

Driver Drowsiness Detection System Based on the Driver's Head Movement and Heart Pulse Rate

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ABSTRACT: In present world, most of the road accidents are caused by driver getting drowsy while driving. This is one of the threats to the traffic safety. The majority of accidents are happened due to driver's reckless lack care of attention. Driver Drowsiness Detection System is a car safety technology which is used for the drivers and passenger's safety against the road accidents caused by the driver getting drowsy. The system is capable of detecting drowsiness at early stage and provide the alert in case of driver getting drowsy in order to prevent accidents. The main objective of the paper is to curtail the number of accidents that are caused by driver drowsiness. This is done by observing the driver's head movements in order to detect drowsiness and keeping heart beat rate under systematic review. Drowsiness detection is accomplished by head motion detection and heart rate detection. If the driver is found to be drowsy while driving, an alert is given to the driver through a buzzer for the safety of the driver along with the passengers. As a preliminary approach, we are simulating the process using Arduino software.

KEYWORDS: Pulse rate sensor, IR sensor, Node Mcu, buzzer etc.

I. INTRODUCTION

It has been a known that automobile usage has been exponentially increasing with corresponding increase in population. Consequently, the accident rates have been increasing due to various reasons. Among these, human negligence while driving has become an important factor also drowsiness and distraction. Hence a system is developed to check and analyse the driver's condition while driving, which is meant to provide safety for the driver and for the passengers by continuously monitoring the driver conditions like drowsiness, heart beat rate and blood alcohol level. The proposed system monitors the drowsiness of the driver and heart beat rate of the driver in order to detect state of the driver while driving on roads. The drowsiness prediction in the driver is done by observing abnormal head or body motion. If the abnormal motion is detected, it can be predicted that driver is in abnormal condition i.e. sleepy.

Simultaneously the pulse rate of the driver is monitored and detected by taking a pulse rate signal of the driver. The detected pulse rate is compared with the normal value (60-100 beats/minute) to predict whether the driver is getting drowsy or not. The outputs of drowsiness and heart beat rate detection are parallel processed and depending on these outputs the driver state is detected. If there is any abnormality in driver's state, a notification is given through buzzer to indicate driver deviancy. Thus, this system provides safety and security for the driver along with the passengers in real time implementation. We are making use of Arduino software for simulation of the proposed system with computer vision tool box and signal processing tool.

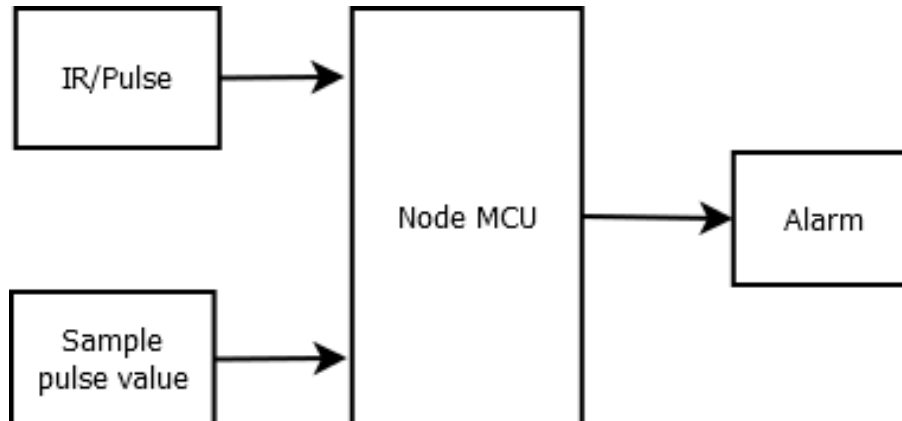


Fig.1. Overview Of The Proposed System

II. PROPOSED SYSTEM

The flow diagram of the proposed system is as follows, Fig.2. depicts the drowsiness detection by taking the pulse rate as an input. From the sensor data processing, the prediction of drowsiness is performed. For the real time implementation of the proposed system the heart rate can be obtained using pulse rate sensors. Pulse rate sample is taken as an input for obtaining heart beat rate. Finally the drowsiness and pulse rate detection outputs are fed to a decision making module using which the status of the driver is evaluated.

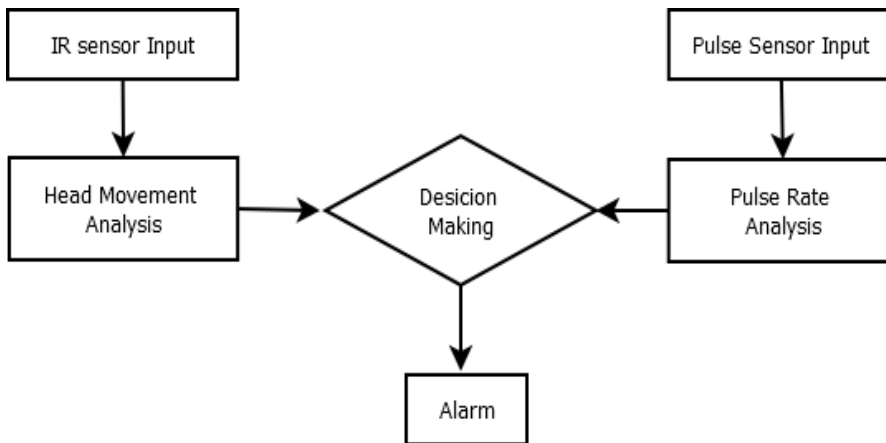


Fig 2 : Flow Diagram of proposed system

Drowsiness Detection :

