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APPLICATION OF RASPBERRY PI BASED EMBEDDED SYSTEM FOR REAL TIME PROTECTION AGAINST ROAD ACCIDENTS DUE TO DRIVER'S DROWSINESS AND/OR DRUNK AND DRIVE CASES

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ABSTRACT

Present work deals with the application of raspberry pi CPU based sensing system to the detection of driver's lethargy and alcoholism in order to avoid the road accidents. The embedded system consists of 5 megapixel digital camera, alcohole detection sensor and the buzzeer interfaced to the microcontroller. The embedded system is controlled by Raspbian operating system. The system detects real time situation of the driver's vigilance and control over the vehicle. If alcoholic and / or drowsiness tests are positive, it (i) switches on the alarm, (ii) turn off the vehicle's engine via microcontroller based program controlling ignition power source and (iii) sends a sms to the person close to the driver's location.

KEYWORDS: MQ6 Alcohol sensor, Haar cascade classifier, raspberry-pi, embedded systems.

INTRODUCTION

Frequently, the loss of driver's control over the vehicle results in the road accidents. Most of the times, even if the vehicles are flawless; the human errors may result in the fatal consequences. Vehicle drivers lose their control on the vehicle when they are feeling sleepy or when they are consuming liquors. Road accidents cause damage to property as well as life. Thus there is need of development of methods for avoiding hazardous effects of drowsiness on roads [1]. Effective method for the correct identification of drowsiness is iris scan. Researchers have been developing several prototypes and modules for iris scanning. Advanced technologies focused on the development of gadgets for the simultaneous detection of drowsiness and alcohol consumption by the driver. When there is drowsiness, blinking of eyes is abnormal. Detection of frequency of opening and closing rate of eye is fundamental objective kept for developing the prototype. Drowsiness is intermediate stage between wakefulness and sleep that has been defined as the state of progressive impaired awareness associate with the desire or inclination to sleep [6]. In driving drowsiness adds to the probability of accidents. Many traffic surveys shows that driver drowsiness causes 22% and alcoholism cause 33% road accidents [2-4]. Researchers have been trying to prepare different drowsiness detectors [7-16]. The alcohol detectors to avoid drunk and drive accidents have also been the fascinating research issue [17-21]. There are very few research works done to combine the both [22]. It will be interesting to create a system that can detect the drowsiness as well as alcohol intake of car driver and take necessary action on real time basis. Haar transform to detect the rate of blinking and alcohol sensor to be used as a breathalyzer and it measures alcohol content in blood from breath air content (BrAC) [5]. Alongwith the high speed Raspberian system, raspberry-pi board is to be used as CPU.

MATERIALS (HARDWARES AND SOFTWARES)

5 megapixel digital camera OVA5647 CMOS QSXGA, alcohol sensor (MQ_6), Haar cascade classifier, KPEG260 buzzer, raspberry Pi board, RS 232, I2C serial ports and PIC 16F877A microcontroller are used to construct the hardware. The raspbian OS is used as software.

