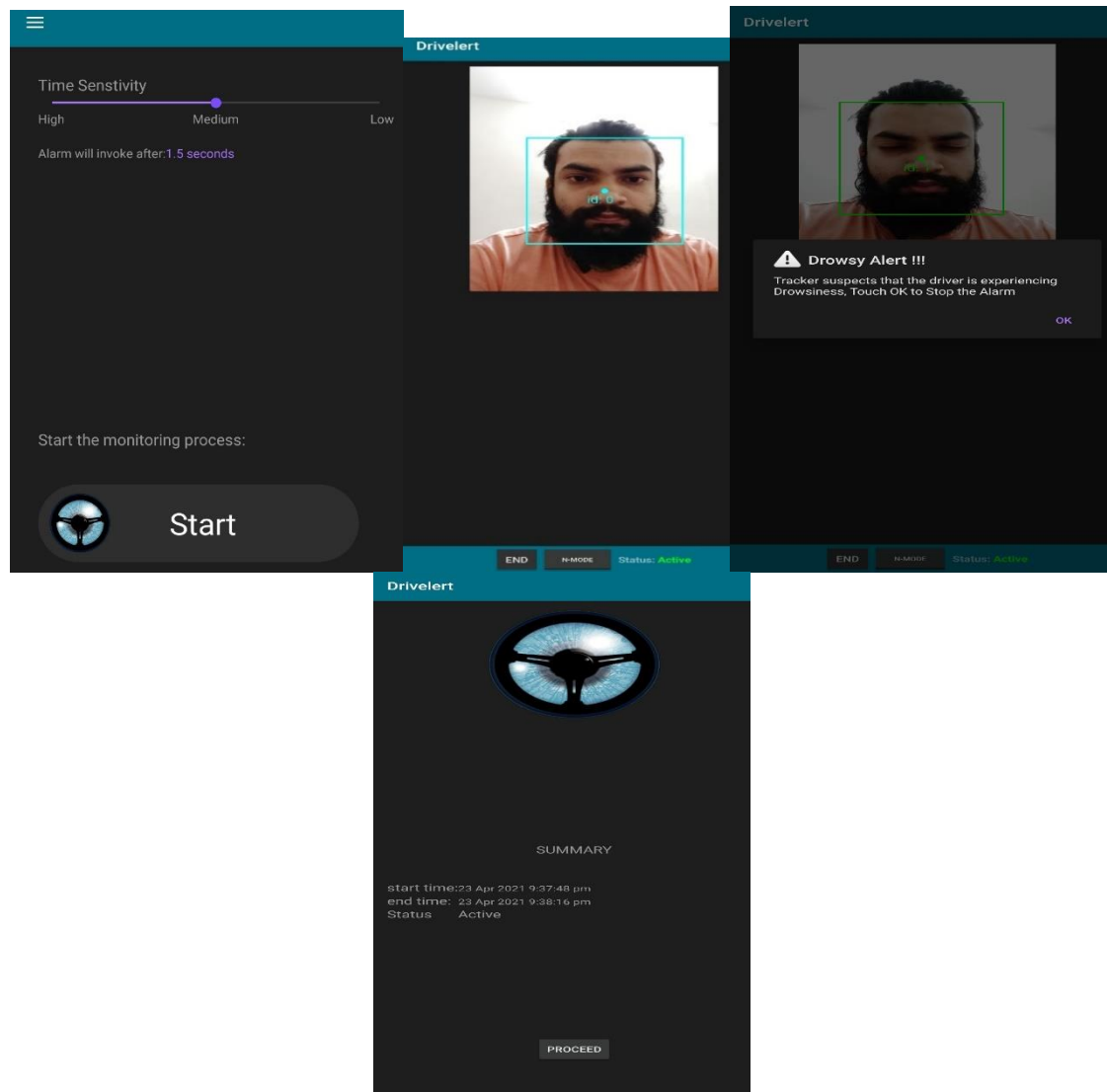
1.   In first picture it is the home screen of the application. The user will start the application when they are driving vehicle.
2.   In second picture the camera of the device is turned on and it is recording the user face/eyes whether they are sleeping or not.
3.   In third picture the camera detects that the user's eyes are closed and then the alarm goes off alerting the user to wake up before any disaster occurs.
4.   In fourth picture the application gives summary of when the app was turned on and when the app gets turned off.

REFERENCES

[1]   Qiang Ji, Zhiwei Zhu and Peilin Lan ‒IEEE transactions on Vehicular Technology Real Time Non-intrusive Monitoring and Prediction of Driver Fatigue, vol. 53, no. 4, July 2004.
[2]   N.G. Narole, and G.H. Raisoni., ‒IJCSNS A Neuro-genetic System Design for Monitoring Driver's Fatigue. vol. 9. No. 3, March 2009.
[3]   Wei-niin Huang & Robert Mariani, ―Face Detecion and precise Eyes Location ‒, Proceeding of the International Conference on Patteni Recognization(ICPPǀOO),Vol.4,2000
[4]   Gonzalez, Rafel C. and Woods, Richard E. ‒Digital Image   Processingǀ, Prentice Hall: Upper Saddle River, N.J., 2002.
[5]   Perez, Claudio A. et al. ‒Face and Eye Tracking Algorithm Based on Digital Image Processingǀ,IEEE System, Man and Cybernetics 2001 Conference, vol. 2 (2001), pp 1178-1188.
[6]   Singh, Sarbjit and Papanikolopoulos, N.P. ‒Monitoring Driver Fatigue Using Facial Analysis Techniquesǀ, IEEE Intelligent Transport System Proceedings (1999), pp 314-318.
[7]   Ueno H., Kanda, M. and Tsukino, M. ‒Development of Drowsiness DetectionSystemǀ,IEEE Vehicle Navigation and Infor mation Systems Conference Proceedings,(1994), ppA1-3,15-20.
[8]   Weirwille, W.W. (1994). ‒Overview of Research on Driver Drowsiness Definition and Driver Drowsiness Detection,ǀ 14th International

Technical Conference on Enhanced Safety of Vehicles, pp 23-26.

[9]   R. Brunelli, Template Matching Techniques in Computer Vision: Theory and Practice, Wiley, ISBN 978-0-470-51706-2, 2009

[10]   J. Cox, J. Ghosn, P.N. Yianilos, ―Feature-Based Recognition   Using   Mixture-Distance,   ―NEC Research Institute,Technical Report 95 - 09, 1995.

[11]   I. Craw, H. Ellis and J.R. Lishman, ―Automatic Extraction of Face-Features,‖Pattern Recognition Letters, 5, pp. 183-187, 1987.

[12]   L.C. De Silva, K. Aizawa and M. Hatori,―Detection and Tracking of Facial Features by Using Edge Pixel Counting and Deformable Circular Template Matching,‖IEICE Transaction on Information and Systems, Vol. E78-D No. 9, pp. 1195- 1207, September 1995.

[13]   C. Huang and C. Chen, ‑Human Facial Feature Extraction for Face Interpretation and Recognition,‖ Pattern Recognition, Vol. 25, NO. 12 pp.1435-1444, 1992.