Development of A Smart Interface For Safety and Protection of Automotives

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Abstract

This paper is mainly directed towards the safety and protection of the human beings by synchronizing both the software and hardware modules. Automotive safety sensors are mainly streamed towards the application in automobiles. The safety and protection of the automobile driver is monitored and abnormalities are detected by these sensors. These abnormalities are highlighted and alerts are provided to the driver, by the combinational synchronization of hardware and software.

Keywords: Eye Blink, Heartbeat, Alcoholic Detection, Object Detection, Face Turn Detection.

1. INTRODUCTION

As we aware of the increase in population rate, there is a rapid increase in the usage of automobiles. This has led to the increase in the average percentage of accidents. This is due to various reasons. One of the main reason is due to human errors in driving method. This can be avoided by adopting technology in the automobile. A smart interface system for an automobile mainly deals with safety of passengers by continuously monitoring the activities of the driver. These monitoring activities can be performed by different modules involved in the smart interface

system such as Eye blink detection, Face turn, Heartbeat, Alcohol detection, GSM module, Object detection. Activities of driver are monitored by these modules and the outputs are interfaced with alerting section which generates audio and visual warnings to alert the driver in abnormal conditions to avoid accidents.

Several smart interface systems exist in literature. Boon-Giin Lee and Wan- Young Chang [1] proposed an eye blink detection using IR light. IR light is harmful to the human eye when it is used for long period. Lai and Liu [3] developed a fuzzy-control massage seat to keep drowsy drivers awake. Bergasa *et al.* [4] proposed a nonintrusive prototype of a computer vision system for monitoring driver's attentiveness in real-time. Kasukabe *et al*. [5] developed a system with visual, cognitive, and decision- making functions for elderly drivers. This system was able to recognize the objects encountered during driving.

Pauwelussen and Feenstra [6] developed a traffic-simulation model in which the vehicle is equipped with an adaptive cruise-control (ACC) and lane- departure warning (LDW) system to monitor the driver's behavior in a real traffic environment. Lee *et al*. [7] proposed a system with two fixed cameras to capture images of the driver and the road respectively. These images are mapped to the global coordinates to monitor the driver's line of sight. The authors found four distinctive driving patterns through analysis by a hidden Markov model (HMM). Zhao *et al*. [8] studied the reliability of steering wheel behavior to detect driver fatigue by multi wavelet packet energy spectrum using a support vector machine (SVM).

Lee and Chung [9] developed a video sensor- based eye-tracking and blink-detection system with Haar-like features and template matching for an automated drowsiness warning system. In addition, Yanget *et al*. [10] demonstrated that drowsiness has a greater effect on rule-based driving tasks than on skill-based tasks using a Bayesian network (BN) paradigm through simulator-based human-in-the-loop experiments. Wang and Gong [11] proposed system. This system adopted a latent variable to represent the attributes of individual drivers for recognizing the emotional state of drivers. Four sensors, each for respiration, skin conductance, temperature, and blood pressure is used. Shin *et al*. [2] proposed the design of an electrocardiograph (ECG) and photoplethysmography (PPG) sensor to measure the driver's metabolic condition. Eye blink was also detected using EEG signal from the neurons. The EEG signals is detected through the electrode placed on scalp of the head in the form of wearable helmet. This device is uncomfortable for the human and when used for a long time. In order to overcome this drawback, we use a webcam to detect the eye blink. ECG signal are used to monitor the heartbeat.

2. PROPOSED METHOD

This paper mainly concentrates on the safety of the automotive by continuously monitoring the driver activities. The complete architecture of the proposed method is shown in FIGURE.1. The complete Process flow is depicted in FIGURE.2. The main modules assisting in the monitoring action are:

2.1 Eye Blink Detection

The webcam is used to continuously monitor the eye blink. The eye blink rate is processed in two ways. Firstly, a normal eye blink rate represents that the driver is normal during driving activity. The other case is when the eye blink rate is not normal i.e. when the eye is closed for certain period of time. The latter represents abnormal eye blink during the driving activity. The abnormal condition is detected by the eye blink detection module. This may indicate that the driver is

drowsy and lead to accidents. This must be detected and the driver must be alerted. To avoid this situation the module generates an alert through a buzzer. The buzzer alerts the driver and he resumes normal eye blinking state. This concept is mainly directed towards the safety and protection of the automobile.