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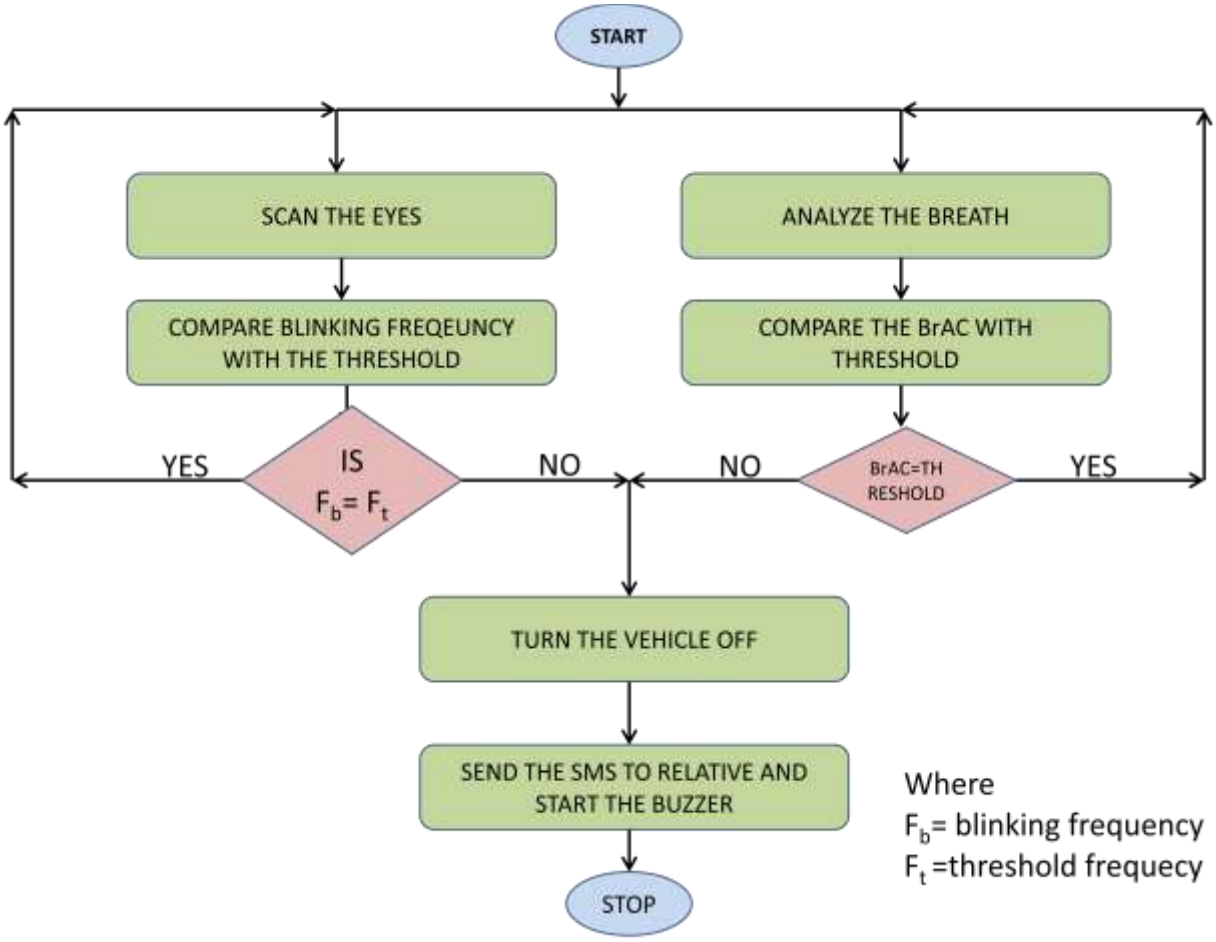
METHODS



The algorithm of the actions is shown above. We have used Adaptive Boost algorithm to train a cascade of boosted Classifiers based on Haar-like features to detect eyes in facial images. The datasets with positive and negative samples were used as training samples in this system. Haar like features were used to locate eyes on the face and extraction of these parts were done. The features of these parts were extracted using adaboost technique by means of which matching samples were identified. When driver was feeling drowsiness, opening and closing of eyes became frequent or longer closing periods have been seen than normal or fresh mood. Along with opening and closing of the eye, by detecting size of the pupil (which was greater as compared to the normal conditions) gives accurate detection of drowsiness. To detect eye region, Haar transform was applied. After detection area of eye region, opening and closing rate of eye was calculated and compared with threshold value in system data base to declare drowsiness and according signaling to alarm.

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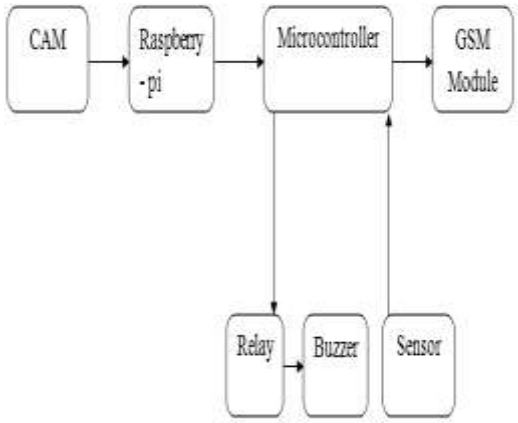

Fig. 1 block diagram of the designed real time system.

