DIP Based Monitoring and Control of Drowsy Driving For Prevention of Fatal Traffic Accidents

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Abstract- *Distracted driving is one of the main causes of vehicle collisions. Passively monitoring a driver's activities constitutes the basis of an automobile safety system that can potentially reduce the number of accidents by estimating the driver's focus of attention. This paper proposes an inexpensive vision-based system to accurately detect Eyes Off the Road (EOR). The system has three main components: 1) robust facial feature tracking; 2) head pose and gaze estimation. From the video stream of a camera installed on the steering wheel column, our system tracks facial features from the driver's face. Using the tracked landmarks and a 3-D face model, the system computes head pose and gaze direction. The head pose estimation algorithm is robust to nonrigid face deformations due to changes in expressions. Finally, using a 3-D geometric analysis, the system reliably detects EOR. The proposed system does not require any driver-dependent calibration or manual initialization and works in real time (25 FPS), during the day and night. Our system is proposed to achieved above 90% EOR accuracy.*

Keyword: Driver monitoring system, eyes off the road detection, gaze estimation, head pose estimation.

I. INTRODUCTION

The main aim of eye gaze tracking based driver monitoring system is to reduce accidents caused by distracted driving. Indian roads, which account for the highest fatalities in the world, became yet more dangerous in 2015 with the number of deaths rising nearly 5% to 1.46 lakh. This translates to 400 deaths a day or one life snuffed out every 3.6 minutes, in what an expert described as a "daily massacre on our roads". According to provisional police data provided by states, Uttar Pradesh recorded the maximum number of road deaths (17,666), followed by Tamil Nadu (15,642), Maharashtra (13,212), Karnataka (10,856) and Rajasthan (10,510).

Distracted drivers tend to decrease attention to important information needed for safe driving which makes them prone to severe car accidents. NHTSA has classified driver distraction into four types which are auditory, visual, biomechanical and cognitive. Reasons for distraction can be driving after drinking alcohol, driving at night time, driving without taking rest, aging, fatigue because of continuous driving, long working hours and night shifts etc. Nowadays another concern for distracted driving is the use of mobile phones and other electronic devices while driving. NSTHA has stated that texting, browsing, and dialling is the reason for longest time of drivers taking their Eyes Off the Road (EOR) and increase the risk of crash by three times. Proposed driver monitoring system based Eye gaze tracking and 3D head pose estimation can help in continuously monitoring and alerting driver in case of eyes off the road (EOR) or distraction and drowsiness. Implementing system which will give audio alerts and wheel vibration alerts depending on situation. To reduce number of accidents caused by distraction is the motivation behind this project in order to improve traffic safety.

II. OBJECTIVES

1. A person's face with open eyes will be stored in MATLAB database as a threshold for doze off calculations in real time.
2. The installed camera will detect the head position and pupil position of the driver. This head position and pupil position

information will be given to our proposed image processing software in MATLAB.

3. This said software will detect whether the driver is Doze off or not by comparing the values taken with a certain threshold value(already stored in data based) .

4. If the values differ then an alarm will be raised. Also, this software will instruct the microcontroller to slow down the speed of the prototype vehicle.

5. This proposed project aims to prevent accidents by continuously monitoring head and pupil position of driver on real time basis.

III. LITERATURE REVIEW

1. C. Ahlstrom, K. Kircher, and A. Kircher, proposed methodology for "A gaze-based driver distraction warning system and its effect on visual behaviour"[4]. This proposed system does not require any driver-dependent calibration or manual initialization and works in real time (25 FPS), during the day and night. To validate the performance of the system in a real car environment, we conducted a comprehensive experimental evaluation under a wide variety illumination conditions, facial expressions, and individuals.

2. Arne. Nabo Saab Automobile AB, proposed methodology for "Driver attention—dealing with drowsiness and distraction"[15]. The project overall objective was to contribute to traffic safety by promoting an alert and attentive driver by technical means in the vehicle. A Driver Attention system – in this project called 'AttenD' – was developed with the purpose to detect and warn the driver in case of visual inattention and sleepiness.

