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DRIVERS BACKING SYSTEM WITH FACTUAL OCCASION EYE RECOGNITION

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Lethargy and low energy automobile drivers reduce the driver's abilities of vehicle control, natural spontaneous effect, gratitude and observation. Such diminished attention level of drivers is observed at night driving or overdriving, causing accident and front severe danger to mankind and society. Therefore it is very much necessary in this recent trend in automobile industry to integrate driver support system that can detect lethargy and low energy of the drivers. This paper presents a different sample computer vision system for monitoring a drivers' observation in real time. Eye tracking is one of the key technologies for future driver backing systems since human eyes contain much information about the drivers' condition such as gaze, attention level, and fatigue level. It is based on a hardware system for the real time acquisition of drivers' images using IR illuminator and the software implementation for monitoring eye that can avoid the accident. The output of the project is, if drivers' eyes are off the road or eyes are closed due to low energy then as a result audio and steering vibration warnings are given to drivers.

I. INTRODUCTION

The increasing number of traffic accident due to drivers' diminished vigilance level is a serious problem for the society. Drivers' abilities of vehicle control, natural response, recognition and observation decline due to sleepiness and low energy, reducing the drivers' care level. These pose serious danger to their own lives as well as lives of other people. According to the National Highways traffic safety administration (NHTSA), drowsiness and falling asleep while driving are responsible for at least 100,000 automobile crashes annually. An annual average of roughly 40,000 nonfatal injuries and 1,550 fatalities result from these crashes.

Distracted drivers tend to decrease attention to important information needed for safe driving which makes them level to severe car accidents. NHTSA has classified drivers' distraction into four types

- Auditory
- Visual
- Biomechanical
- Cognitive

Reason for disturbance 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., Nowdays another concern for troubled driving is the use of mobile phones and other electronic devices while driving.

NHTSA has stated that texting, browsing and dialing is the reason for longest time of drivers taking their Eyes Off Road(EOR) and boost the risk of crash by three times.

There are many literatures reporting the fatigue monitoring systems based on active real-time image processing technique. Detection of driver fatigue is primarily focused in efforts. Characterization of a driver's mental state from his facial expression is discussed by Ishii et al.. A vision system from line of sight (gaze) to detect a driver's physical and mental conditions is proposed by Saito et al.]. A system for monitoring driving vigilance by studying the eyelid movement is described by Boverie et al. and results are revealed to be very promising. A system for detection of drowsiness is explained at Ueno et al. by recognizing the openness or closeness of driver's eyes and computing the degree of openness. Qiang et al. describes a real-time prototype computer vision system for monitoring driver vigilance, consisting of a remotely located video CCD camera, a specially designed hardware system for real-time image acquisition and various computer vision algorithms for simultaneously, real-time and non-intru-sively monitoring various visual bio-behaviors typically characterizing a driver's level of vigilance. The performance of these systems is reported to be promising and comparable to the techniques using physiological signals.

Feature-based methods extract particular features such as skin-color, color dis-tribution of the eye region. Kawato et al. use a circle frequency filter and background subtraction to track the in-between eyes area and then recursively binaries a search area to locate the eyes. Sommer et al. utilize Gabor filters to locate and track the features of eyes. They construct a model-based approach which controls steerable Gabor filters: The method initially locates particular edge (i.e. left corner of the iris) then use steerable Gabor filters to track the edge of the iris or the corners of the eyes. Nixon demonstrates the effectiveness of the Hough transform modeled for circles for extracting iris measurements, while the eye boundaries are modeled using an exponential function. Young et al.show that using a head mounted camera and after some calibration, an ellipse model of the iris has only two degrees of freedom (corresponding to pan and tilt). They use this to build a Hough transform and active contour method for iris tracking using head mounted cameras. propose the Fast Radial Symmetry Transform for detecting eyes in which they exploit the symmetrical properties of the face. Explicit feature detection (such as edges) in eye tracking methods relies on thresholds. In general defining thresholds can be difficult since light conditions and image focus change. Therefore, methods on explicit feature detection may be vulnerable to these changes.

In this paper real time eye detection and tracking method is presented that works under variable and realistic lighting conditions which is applicable to driver assis-tance systems. Eye tracking is one of the key technologies for future driver assistance

Fatigue in people can be easily observed by certain visual behaviors and changes in their facial features like the eyes, head, and face. The image of a person with reduced alertness level exhibits some typical visual characteristics that include slow eyelid movement, smaller degree of eye openness (or even closed), fre-quent nodding , yawning, gaze (narrowness in the line of sight), sluggish in facial expression, and sagging posture. To make use of these visual cues, increasingly popular and non-invasive approach for monitoring fatigue is to assess a driver's vigilance level through visual observation of his/her physical conditions using a camera and state-of-the-art technologies in computer vision. Techniques using computer vision are aimed at extracting visual characteristics that typically characterize a driver's vigilance level from his/her video images. In a recent workshop sponsored by the Department of Transportation (DOT) on driver's vigilance, it is concluded that computer vision represents the most promising non-invasive technology to monitor driver's vigilance.

