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An Intelligent Driving Assistive System for Monitoring Driver's Vigilance

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Abstract: ***Distracted driving is one of the main causes of vehicle collisions. Passively driver's activities can be monitored with the help of automobile safety system which can potentially reduce the number of accidents by estimating the vigilance of the person while driving. Drowsiness is one of the reasons of the accidents. This paper proposes an inexpensive vision-based system to detect the driver's pupil and provide alert. Here we are using Digital Image Processing techniques that are Image Acquisition, Facial Features Detection and Tracking and Gaze Estimation and Microcontroller to provide an alert. By default the vehicle is in running condition and during the time if driver closes his eyes the vehicle will be in halt condition, the message will be displayed on the 16x2 LCD and alertness is provided with the help of vibrator over vehicle steering and alarm. This system works in real time i.e. day and night and it does not require any manual calibration.***
Keyword: ***Digital Image Processing, Driver's Vigilance, Detection, Tracking, Microcontroller, Distraction, Alertness.***

I. INTRODUCTION

Driver distractions are the leading cause of most vehicle crashes and near-crashes. The number of accidents is increasing day by day and the number of people injured in accidents has been increased. One serious road accident in the country occurs every minute and 16 die on India road every hour. According to National Highway Traffic Safety Administration (NHTSA) and the Virginia Tech Transportation Institute (VTTI), 80% of crashes and 65% of near-crashes occurred because of the distracted driving. There is one death every four minutes due to road accidents and most of accidents are because of the distracted driving.

Fig. 1 A person having concentration while driving

The main reasons for accidents are drowsiness, unawareness and lack of concentration while driving [2]. Most of the vehicle crashes and nearby crashes are caused because of the driver's distraction. Any kind of activities that diverts the attention of a person while driving can be defined as distracted driving and these activities can be busy in talking to nearby person , listening music, using smart phones, texting a message, drinking and driving. A recent study has shown that browsing, texting, dialling i.e. using cell phones while driving has increased the risk of accidents these behaviour of the person while driving has increases a risk of accidents. Nowadays, wide spectrum of technologies have been introduced into the automobile industries, therefore cognitive load caused by secondary tasks that driver manages during driving has increased which results in distracted driving. This cognitive load affects driver visual behaviour and driving performance [7]. The distraction i.e. drowsiness , fatigue , long time driving , overnight driving , using cell phone reduces the concentration of the person while driving which increases the risk of accidents and causes the loss of human life. Hence to avoid accidents it becomes necessary to implement any system which can detect the anomalous situation and provide alert which can save the human life. According to [5] this cognitive load distracts the vigilance of the person due to which numbers of accidents are increasing day by day. Drivers with the distracted vigilance are not able to recognize the situation hence, looses the control over vehicle and causes danger to human life. Driver's fatigue it is the one of the reason behind the crashes. This continuously growing traffic again creates more problems for society. This leads to develop a system which provides the safety

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driving. Safety system can be implemented by monitoring driver activities which helps to avoid accidents by detecting dangerous situations. Here we have showed that a vigilance based driving system depends on more reliable eyes of the road estimation i.e. to detect the concentration of the driver. The system works in real time i.e. during day and night, variety of people, changes in facial features etc. And the vigilance detection is only the main component of a system for detecting and alerting distracted drivers.

II. PREVIOUS WORK

According to survey [8] an algorithm was proposed for yaw and pitch estimation based on normalized histograms of horizontal and vertical edge projections combined with an ellipsoidal face model and SVM i.e. Support Vector Machine classifier for gaze estimation. But this system has one disadvantage as every time the shape of the face was consider in ellipsoidal shape due to which we can't get accurate result. The drowsiness, fatigue, long driving, secondary work leads to lack of concentration and unfortunately accidents take place [4]. The existing system to avoid accidents is based on hardware and software using IR illumination system. IR based systems are mostly used in industry. DIP based technique i.e. Eye Tracking is one of the most important technique used to detect vigilance of the person while driving. This system tells about the real time eye detection and tracking method which works in variable and realistic lighting conditions. The hardware part is used to generate the bright pupil effect by estimating driver head pose and gaze estimation which rely on near – infrared IR illuminators and software part detects the eyes off the road and alarm is triggered when distraction is detected [10]. But near-illumination systems work well at night but performance is not well during day time because of the external light source. Filters were used to avoid contamination caused by external source but it still exists because of sun light and it cannot be avoided. Also the system is person dependent and manual calibration was also required at every time [9].Head pose and gaze estimation when combined into hardware and software approaches but it has drawback as distance between the driver's head and camera in car is fixed and the manual help is needed to vary this distance.