DC Power Supply for system is depends on selection of micro controller. We have used PIC 16F877A which runs on 5V supply and this supply can be derived from raspberry pi board hence there is not necessity to use additional supply. A digital camera of 5 megapixel was used to capture real time images. The input from camera was given to Raspberry Pi. For raspberry pi we have used on board pi camera (USB camera can also be interfaced with raspberry pi). Real time images of face were periodically detected. The captured images were sent to the Raspberry pi for further processing. In Raspberry pi board image processing based eye and pupil detection algorithm was implemented. The output of high speed Raspberry pi was send to micro controller. Based on the detected blinking rate of eye, drowsiness level was calculated. And if drowsiness detected, respective signal to PIC microcontroller will be sent by the prepared program. MQ_6 was interfaced with micro controller.
If alcohol content in the breath is detected, (i) this information as an SMS is send to the pre-fed numer via GSM. (ii) The buzzer is turned on.

RESULTS

As shown in figure 2, the OVA5647 camera has detected (i) complete face position to sense its position and (ii) the eye scan to check the blinking rate. Here for the normal person, we did not find any variation in the number of blinks per 5 seconds. Also the opening and closing time of eyelids was found same as the calibrated time. Then the MQ_6 sensor's signal is fed to the system which is digitally calibrated as voltage *vs* time graph (Figure 3). During the test, the subject was about 10 cm away from the breath-alcohol sensor. The output of the alcohol peak is inverted. The blue curve in the figure corresponds to the breath peak, while the red curve corresponds to the alcohol peak. The peak tailing of the alcohol peak is larger than that of the breath peak, which is mainly due to the characteristics of semiconductor alcohol sensors. The position of the breath peak was same as that of the alcohol peak but the peak-top position for normal peak was smaller (2 sec in this case) than the full width half maxima (FWHM) value of the alcohol peak (15 sec in this case). These results indicate that breath and alcohol peaks in breath containing alcohol can be simultaneously detected by using the the MQ_6 breath-alcohol sensor. As alcohol content in the breath was detected, (i) the informative SMS was send to the pre-fed numer via GSM. (ii) The buzzer was turned on.

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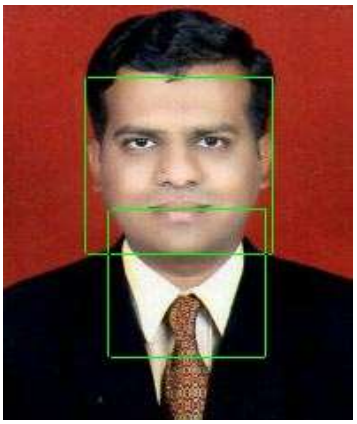

Fig 2a. Results Obtained Of Face Detection by Haar cascade face detection using open CV

Fig 2b. Results Obtained for Closed and Open Eye Region Detection By Haar Transform

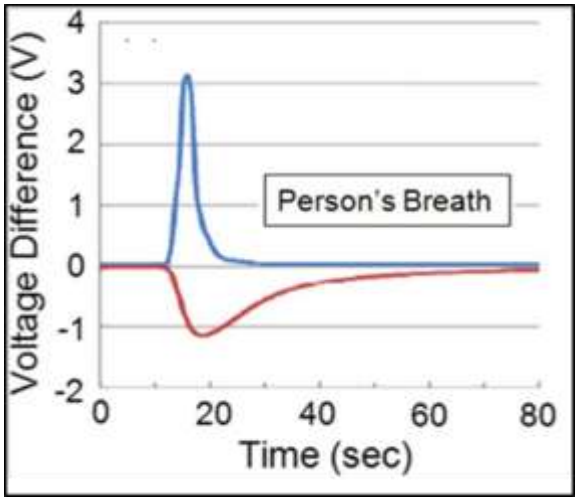

Fig. 3. Simultaneous detection of normal breath and breath alcohol

CONCLUSION

The system performs well for drivers' drowsiness and alcohol intoxication detection. This system will give appreciable control over accidents caused by driving after alcohol intake and under drowsiness condition. Implementation will work in real time with acceptable success rate.

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