Eye tracking and detection methods fall broadly within three categories, namely deformable templates, appearance-based, and feature-based methods. Deformable template and appearance-based methods are based on building models directly on the appearance of the eye region while the feature-based method is based on extraction of local features of the region.

In general appearance models detect and track eyes based on the photometry of the eye region. A simple way of tracking eyes is through template-based correlation. Tracking is performed by correlation maximization of the target model in a search region. Grauman et al. uses background subtraction and anthropomorphic constraints to initialize a correlation-based tracker. Matsumoto and Zelinsky present trackers based on template matching and stereo cameras. Excellent tracking performance is reported, but the method requires a fully calibrated stereo setup and a full facial model for each user.

The appearance of eye regions share commonalities across race, illumination and viewing angle. Rather than relying on a single instance of the eye region, the eye model can be constructed from a large set of training examples with varying pose and light conditions. Based on the statistics of the training set a classifier can be constructed for detection purposes over a larger set of subjects. Eye region local-ization by Eigen images uses a subset of the principal components of the training data to construct a low-dimensional object subspace to represent the image data. Recognition is performed by measuring distances to the object subspace. The limitations of the methods, which are purely based on detection of eyes in indi-vidual frames, are that they do not make use of prior information from previous frames which can be avoided by temporal filtering.

This paper focuses an effort to develop a low cost hardware system that may be incorporated at dashboard of vehicles to monitor eye images movements pertaining to drowsiness of driver. The paper is organized with background theory describing various processes of eye detection, followed by proposed scheme and implementation. Finally experimental observations and results are tabulated and discussed.

II. PROPOSED WORK

To spot and track eye images with compound background, individual features of user eye are used. Generally, an eye-tracking and detection system can be divided into four steps:

(i) Face detection,

(ii) Eye region detection,

(iii) Pupil detection and

(iv) Eye tracking.

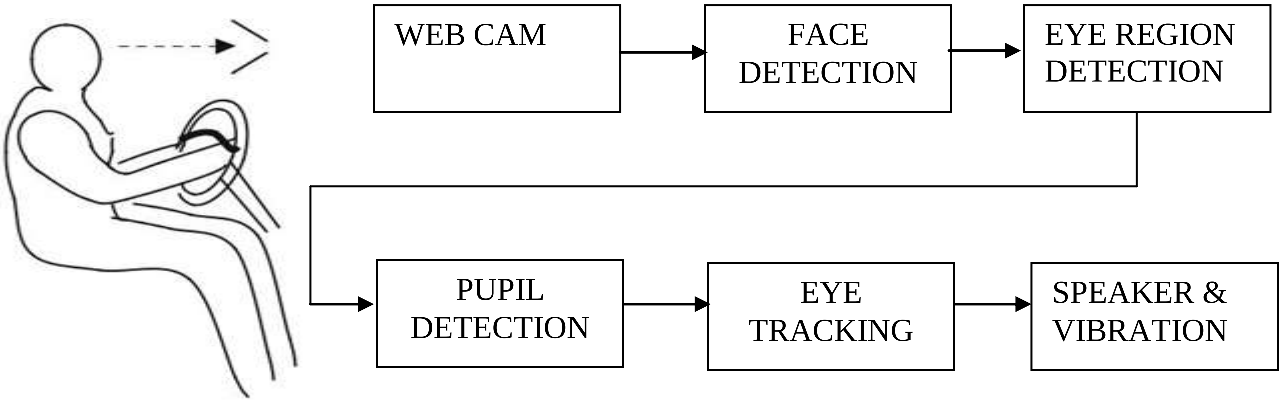

Fig. 1 Image acquisition scheme

Features:

1.Daytime eye detection using RGB mode

2.Night time detection using IR mode.

3.Eyelid distance tracking to detect the sleepiness.

4.Real time image processing more than 1 frame/second

5.Sound and vibration warning system to redraw driver's attention

Image processing technique is incorporated for detection of these. Figure 1 illustrates the scheme. Camera is incorporated in the dashboard of vehicle which takes the images of the driver regularly at certain interval. From the images first the face portion is recognized from the complex background. It is followed by eye region detection and thereafter the pupil or eyelid detection. The detection algorithm finally detects the eyelid movement or closeness and openness of eyes. In the proposed method, eye detection and tracking are applied on testing sets, gathered from different images of face data with complex backgrounds. This method com-bines the location and detection algorithm with the grey prediction for eye tracking.