The system can be implemented with the help of visual based sensors using algorithm to detect the distraction so that accidents can be avoided [3] .But this system has increased the cost of hardware as sensors are costly unfortunately the system has become expensive and again calibration is required.

III. SYSTEM DESCRIPTION

In this paper we have focused on digital image processing tools used to implement the system which can detect the vigilance of the person while driving and provides an alert to avoid accidents. Digital image processing is the use of computer algorithms to perform image processing on digital images which helps us to find distraction.

A. Image Acquisition

Image acquisition is the first step of any vision based system and it can be defined as action of retrieving an image from some source, usually a hardware-based source for example camera, after that it is passed through different process. Image Acquisition is the process in which we get the image from hardware which was used to generate it and it is also known as real time image acquisition process. In this system we are going to use a low cost CCD camera for image acquisition module which will be integrated on dashboard through which it will be able to capture all the movements of the person while driving. As the camera is placed on top of the steering wheel it provides to estimate gaze angle while driving and from production point of view it is convenient to integrate on dashboard. For night time operation lights inside the cars can provide the light source. Hence, through image acquisition we can get the images as shown in Fig.2 which are processed further with some mathematical operations [2]

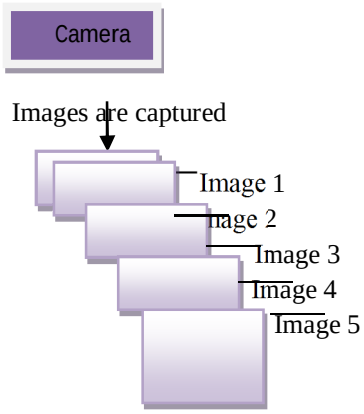

Fig.2 Image acquisition

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B. Facial Features Detection and Tracking

According to human behavioral studies, facial expressions are generally used to analyze the actives of the person. Hence by using the facial features we can determine the vigilance of the person while driving [1]. The mental abilities of the person while driving can be recognised by detecting the facial expression. Facial features also provide information regarding the secondary task performing by the person while driving. The fatigue in the person while driving can be detected using facial features like like eye, head, face and vigilance [6]. In this system we have used Digital Image Processing based software Matlab for detecting and tracking the facial features of the person while driving. Viola-Jones algorithm is used to detect people's faces, noses, eyes, mouth, or we can say an upper body. It is widely used method for real-time face detection. Facial Feature detection and tracking is very fast by using Viola-Jones algorithm. The characteristics of Viola–Jones algorithm which is used for face detection are robust i.e. very high detection rate; it works in real time condition hence, used in practical applications and face detection. The main objective of the algorithm is to detect the face not to only recognize i.e. it distinguishes faces from non-faces and rectangular box appears when face is detected and tracked.

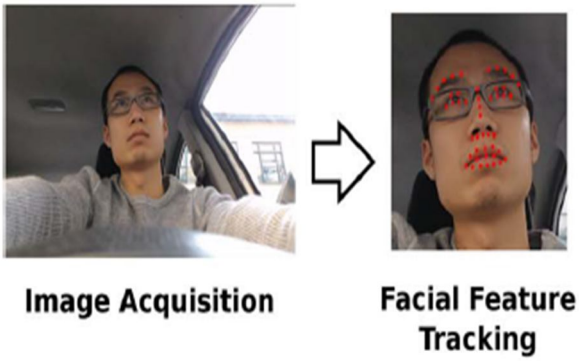

Fig.3 Facial Feature Tracking

C. Gaze Estimation

According to [2], gaze direction of a person while driving provides the crucial information about the vigilance of a person through which concentration can be detected as shown in Fig.5. Eye gaze can be defined as a ray arising from the pupil of the person. The gaze means to look steadily and intently at something especially at that which requires admiration, concentration. The ability to detect the presence of visual attention from human users or determine what a human user is looking at by estimating the direction of eye gaze is known as gaze estimation as shown in Fig. 4. Gaze estimation is used in many of the real time applications. Gaze angle can provide the very important information whether the driver is distracted or not.

