Drowsiness Detection for Cars using Eye Blink Pattern and its Prevention System

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Abstract— Drivers driving long distances without any break are at a high risk of becoming drowsy. Driver fatigue is one of the significant reasons for a large number of vehicle accidents. Driver inattention is due to fatigue which causes traffic accidents. Monitoring a driver to detect inattention is a complex problem that involves physiological and behavioral elements [5]. Different approaches have been made, and among them IR sensor based approach to detect drowsiness has the potential of monitoring the person without interfering with his driving. In this paper we have developed a system that monitors the alertness of drivers in which drivers are prevented from falling asleep at the wheel. This paper presents a real-time method for drowsy driving detection system in which IR sensor mounted on spectacle to detect blink rate which is used for detection of drowsiness. The output of IR sensor is given to Controller of transmitter which decides drowsiness of driver. Signal is transmitted given by the transmitter to receiver. At the receiver which acts as alerting system alerts the driver when fatigue or drowsy state detected. The alerting system consists of musical buzzer, a vibrator mounted on spectacle, LCD display and flashing LED. The algorithm used is very accurate and with high performance. This system will help to decrease the amount of crashes due to fatigued drivers.

Key words: IR Sensor, Bluetooth Module, Drowsiness Detection, Spectacle

I. INTRODUCTION

Studies have shown that a large proportion of traffic accidents around the world which are related to inadequate or disordered sleep. Recent surveys have linked driver fatigue to 16% to 20% of serious highway accidents. Recent statistics estimate that annually 1,200 deaths and 76,000 injuries can be attributed to fatigue related crashes [4]. Because of the hazard that drowsiness causes on the road, methods need to be developed for counteracting its affects.

Signs of a drowsy or distracted driver include [2]:

- Frequent Yawning
- Rapid, constant blinking
- Nodding or swinging head
- Difficulty in focusing
- Drifting from lane

Many solutions are there to detect the fatigue for monitoring the eyes. One of them is noninvasive method in which a camera is used to monitor it [1], [3], [4]. We were working on this initially what we found that it requires lot of image processing and costlier processors like Raspberry-Pi to become a standalone system. So to make a system simple and work efficiently with fewer errors and real-time we are using an IR sensor from Robosoft systems fixed on the spectacle to detect drowsiness. There are two units one is Transmitter and other is Receiver.

The Transmitter unit is used to detect drowsiness of a driver with the help of IR sensor. Two different signals are being transmitted to indicate drowsiness detected and drowsiness not detected to receiver unit. At the receiver end depending on the signal received the controller alerts the driver and passengers if drowsiness detected.

The development of system for detecting or preventing drowsiness at the wheel is a real challenge in the field of accident avoidance systems. Due to the hazard that drowsiness presents on the road, methods need to be developed for counteracting its affects. The aim of this is to develop a standalone model for drowsiness detection system. The main focus will be placed on designing a system that will accurately monitor the blink rate of the driver's eyes in real-time [6], [7]. By monitoring the eyes, it is believed that the symptoms of driver fatigue can be detected early enough to avoid a car accident.

In future we can also add automatic speed minimize system, if Drowsiness detected. Also we can interface this device to automatic Breaking System of vehicle.

II. SYSTEM DESIGN

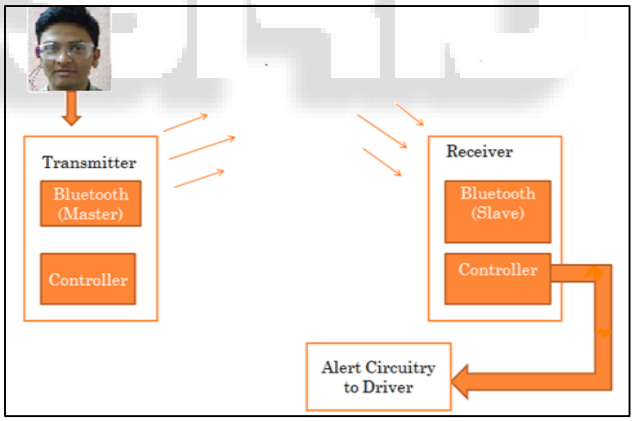

Fig. 1: System Block Diagram

A. Working of System

Spectacle is mounted with IR sensor and vibrator in such a way that it will not affect the viewing of driver. Transmitter can be placed on the side edge of spectacle or in the pocket of driver. As from Fig.1. IR sensor placed on spectacle continuously sends output to controller.

Depending on the output of IR sensor and Transmitter flow chart shown in Fig. 5 Bluetooth module will transfer the signal to receiver. After receiving the signal by the Bluetooth receiver it will process the signal as given by flow chart of receiver from Fig.6. Now if Drowsiness detected then alerting system will alert the driver. In alerting system Buzzer/Voice message, LCD display, Flashing LED is given. Also a vibrator is mounted on spectacle, which will

vibrate spectacle and keep driver awake if drowsiness detected.