2.2 Heart Beat Detection

The heart beat detection module is used to continuously monitor the heart beat rate of the driver. Abnormal heart beat rate of the driver is detected. Under such conditions, two simultaneous actions take place. Firstly, the speed of the car is reduced. Secondly, an alert is generated through the buzzer and finally a visual alert is given by the LCD. This visual alert displays a message denoting a normal or abnormal heart beat rate to the driver.

On the other hand, if the heart beat rate of the driver is normal, the alert system remains off.

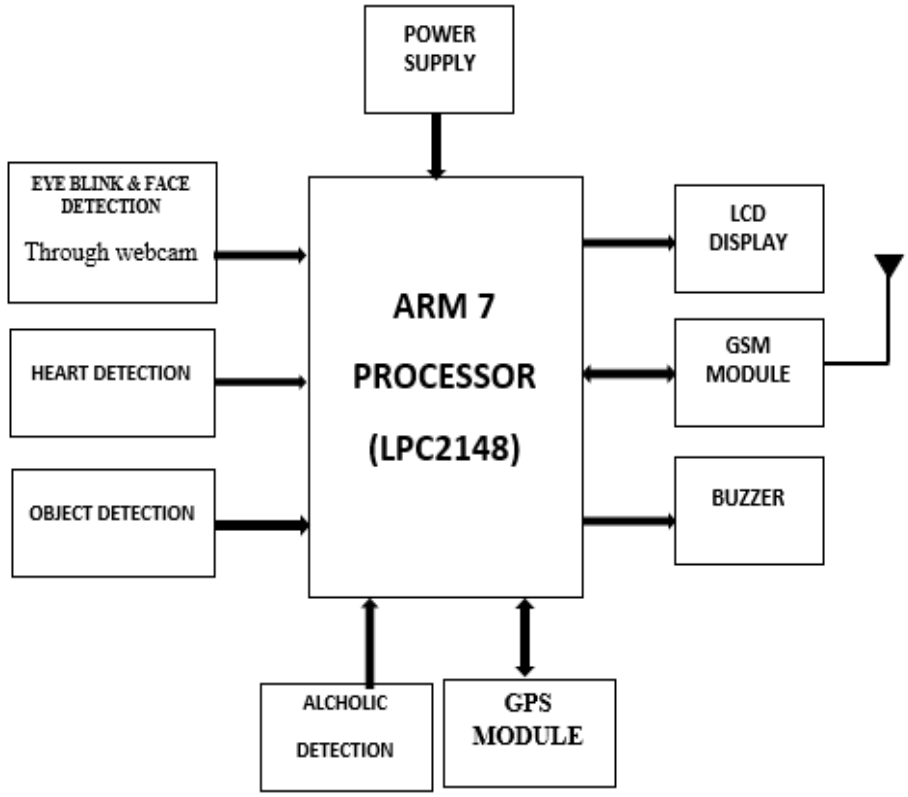


FIGURE 1: Complete Architecture of Proposed Method.

2.3 GSM Module

This module is mainly used for alerting the second party, when the first party (driver) is in an abnormal state. This is achieved by synchronizing the continuously monitored eye blink rate and the pulse rate. In other words, this indicates that eye is closed for a certain period of time (abnormal state) during driving activity and the pulse rate is in abnormal state. When both the condition are synchronized, this module generates an alert to the second party.

2.4 Face Detection

The face detection module is used for detecting the position of the drivers face. This indicates that the driver is visualizing in some direction with his face directed towards an abnormal position

than the normal driving position during the driving activity for a certain period of time. This generates an alert through a buzzer. This alerts the driver and he resumes normal visualization.