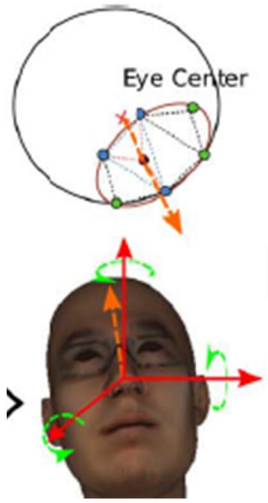

Fig.4 Gaze Estimation

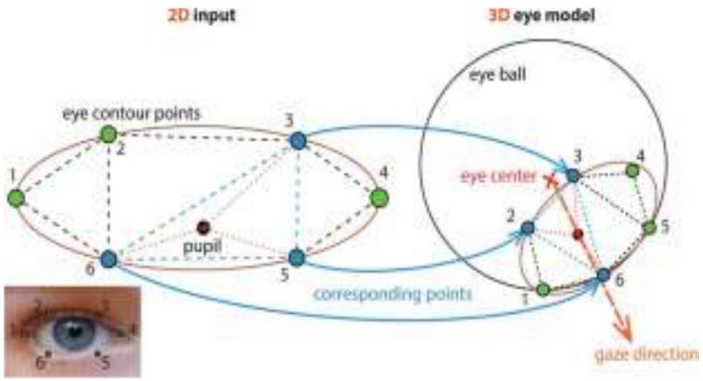

Fig. 5 3D Gaze Estimation

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IV. SYSTEM ARCHITECTURE

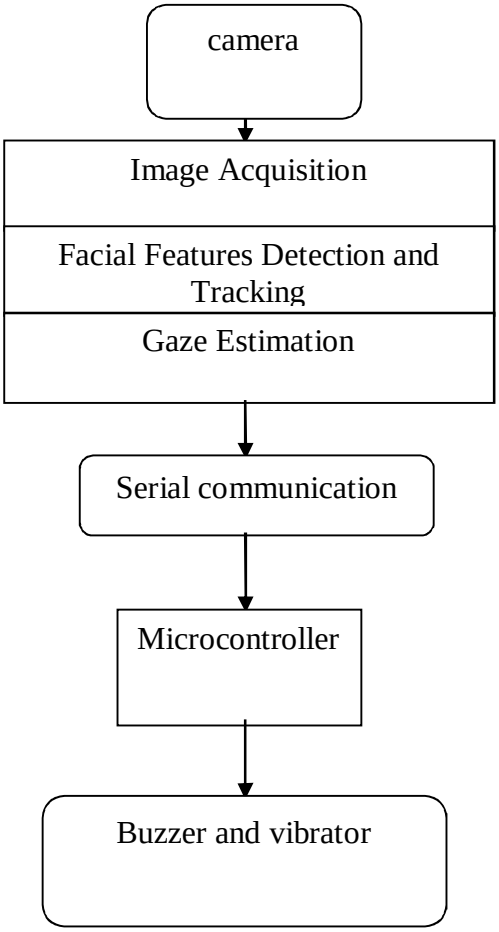

Fig.6 System Block Diagram

The system can be developed using Hardware and Software. As shown in Fig.6 camera is used to capture all the movements or we can say that motion of the person who is driving and the detection is made on the basis of digital image processing techniques such as Image Acquisition, Feature Detection and Tracking, Gaze Estimation and a DIP based MATLAB software is used through which a person while driving is distracted or not distracted detected for this we have define four conditions straight, left, right and no face. According to this if a person is driving with a full concentration no alertness will be provided and if distracted condition i.e. no face is found a signal is passed to microcontroller with the help of serial communication and alertness is provided with the help of buzzer and vibration.

V. EXPERIMENTAL RESULTS

The illustration of proposed system is shown below with the experimental results.
The input image is given with the help of camera as shown in below Fig .7 a video window will get open and code design in MATLAB software will check each and every clip of video according to which we get output if left, right, straight condition occurs then we get the output result as shown in Fig.8 and 9 and if no face condition occurs then signal is given to microcontroller through which alertness is provided with the help of buzzer and vibrator as shown in Fig.7.