III. HARDWARE IMPLEMENTATION

A. IR Sensor

The IR Sensor is a general purpose proximity sensor. Here we use it for open and closed state of eye detection. The module consists of an IR emitter and IR receiver pair. The high precision IR receiver always detects an IR signal. The module consists of 358 comparator IC. The output of sensor is high whenever it IR frequency and low otherwise. The sensitivity of the IR Sensor is tuned using the potentiometer. The potentiometer is tunable in both the directions. Initially tune the potentiometer in clockwise direction such that the Indicator LED starts glowing. Once that is achieved, turn the potentiometer just enough in anti-clockwise direction to turn off the Indicator LED. At this point the sensitivity of the receiver is maximum. Thus, its sensing distance is maximum at this point. If the sensing distance (i.e., Sensitivity) of the receiver is needed to be reduced, then one can tune the potentiometer in the anti-clockwise direction from this point. The on-board LED indicator helps user to check status of the sensor without using any additional hardware. The power consumption of this module is low. It gives a digital output.

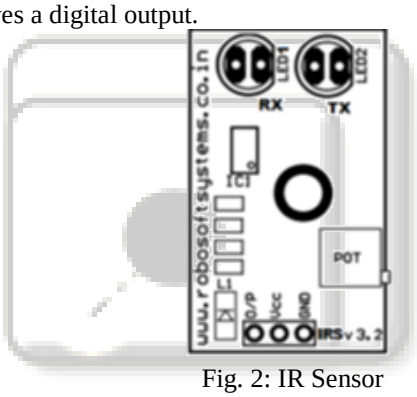

Fig. 2: IR Sensor

B. Working Principle of system using IR sensor

IR transmitter transmits infrared light when eyes are closed infrared light is reflected and is detected by IR receiver. As it gives digital output it is given to controller where processing takes place. If continuously we get high output for few seconds then a conclusion can be drawn drowsiness detected. The Fig. 3 gives clear idea of working principle of IR sensor. [9]

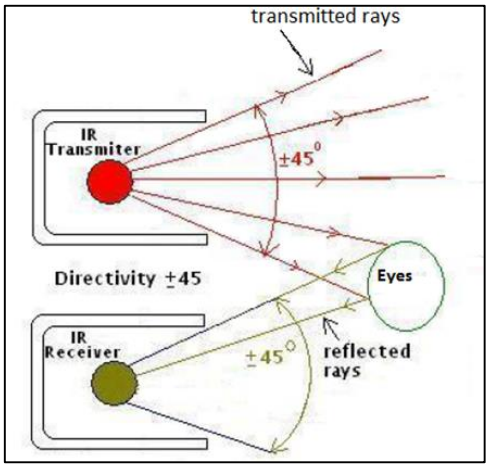

Fig. 3: Principle of IR sensor

C. Bluetooth Module

Bluetooth is used for transmission of data serially. There are two modules used one at transmitter and other at receiver. These Bluetooth used are auto connected when the system is power ON [8].

Bluetooth module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup. Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Bluecore 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature).

Fig. 4: Bluetooth Module

Hardware specifications of Bluetooth Module (HC05):

1) Typical -80dBm sensitivity.
2) Up to +4dBm RF transmits power.
3) Low Power 1.8V Operation, 3.3 to 5 V I/O.
4) Auto pairing within range of 30m.

IV. FLOW CHART

There are two flow charts one is for Transmitter (Fig. 5) and second is for Receiver (Fig. 6). The algorithm gives very high performance.

A. Transmitter Flow Chart Description

In this controller makes a decision whether driver is drowsy or awake. For this we have decided when continuous for 2.5 sec driver's eyes are closed then conclusion is drawn that driver is drowsy. And when drowsiness detected we are sending character 'a' to receiver through Bluetooth. Also a vibrator is ON for 5 sec. When drowsiness not detected then character 'b' is sent. The communication is very fast between Transmitter and Receiver.

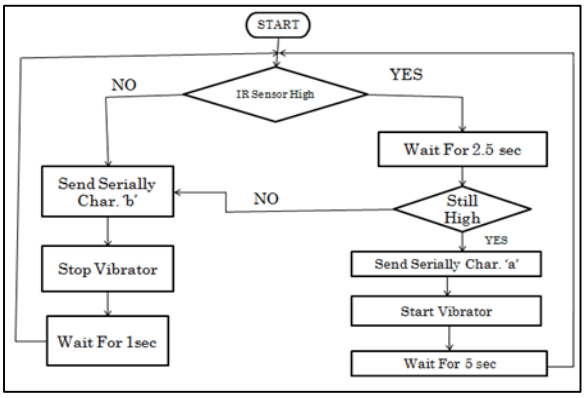

Fig. 5: Transmitter flow chart

B. Receiver Flow Chart Description

If character 'a' is received then alerting system is to be activated. In alerting system Buzzer/Voice message,

Message ON LCD, Flashing LED has to be activated which is efficiently done by controller. And if character 'b' is received then NO action is taken by alerting system.

