EYE GAZE TRACKING BASED DRIVER MONITORING SYSTEM

Annu George Mavely[1], J.E Judith[2],Sahal P A[3], Steffy Ann Kuruvilla[4]
[1,3,4] *UG Scholar, CSE,* [2]*Assistant Professor, CSE*
[1,2,3,4] *Noorul Islam University, Kumaracoil, Tamil Nadu, India*
[1]annumavely@gmail.com, [2] judithjegan@gmail.com, [3] sahalazad@gmail.com, [4] steffyann@gmail.com

***Abstract*-Eye Gaze Tracking is a technique that involves tracking a person's eye gaze using either contact and invasive hardware, or expensive and non-standard hardware. In this paper a driver monitoring system using eye gaze technique is introduced. In this method, the first step is the tracking of human face from a real time video sequence to locate the eye region and to determine the number of times the user blinks his/her eye. The main focus is to use this eye gaze tracking system to detect the drowsiness of the driver while driving thereby reducing the number of automobile accidents happening day by day. It was implemented in raspberry pi board in order to create a more convenient portable system. If the blinks takes more time than 2 seconds driver's drowsiness is detected and the driver is alerted by audio and steering vibration warning.**

***Keywords*- Eye gaze tracking, Drowsiness detection, driver monitoring system**

I. INTRODUCTION

Eye Gaze Tracking System is still in its developing stage. It has so many applications like human computer interaction, virtual reality, eye disease diagnostic etc….By observing the gaze movement of a person it provides much information about his/her thoughts. Thus the study of eye movement may determine what people are thinking based on where they are looking. Eye tracking is the measurement of eye movement/activity and gaze tracking is the analysis of eye tracking data with respect to the head/visual scene. However, the gaze tracking system can be used for different applications. The obvious application of gaze tracking is for Human-Computer interactions, as a new system or as an aid to those with disabilities. In 1940 the first video based eye tracking study was made on pilots operating airplane controls [1]. In 1960 research on head-mounted eye trackers advanced and in 1970gaze tracking developed with focus on improving accuracy and reducing the constraints on user. Eye gaze information is used in a variety of user platforms.

Driver monitoring system aims at reducing the auto mobile accidents that occurs while driving. According to the study of NHTSA (National Highway Traffic Safety Administration) in 2013 its points that distraction as a cause in 78% of crashes and 65% of near-crashes. The main motivation to develop driver monitoring system using eye gaze tracking is to reduce the accidents and to improve the road safety. By implementing this algorithm it detects the subject's drowsiness and alerts the subject's by producing huge sound and vibration from steering.

II.RELATED STUDY

A. Eye gaze tracking method

This Section deals with various feature based and appearance-based visible imaging gaze tracking methods. In feature based gaze tracking method, the eye region features that is the center of the iris is extracted. Zhu and Yang et.al [2] proposed a method to perform feature extraction from an intensity image. The eye corners are extracted with the help of a preset eye corner filter. Eye corners and the eye iris centers are detected and the gaze direction is determined through a linear mapping function. One of the main limitation of this method is that the head must be kept stable by the user since the gaze direction is sensitive to the head pose. To obtain geometric features Trricelli et al. [3] used the iris and corner detection method, and uses general regression neural network (GRNN) to map it to the screen. The drawback of this system is that, if an error occurs with any input vector of GRNN, the accuracy of the system decreases. Ince and Kim [4] proposed a gaze tracking system, which is of low cost. This method performs pupil center detection based on shape and intensity-based deformable eye and movement decision algorithms. The disadvantage of this proposed method is that the accuracy of result is sensitive to head pose and system performance is

reduced for low-resolution video sequences. A training model was introduced by Nguyen [5] to detect and track the eye and train Gaussian process functions for gaze estimation using the cropped image of the eye. The disadvantage of this method is that the user has to stabilize the position of his/her head in front of the camera after the training procedure. Lu et al.[6] have proposed an eye gaze tracking method based on the Local Pattern Model (LPM) and a Support Vector Regressor (SVR).In this method the system will extract texture features from the eye regions using the LPM, and feeds the spatial coordinates into the SVR to obtain the gaze mapping function.