A. Distraction

If a person is distracted while driving no face condition will be detected and alertness is provided with the help of microcontroller as shown in Fig.7.

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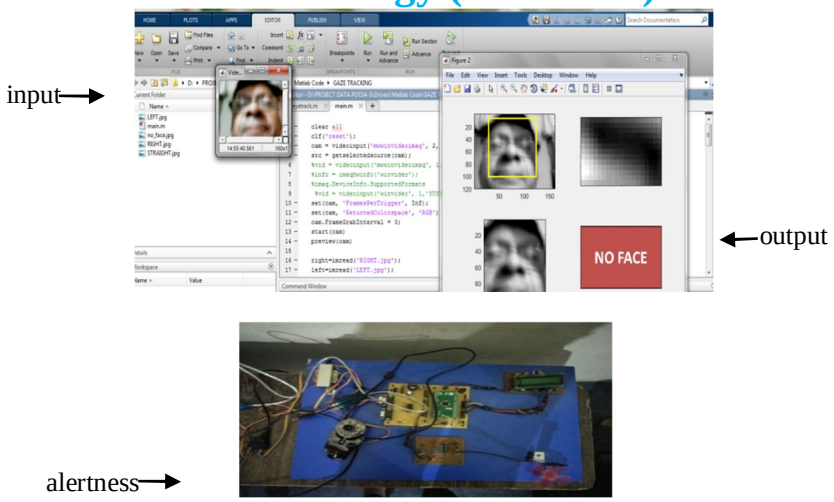

Fig.7 Distraction While Driving and Providing Alertness

B. No Distraction

If a person is driving with a full concentration i.e. no distraction we get the result as shown in Fig.8 and Fig.9.

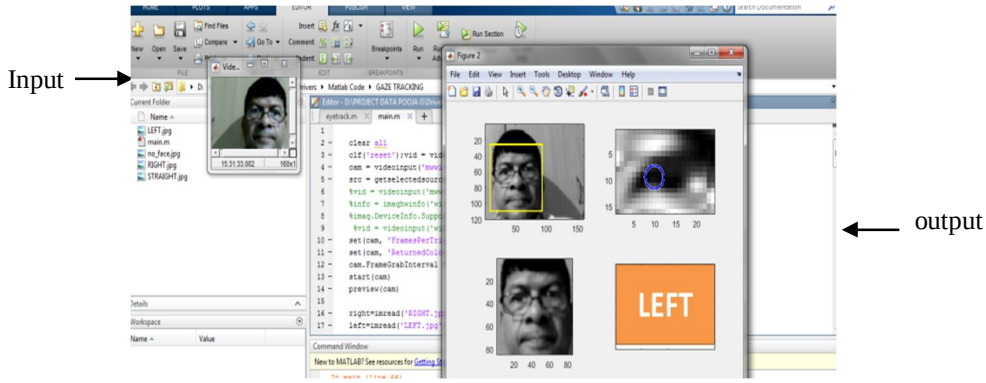

Fig.8 No Distraction While Driving

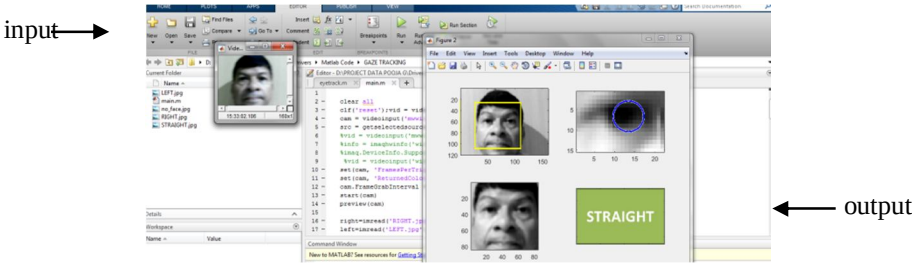

Fig.9 No Distraction While Driving a Vehicle

Therefore, we get the result for our proposed system as shown above.