The accuracy and robustness of the system depends on consistency of image acquisition of the driver face in real time under variable and complex background. For this purpose the driver's face is illuminated using a near-infrared (NIR) illuminator. It serves three purposes:

- It minimizes the impact of different ambient light conditions, and hence the image quality is ensured under varying real-world conditions including poor illumination, day, and night;
- It allows producing the bright pupil effect, which constitutes the foundation for detection and tracking the visual cues.
- As the near-infrared illuminator is barely visible to the driver, any interference with the driver's driving will be minimized.

If the eyes are illuminated with a NIR illuminator at certain wavelength beaming light along the camera optical axis, a bright pupil can be obtained. At the NIR wavelength, almost all IR light is reflected from the pupils along the path back to the camera. Thus bright pupil effect is produced which is very much similar to the red eye effect in photography. The pupils appear dark if illuminated off the camera optical axis, since the reflected light will not enter the camera lens which is called dark pupil effect. It is physically difficult to place

IR light-emitting diodes (LEDs) as illuminators along the optical axis since it may block the view of the camera, limiting the camera's operational field of view.

Therefore quite a few numbers of IR illuminator LEDs are placed evenly and symmetrically along the circumference of two coplanar concentric rings, the center of both rings coincides with the camera optical axis as shown at Fig. 2.

In the proposed scheme, the camera acquires the images of face of the driver at certain interval. Every time the image is analyzed and bright pupil effect is detected. Whenever dark pupil effect is detected i.e., eyelid is at closed condition at prolonged time, it may be assumed that driver's vigilance level has been diminished. Subsequently alarm is activated to draw the attention of the driver.

Fig. 2 IR illuminator with camera

A laboratory model has been developed to implement above scheme. A web camera with IR illuminators has been employed focusing the face region of a person (driver) to acquire the images of face. The acquired image signal is fed to Data Acquisition Card and subsequently to a microcontroller. The microcontroller analyses the images and detects the pupil characteristics. If the eyelid is closed for several seconds, it may be assumed that the drowsiness occurred to the person and alarm is activated by the microcontroller. The circuit scheme is shown at Fig. 3. Microcontroller ATMEGA 8 is employed here in association with voltage regulator IC 7805 and driver IC L2930 for buzzer.