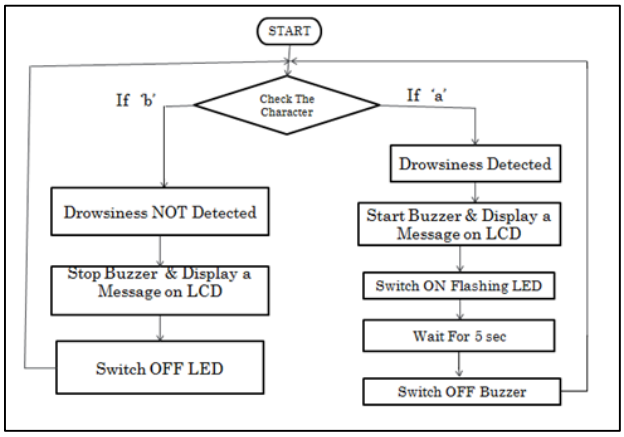

Fig. 6: Receiver Flow Chart

V. EXPERIMENTAL RESULTS

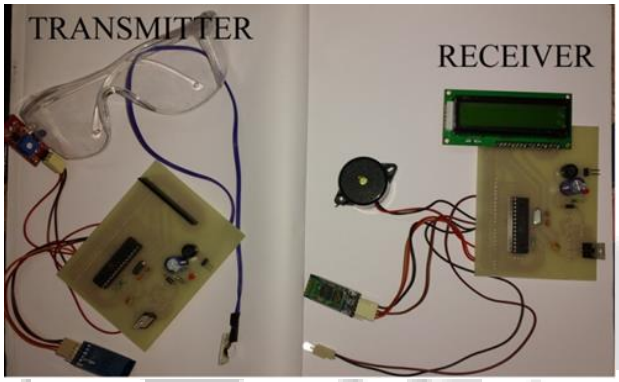

Fig. 7: Transmitter and Receiver of System

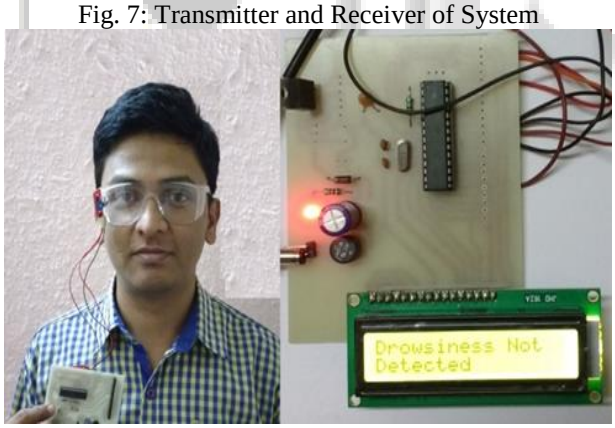

Fig. 8: Drowsiness Not Detected

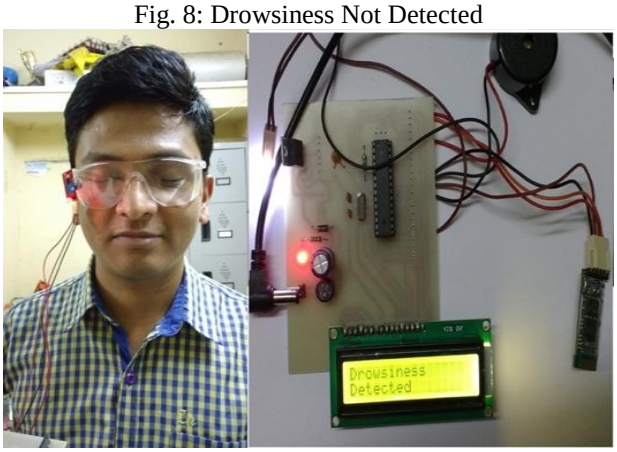

Fig. 9: Drowsiness Detected

Figure No. 7 shows the prototype model which consists of transmitter and receiver. The experiment results are shown in Fig. 8 and Fig. 9. Figure No. 8 shows the message "Drowsiness Not Detected" on LCD which accurately determines the awake state, as the eyes are open. Figure No. 9 shows the message "Drowsiness Detected" which accurately determines the drowsy state as the eyes are closed. The IR sensor which can be seen from Fig. 8 and Fig. 9 is mounted in such a way that it will not interfere the driver while driving vehicle. If we compare Fig. 8 and Fig. 9, if drowsiness detected a RED light is ON (right eye of Fig. 9) and if drowsiness not detected RED light is OFF (right eye of Fig. 8).

VI. CONCLUSION

This system can significantly predict Drowsiness and alert the driver also display the message drossiness detected or not with fine Accuracy and High Speed.

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