VI. CONCLUSION

This research paper describes an implementation of driver's pupil detection and eyes off tracking for monitoring driver's vigilance to avoid accidents and to save human life. During this project, we have studied how to implement Digital Image Processing Techniques i.e. image acquisition, facial feature detection and tracking and gaze estimation for detecting the vigilance of the person while driving. This system works at day and night, and under a wide range of driver's characteristics. The system does not require specific calibration or manual initialization once the camera is fixed on steering wheel column. In this project alertness is provided with the help of voice module and vibrator for which a database is created by using a microprocessor. While our system provided

encouraging results, we expect that the facial feature detection in challenging situations will boost the performance of our system. Hence, if we install this system in different car models it will help to detect the vigilance through which distraction is detected and accidents can be avoided.

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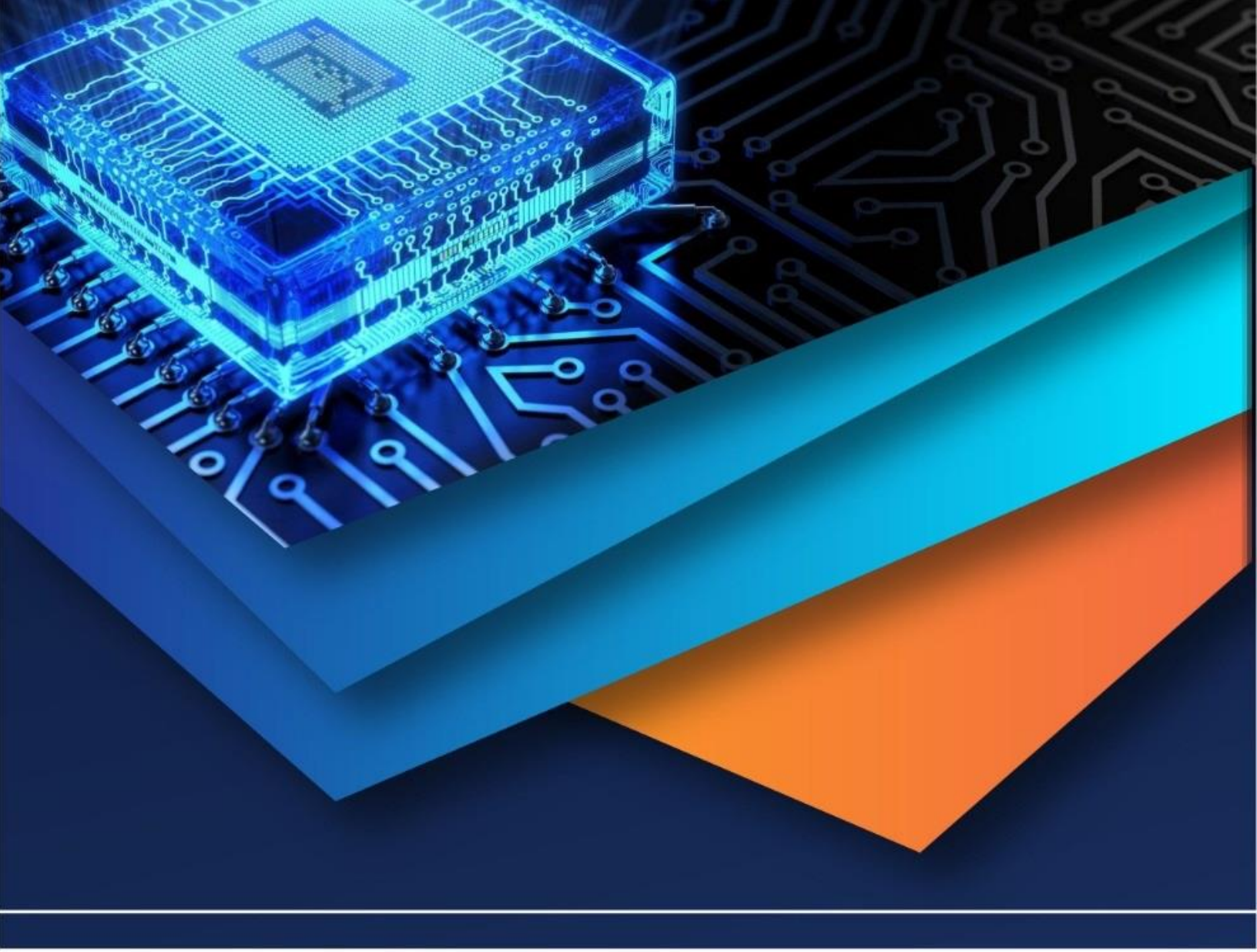

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