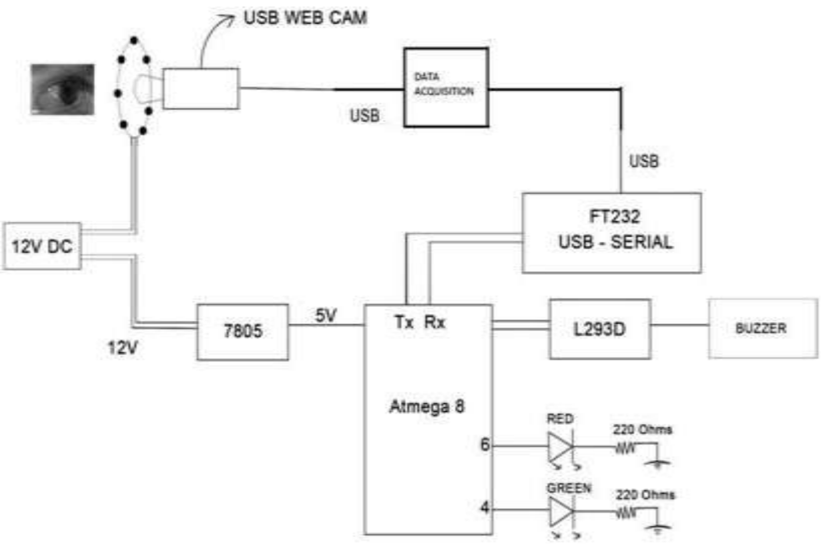

fig. 3 Circuit scheme

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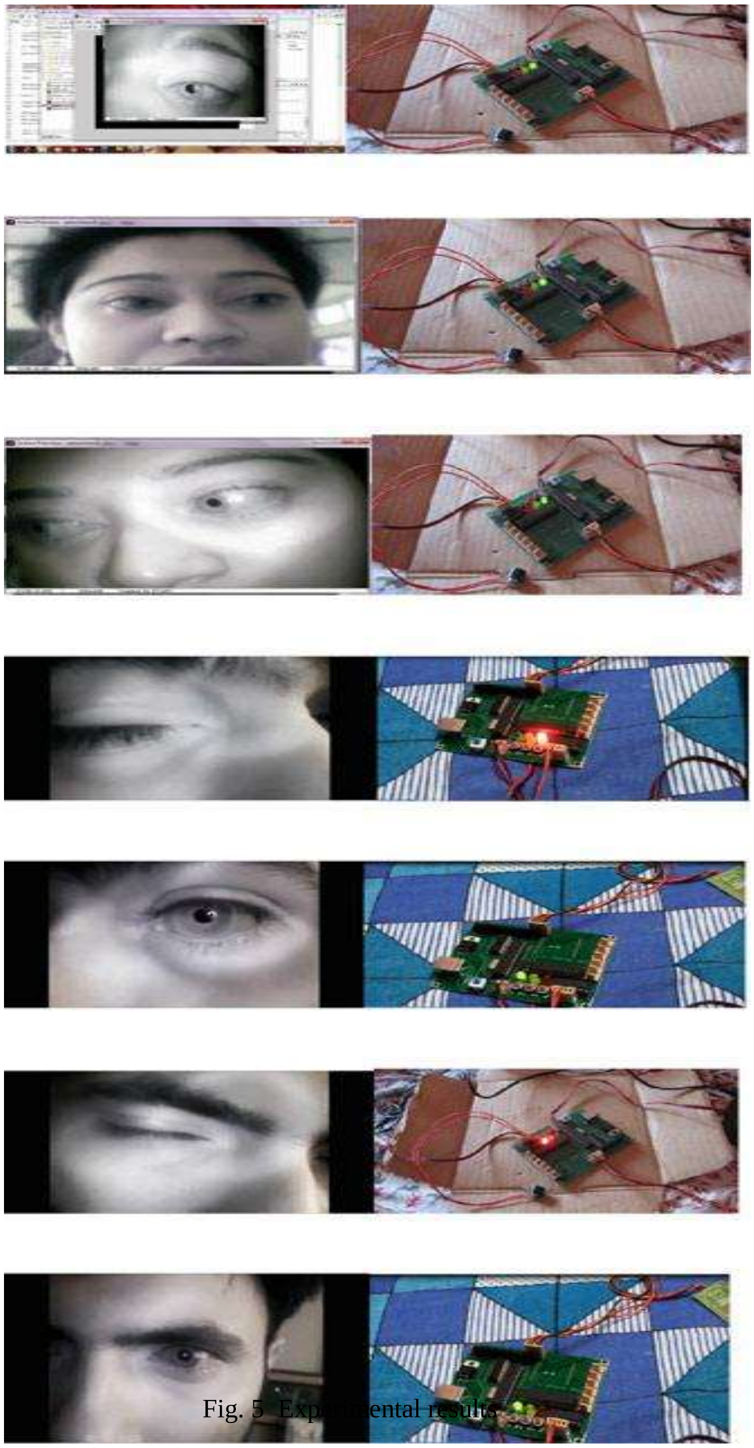

Fig. 5 Experimental results

	Eye condition	Alarm condition
Observation 1	Open	Green LED is ON. No buzzer
Observation 2	Open	Green LED is ON. No buzzer
Observation 3	Open (at night)	Green LED is ON. No buzzer
Observation 4	Closed	Red LED is ON. Buzzer raise the alarm
Observation 5	Open	Green LED is ON. No buzzer
Observation 6	Closed	Red LED is ON. Buzzer raise the alarm
Observation 7	Open	Green LED is ON. No buzzer

Table 1 Observations on alarm conditions with respect to the eye condition

III . IMPLEMENTATION

Experiments have been carried out on different person and different time. These indicate the high correct detection rate which is indicative of the method's supe-riority and high robustness. In the experimental set up two different colors of LEDs —Red and Green are used to indicate fatigue condition (closed eyes) and normal condition (open eyes) respectively. A buzzer is also incorporated whenever fatigue condition is detected. The experimental results for image sequence of eye tracking are given at Fig. 5, and observations on alarm conditions with respect to the eye condition are also tabulated at Table 1. It may be noticed that at closed eye con-dition the Red LED glows as well as buzzer is activated. These observations show that the model can track eye region robustly and correctly and can avoid the accident as well.

IV. CONCLUSION

The experimental model as developed in the laboratory is of minimum complexions. Experiments and observations have been carried out at different time, person and environmental condition that prove its good robust performance. It is helpful in driver vigilance and accident avoidance system. However the performance and effectiveness of the project depends on the quality of the camera and finding out the threshold while removing noise from the acquired picture.

In this model the alarming system is only to alert the driver. The system can be integrated with brake and accelerator system of the vehicle. Also this alarming system may be attached with the front end and the back end light indicator with good audible sound to alert other drivers and passer-by on that road to minimize the fatal rate.

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