3. Jorge P. Batista proposed methodology [14] for this paper describes a framework for analyzing video sequences of a driver and determining his level of attention. The proposed system deals with the computation of eyelid movement parameters and head (face) orientation estimation. The system relies on pupil detection to robustly track the driver's head pose and monitoring its level of fatigue. Visual information is acquired using a specially designed solution combining a CCD video camera with an NIR illumination system. The system is fully automatic and classifies rotation in all-view direction, detects eye blinking and eye closure and recovers the gaze of the eyes Experimental results using real images demonstrates the accuracy and robustness of the proposed solution.

Driver monitoring systems Fatigue/distraction detection can be mainly categorized into three categories [10]. (1) Approaches based on bioelectric measurements (for e.g., ECG and EEG), (2) Approaches based on steering motion, lane departure (3) Approaches based on driver face monitoring (eye closure %, eyelid distance, blinking rate, gaze direction and head rotation etc.) Driver monitoring systems which use driver face monitoring can be classified into intrusive and nonintrusive techniques. Intrusive techniques need special attachments such as electrodes, goggles or head mounted device. These devices are attached to the skin and hence interfere with the user. Intrusive methods interfere with the user and are inconvenient, hence limited for laboratory testing. The systems that do not have any physical contact with the user are called remote systems or non-intrusive systems. These techniques are mostly based on image processing and can be passive image based or video feed based .

If any other features like head pose estimation is combined with eye gaze tracking can give better accuracy than eye gaze tracking alone especially in cases where spectacles and sunglasses are used by driver [3]. The detection of driver distraction mostly depends on the classification technique [2]. Support Vector Machine (SVM) classifier is widely used for gaze estimation. One or more features are used to design SVM. Real time Hidden Markov Models (HMMs) are also used in some approaches. But SVM are more common and accurate with average accuracy of 82%.

Eye gaze tracking methods The concept of eye-gaze tracking and estimation is hot research topic in last few years. Eye-gaze tracking methods can be categorized into two approaches.

Appearance based model: It use the position of the pupils and general shape of the eyes and relative to the eye corners for finding the point of gaze [8]. A pretrained model of the appearance and shape of the eye region is fitted to a sequence of image frames. Feature based model: These methods use characteristics of the eye to identify a set of features like contours, eye corners of NIR illuminators (LEDs) [7]. They can be further divided into model-based methods and regression based. The eye-model-based techniques use the geometrical model of the eye along with NIR light sources. In regression based method, vector between the pupil center and corneal reflections is mapped and tracked geometrically with a polynomial regression function to find gaze coordinates on a virtual screen.

Head pose estimation methods The methods for head orientation can be categorized into four categories [9].

Methods based on shape features with eye position: These methods analyze the geometric arrangement of facial features to determine the head orientation e.g. AAM (Active appearance model) [8]. Methods based on shape features without eye position: These methods use simpler features like center of the face, left and right borders etc. rather than detailed features of face such as nose, eyes, and face contour. Thus this method is simpler [6]. Methods based on texture features: These methods identify driver's face in the image and analyzes intensity pattern to determine the head orientation. Many learning techniques such as KPCA, PCA, LDA, and kernel discriminant analysis (KDA) are used to extract texture features. These features are then classified to obtain head orientation [11]. Methods based on hybrid features: These methods based on hybrid features combine texture and shape features to determine the head orientation. Initial head orientation is determined using texture based features and detailed head orientation is found by using 3-D face model tracking and fitting [6].

IV. SYSTEM DESCRIPTION

A. System specifications

The camera will be used for capturing the image of the driver, placed on the dashboard.The captured image will be sent to the IC ATMEGA through the bluetooth device(HC05). The microcontroller will then send signals to the buzzer and the motors.The signals sent will make the buzzer blow and the motors will gradually decrease the speed of the vehicle.The LCD will display the messages sent through the controller.