B. Driver monitoring system

There are various approaches to detect the drowsiness/distraction [7]. The approaches include driver monitoring system 1) based on biometric signal 2) based on lane departure 3) based on driver face monitoring.

1) Driver monitoring system based on bioelectric signals

Driver monitoring system based on bioelectric signal deals with the dependence among the driver's bioelectrical impedance status and surrounding effects, which can negatively influence the driver's attention and lead to decrease the driver's safety while driving. In this approach AD5933 circuit and two conductive silicon electrodes are used to measure bioelectrical impedance. Here the measurement is performed with many drivers of different age at various time conditions and in a different grade of traffic. The obtained data were statistically analysed and significant values which affect the measured driver's impedance with given probability were identified. From the result of evaluation, an algorithm for detection the events that could possibly decrease the driver's safety was developed. For the detection algorithm the driver's impedance data acquired from the steering wheel is used as a control variable[8]

2)Driver monitoring System based on lane departure approach

In this approach it proposes architecture for driver assistance system based on image processing technology. For tracking possible Lane departure, camera is placed on the windshield of car to determine the layout of roads and determines the position of the vechicle on line lane. The proposed system analysis and process the sequence of images captured and which, automatically detects the lane lines [9]. Lane departure warning system is one of latest and advanced technology used now a days. FPGA based Hough transform technique is the best one which shows reduced logic area and optimized memory utilization. Some of the limitations of this approach are it consumes more power, Sometimes faulty detection may occur [10].

3) Driver monitoring System based on driver face monitoring

Eye detection methods can be divided into two general categories: (1) methods based on imaging in IR spectrum; and (2) feature-based methods. Methods based on imaging in IR spectrum, which are commonly called "hardware -based " approaches, rely on IR illuminators to generate the bright pupil effect to driver head pose and gaze estimation. In driver monitoring system based on driver face monitoring system consists of a remotely located video CCD camera, a specially designed hardware system for real-time image acquisition and for controlling the illuminator and the alarm system, and various computer vision algorithms for simultaneously. The Gaze movement, face orientation, eyelid movement are some of the visual behaviours considered. The system was evaluated with people of different ages, gender with or without spectacles ,different illumination conditions and different environmental conditions, and the obtained result shows that it was very reliable, robust and accurate [11].

III.PROPOSED METHOD

A.WORKING PRINCIPLE

In the proposed method Raspberry Pi 2 [12] is soul of the framework, which control the total framework operation. Fig.1 describes the proposed methodology of driver monitoring system using eye gaze tracking. It is used as the image and general processing unit. In raspberry Pi Broadcom 700MHz Chip is used as main signal processing chip unit in which CPU is a 32 bit ARM11-RISC processor. This project uses a Logitech c270 HD webcam and LED IR illuminator for image capturing.

A version of LINUX called Raspbian-wheezy operating system is installed. It is a free operating system optimized specially for the

hardware of Raspberry Pi. A 32GB MicroSD card is used to install OpenCV 3.2[13] on Pi board.

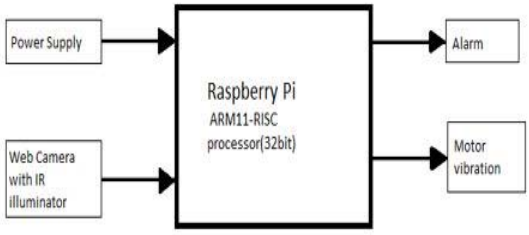

Fig.1: Proposed Methodology of driver monitoring system

Vibration motor is used to generate steering vibrations based on the algorithm. With the help of speaker or headphone or with any sound producing devices alarms are produced.

B.Frame Capture

For image capturing process uses a low cost web camera. Camera is connected to the Pi board using USB port. In automobile vehicles camera is placed above the steering wheel pointing straight to the user. By placing camera in this manner helps to capture drivers face easily. An IR illumination source is used to capture the image during night without causing any discomfort to the driver. For automatic on off purpose the LED's are fitted with LDR.