2.5 Obstacle Detection

This feature is used to detect the obstacle which is present behind the automobile. In some situations, this is normally not visible to the driver. This module detects the obstacle and then alerts the driver. This is achieved by using an LCD. IR transmitter and receiver is used for object detection.

2.6 Location Tracker

Location tracker is used to identify the location of the automobile in emergency situations.

2.7 Alcoholic Detection

This module works for two different conditions. Firstly, if the driver is drunk, before he starts the automobile, his attempts to start the vehicle fails. Secondly, if the driver consumes alcohol while driving the automobile, the vehicle slows down and finally stops. MQ3 Sensor is used for alcohol detection.

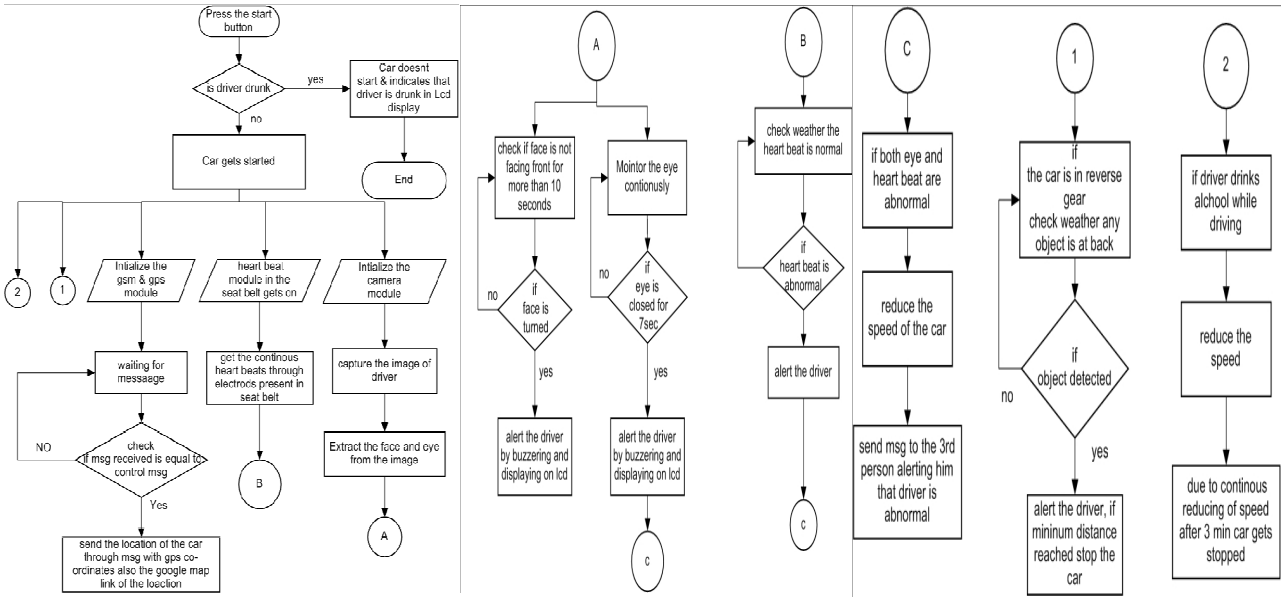


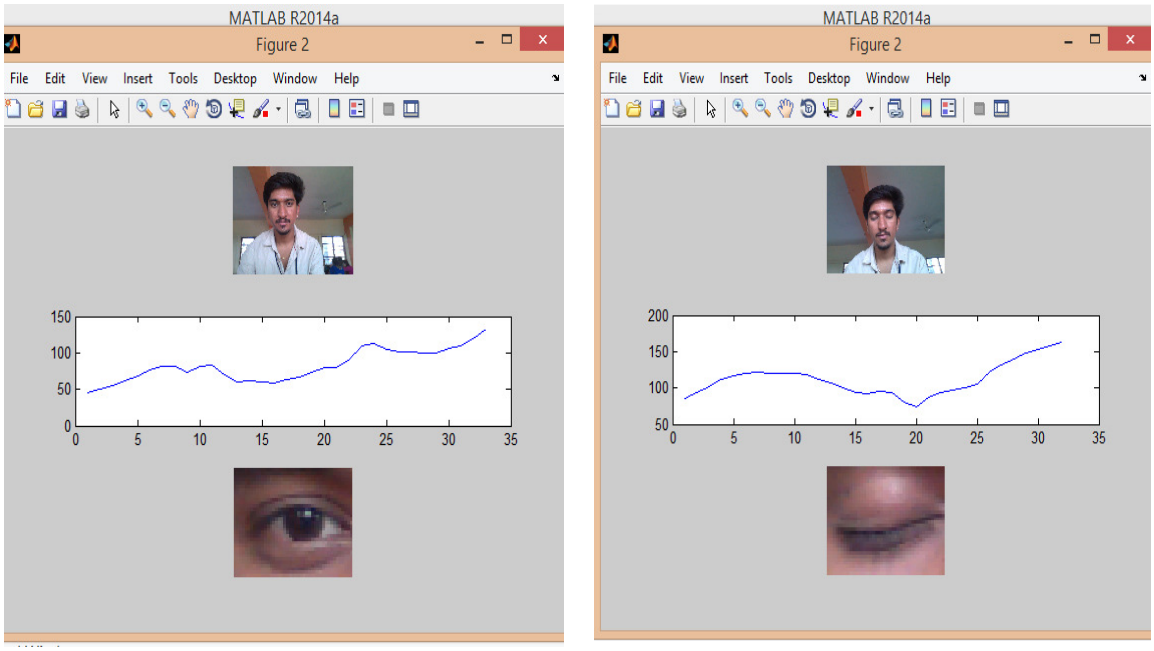
FIGURE 2: Flow Chart for the Proposed Method.

3. RESULTS AND DISCUSSIONS

Webcam is used to capture the images, Vision Cascade Tool in the Matlab Tool Box is used for the detection of eye and face in captured image. Detection is done based on Viola-Join Algorithm. Here, the retina of the eye is monitored. If retina of the eye is not detected, then it indicates that eye is closed. The simulated output images are given in FIGURE 3. Fig 3a shows the eye is open the corresponding graph is plot of pixel point vs pixel intensity, the two graphs show the diff between eye open and eye close.