The objective of this research is to detect the driver’s state based on his/her head movement. In this, driver’s head movements are calculated when driver is normal and drowsy. Then both the results are compared and analysed for future use. The ‘Collecting Drivers’ Head Movement’ process of the Figure 2 is the collecting process for the driver’s head movement, state and the circumstance during the real driving situations. The driver’s head movements were collected by IR sensors. For this, the “IR Sensing Module” which can gather the driver’s head movements were implemented. The IR sensing module consists of IR sensors and the micro-computer which transfers the signal from the IR sensors to the node mcu. The IR sensors are attached to the headrest of the driver’s seat and placed horizontally with the driver’s head. This positioning of the IR sensors makes the driver’s head movement can be obtained from the reflection of IR ray.

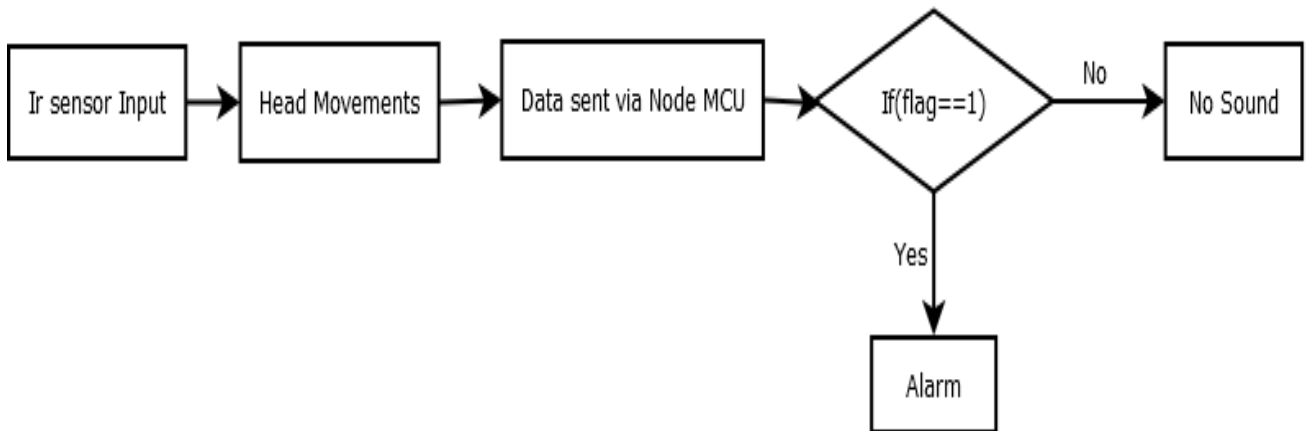


Fig 3: Flow Diagram Of Drowsiness Detection

Heartbeat Detection :

Pulse rate sensor is a test that records the electrical activity of the heart. It will give information regarding the pulse rate of blood flowing through capillaries. The sensor has two sides, on one side the LED is placed along with an ambient light sensor and on the other side have some circuitry. This circuitry is responsible for the amplification and noise cancellation work. The LED on the front side of the sensor is placed over a vein in driver’s body. The LED emits light which is fall on the vein directly. The veins have blood flow inside them only when the heart is pumping, soflow of blood is monitored the heart beats can also be monitor. If the flow of blood is detected then the ambient light sensor will pick uplight since they will be reflected by the blood, this minor change in received light is analysed over time to determine driver heart beats.