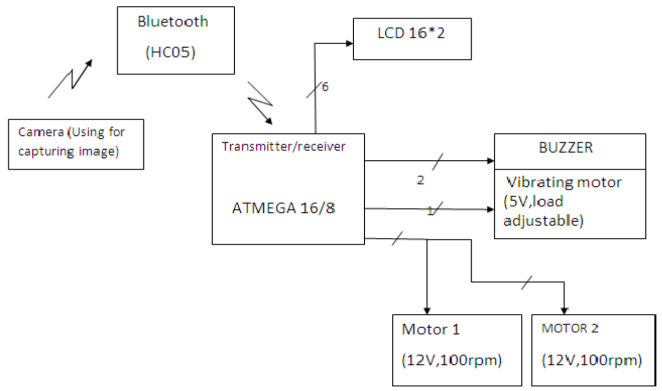

Fig.1.System block diagram

B. Image acquisition.

The image acquisition module uses a low-cost web camera. USB webcam is used based on CCD mechanism. Camera is interfaced to Raspberry Pi 2 using USB port. Camera is placed on car dashboard above the steering wheel approximately 35-40 cm away pointing straight to the driver. Placing camera in this way makes capturing driver's face very easy. Operation of the camera at night time is achieved using an IR illumination source to provide a clear image of the driver's face without distracting driver. 36 LED IR illuminator is used which is fitted with LDR for automatic on off.

C. Facial feature tracking Facial feature tracking algorithm is implemented in Open CV using Raspberry Pi. Viola Jones algorithm is used which is a four step algorithm 1) Haar feature selection (eyes) 2) Create an integral image 3) Adaboost training on integral image 4) Cascading the classifier. Eyes.xml is the library file used for eye detection Rectangular frames are used to denote eye. The Haar Classifiers algorithm rapidly detects object using AdaBoost classifier cascades with help of Haar features [4].

D. Eye gaze tracking and estimation Driver eye gaze is constantly changing during driving depending on surrounding conditions. Thus detecting eyes is not sufficient. Eyes need to be tracked in real time. Continuously Adaptive Mean Shift (CAMSHIFT) algorithm is used for real time eye tracking. Pupils of the eyes are tracked.

E. Head pose estimation Drivers tend to change their head pose while driving. 3D head pose estimation is required to recognize in which direction driver is looking. 3D Head pose is estimation is proposed by combining Active Appearance Models (AAM) and Pose from Orthography and Scaling with ITerations (POSIT). Out of the three Euler angles only yaw and pitch angles are extracted and used and not roll angle. Yaw and pitch angles are sufficient to detect head pose direction.

F. Eyes off the road detection and fatigue detection Similar to concept used in [3] [6] [9], Different zones are defined in the car as shown in fig.3. Zones are defined in point of view of a driver with left hand drive system. 11 different gaze zones representing the dashboard, the centre console, the rear-view mirror, two side mirrors and six zones on the windshield. These defined zones cover most of the possible gaze directions involved in real-world driving.

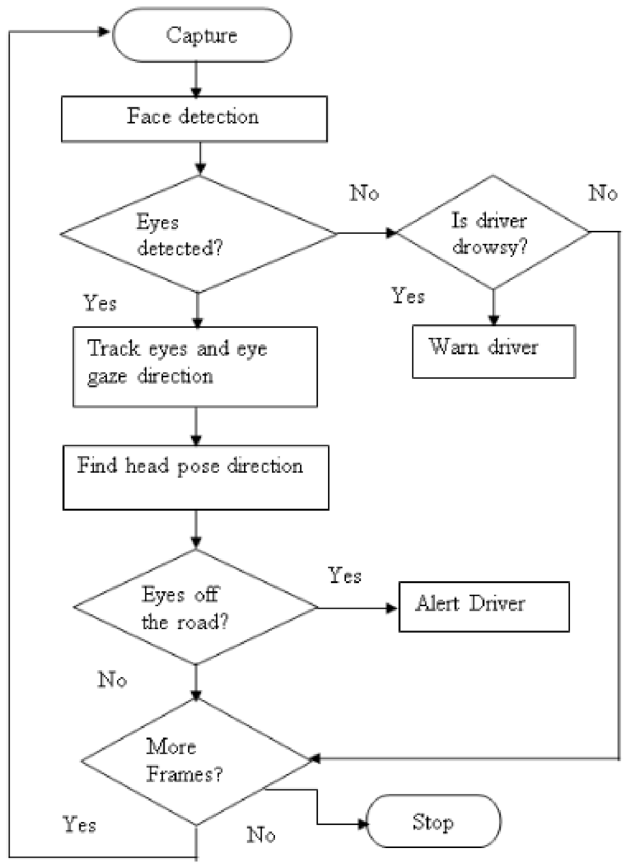

Fig. 2 Flowchart of the proposed system

V. CONCLUSION

1. A person's face with open eyes will be stored in MATLAB database as a threshold for doze off calculations in real time.
2. The installed camera will detect the head position and pupil position of the driver. This head position and pupil position information will be given to our proposed image processing software in MATLAB.
3. This said software will detect whether the driver is Doze off or not by comparing the values taken with a certain threshold value(already stored in data based) .
4. If the values differ then an alarm will be raised. Also, this software will instruct the microcontroller to slow down the speed of the prototype vehicle.
5. This proposed project aims to prevent accidents by continuously monitoring head and pupil position of driver on real time basis.