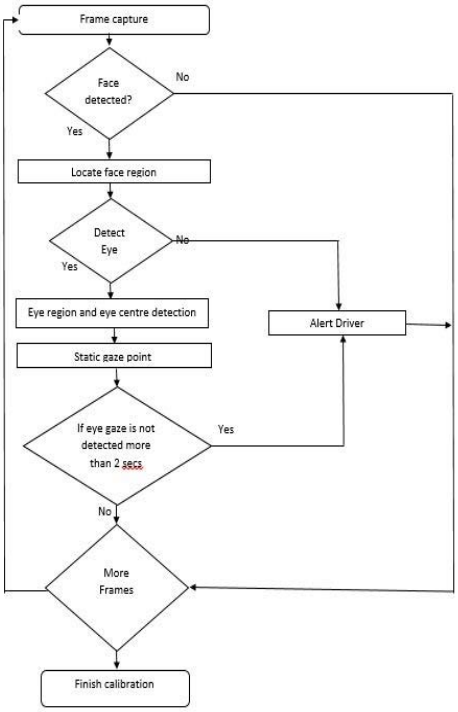

Fig.2 Flow Diagram for Driver Monitoring System

C. Eye gaze tracking

For monitoring the driver not only the eyes were detected but also eye gaze also calculated. The eye gaze are tracked from a real time video sequence. CAMSHIFT (Continuously Adaptive Mean Shift) algorithm is used for extracting the ROI (Region of Interest).

Algorithm for Eye Gaze Tracking

1. Start
2. Initialize frame capturing
3. Detect face, if face is detected locate the Eyes
4. Else go to step 8
5. If eyes were not detected alert the driver
6. Else locate Eye region and Eye centre
7. Mark the gaze points
8. Eye gaze is not detected more than 2sec alert driver, then goto step 8, Else
9. Capture more frames
10. End

D.Drowsiness Detection

The user's drowsiness is detected by determining whether the eyes were opened or not. The eye detection algorithm detects whether the eyes are opened this helps as in determining the users drowsiness. In the frame when the user's face is detected and eyes are not detected, assume that the user is falling asleep. When the eyes of the user is not detected more than a particular time period the user is alerted to wake up.

E. Advantages of proposed method

- It is robust and the accuracy of captured data is high in any light conditions.
- It can robustly extract the eye region, and also can tolerate illumination changes
- It provides an accurate method for the detection of the iris centre and eye corner.
- It is less expensive.

IV. RESULT ANALYSIS AND DISCUSSION

A. Face detection and Eye detection

When the face is detected it is represented inside a blue square. If the driver wears a spectacle

then also the system is able to detect the driver's eye. Also the system detects whether the eyes were opened or closed. Each eyes is detected separately inside a square.

B. Eye Region and Eye Gaze Tracking

After face is detected it is represented inside a rectangular box. Each eye region is identified separately and shown inside squares. When Eye pupil is detected it is marked inside a circle.

C. Comparing with existing methods

The proposed method is compared with other types of approaches and has been found that the proposed method is very cost effective and has high rate of accuracy and speed.

TABLE I
COMPARISON WITH EXISTING METHODS

Methods	**Drowsiness Detection**	**Accuracy**	**Speed of Detection**	**Complexity**
Bioelectric Signal	Yes	Excellent	Very Fast	Complex
Lane Departure	No	Good	Slow	Moderate
Driver Face Monitoring	Yes	Moderate	Slow	Moderate
Proposed Method	Yes	Good	Fast	Easy

V.CONCLUSION AND FUTURE WORK

The main goal of this system is that traffic safety can be improved and thereby reduce the number of accident rates. It alerts the driver while driving when he/she is drowsy. Warning signal is given to the user by producing huge sound and vibrating the steering. It can be operated in any light conditions. It is more efficient than the existing monitoring systems.

In future this system can be improved by including automatic calibration which include if it detects the driver is in drowsy state then automatically reduce the speed of the vehicle for road safety , determining vehicles states ie; calculating the distance from the next vehicle, weather conditions, vehicle speed etc.

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