Heart beat module detects the ECG signal from the heart. This module mainly consists of electrode, amplifier, and analog to digital converter. Since, ECG signals are weak signals, they are amplified using ECG amplifier. Later they are converted into digital form to interface with the processor/ controller. Digital value is compared with pre-programmed normal heart beat value. When this value doesn't match with later, the output goes high.

Alcoholic detector is basically a breath analyzer which detects the alcoholic content in the breath. In case alcohol is detected output of this module goes high. Figure 4 shows the location of various sensor in the vehicle. The normal and abnormal conditions is depicted in Table 1.



a) b)

FIGURE 3: Simulated Output Images a) Eye Open, b) Eye Close.

Fig 4a. Webcam & Alcohol

Fig 4b. Heart Beat Sensor.

Fig 4c. Complete Model.

FIGURE 4: Location of sensors in the Vehicle.

Table 1: Different parameters of proposed system.

Parameters	Normal	Abnormal
Eye close (drowsiness)	Less than 4sec	More than 4sec
Face turn	Less than 4sec	More than 4sec
Heart beat	More than 68 less than 75	Less than 68 more than 75
Alcohol	Less than 30%	More than 30%

4. CONCLUSION

This paper mainly highlights the factors responsible for the safety and protection of the automobile driver. The interrupts responsible for causing accidental acts is being detected leading to a safer pathway. In this paper an attempt is made to describe various modules used to avoid the causes of accidents caused by human errors during driving period such as drowsiness and face turn. This paper also concentrates on drivers violating traffic rules i.e. consumption of alcohol during driving that leads to accidents. We have also made an attempt to provide medical aid during abnormal conditions.

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