VI. REFERENCES

1. *Gregory A. Maltz , "Eye gaze user interface and caliberation method," US patent 20140049452, Feb 20, 2014.*
2. *Y. Liao; S. E. Li; W. Wang; Y. Wang; G. Li; B. Cheng, "Detection of Driver Cognitive Distraction: A Comparison Study of Stop-Controlled Intersection and Speed-Limited Highway," in IEEE Transactions on Intelligent Transportation Systems , vol.PP, no.99, pp.1-10`, Jan 2016.*
3. *F. Vicente, Z. Huang, X. Xiong, F. De la Torre, W. Zhang and D. Levi, "Driver Gaze Tracking and Eyes Off the Road Detection System," in IEEE Transactions on Intelligent Transportation Systems, vol. 16, no. 4, pp. 2014-2027, Aug. 2015.*
4. *C. Ahlstrom, K. Kircher, and A. Kircher, "A gaze-based driver distraction Warning system and its effect on visual behavior," IEEE Trans. Intell. Transp. Syst., vol. 14, no. 2, pp. 965–973, Jun. 2013.*
5. *O. Stan, L. Miclea and A. Centea, "Eye-Gaze Tracking Method Driven by Raspberry PI Applicable in Automotive Traffic Safety," Artificial Intelligence, Modelling and Simulation (AIMS), 2014 2nd International Conference on, Madrid, 2014, pp. 126-130, Nov 2014.*
6. *Dasgupta, Anjith George, S. L. Happy, and Aurobinda Routray, "A Vision-Based System for Monitoring the Loss of Attention in Automotive Drivers," IEEE Transactions on Intelligent Transportation Systems, vol. 14, no. 4, pp.1825-1838, December 2013.*
7. *Xianping Fu, Xiao Guan, Eli Peli, Hongbo Liu, and Gang Luo "Automatic Calibration Method for Driver's Head Orientation in Natural Driving Environment", IEEE Transactions on Intelligent Transportation Systems, vol. 14, no. 1, pp.303-312 March 2013.*
8. *S. Bazrafkan, A. Kar and C. Costache, "Eye Gaze for Consumer Electronics: Controlling and commanding intelligent systems.," in IEEE Consumer Electronics Magazine, vol. 4, no. 4, pp. 65-71, Oct. 2015.*
9. *F. Lu, T. Okabe, Y. Sugano, and Y. Sato, "Learning gaze biases with head motion for head pose-free gaze estimation," Image Vis. Comput ., vol. 32, no. 3, pp. 169–179, 2014.*
10. *S. J. Lee, J. Jo, H. G. Jung, K. R. Park and J. Kim, "Real-Time Gaze Estimator Based on Driver's Head Orientation for Forward Collision Warning System," in IEEE Transactions on Intelligent Transportation Systems, vol. 12, no. 1, pp. 254-267, March 2011*
11. *Mohamad S, Muhammad.P., Mohsen.S., Mahmood F., "A Review on Driver Face Monitoring Systems for Fatigue and Distraction Detection", International Journal of Advanced Science and Technology Vol.64 (2014), pp.73-100.*
12. *P. M. Corcoran, F. Nanu, S. Petrescu, and P. Bigioi, "Real-time eye gaze tracking for gaming design and consumer electronics systems," IEEE Trans `1Consum. Electron., vol. 58, no. 2, pp. 347–355,2012*
13. *Smart Eye, Gothenburg, Sweden, Tech. Rep., 2009.*
14. *J. P. Batista, "A real-time driver visual attention monitoring system," in Pattern Recognition and Image Analysis, vol. 3522, Berlin, Germany.*
15. *A. Nabo, "Driver attention—Dealing with drowsiness and distraction,"Smart Eye, Gothenburg, Sweden, Tech. Rep., 2009.*