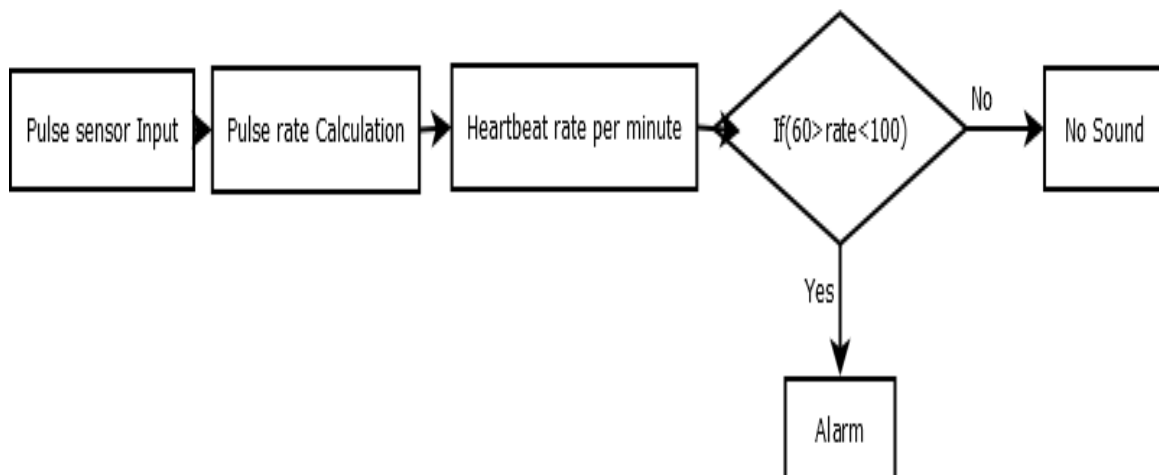


Fig 4: Flow Diagram Of Heartbeat Detection

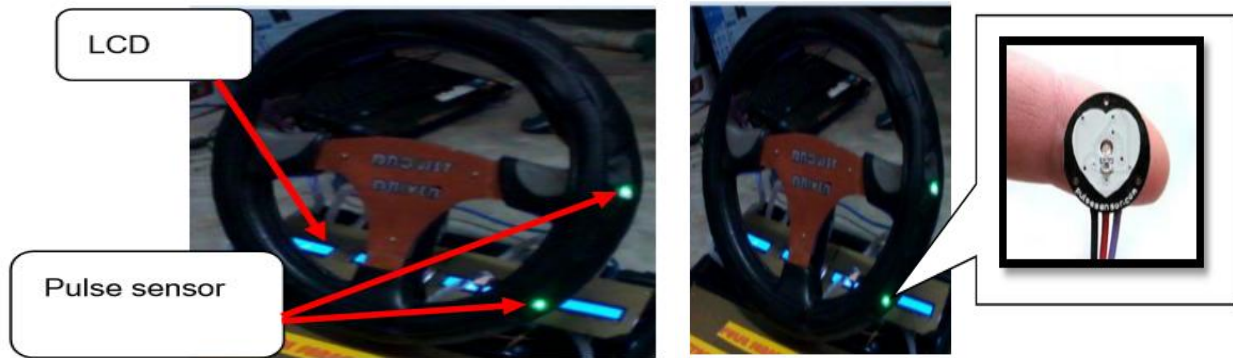


FIG 5 : PULSE SENSOR ON STEERING WHEEL

This technique is based on the principle of photoplethysmography (PPG). The technique has two basic types. Transmittance and reflectance. The types of PPG can be used because adult human bodies such as fingers, cheek, hand, are semi-transparent. In transmittance PPG, a light source is emitted into the tissues and a light detector is placed in the opposite of the tissue to measure the resultant light. The light source and the light detector of reflectance PPG are both placed on the same side of a body part. The light will be then emitted into the tissues and it will reflect to the detector. Since the light need not have to penetrate the body, the reflectance PPG can be applied to any parts of human body and it is suitable to use for this project. The theory is applied when the blood is pumped through the body, it gets squeezed into the capillary tissues and the volume of those tissues will increase very slightly. Then, the volume decreases between heartbeats. So, the amount of light emit is absorbed and it is dependent on the tissues blood volume. The intensity of the reflected light varies with the pulsing of the blood with heartbeat. When a plot of variation against time is produced, the fluctuation is seen.

Configuration of Pulse Sensor

The configuration of the proposed pulse sensor is illustrated in dig 1. The pulse sensor is installed around the inner circle of the steering wheel. It is used to measure heart pulse wave, which can ensure the detection even with single hand driving. Each sensor unit has a pair of infrared emitter and detector diode that placed side by side to detect clear pulse signal.

Beat per Minutes (BPM)

In this the BPM of the drivers; in normal stage and in state of drowsiness. Two experiments is run on both subjects; the male and female driver. In this, the pulse sensor is attached at their finger so that the heartbeat can be detect while they are in normal stage condition and drowsiness stage condition. In the normal stage condition, they are in condition at rest and do not do the kind of work, which will make their heartbeat beat rapidly. It is very important to know that when driver’s heartbeat is at normal condition, it was easy for the data to be analyse and remember. Table 1, the heartbeat for the male driver is around 75 to 100 BPM while for the female driver is about 70 to 95 BPM. There is a difference between male and female heartbeat because male’s heartbeats faster than female’s heart. The experiment is carried out when they are being tired after went through all activities the whole day without any asleep such as to focus on their study. This is important to get the best result for drowsiness stage condition. If the driver is extremely drowsy, his BPM will decrease rapidly. So, in this case, we just focus on the driver at early drowsy stage condition. In Table 1, the male’s BPM is between 50 to 65 BPM while the female’s BPM is around 45 to 63 BPM.

Type of stages	Male	Female
Normal	75BPM < BPM <100BPM	70BPM< BPM <95BPM
Drowsiness	50BPM < BPM <65BPM	45BPM <BPM <63BPM

Table 1 : BPM results for 2 drivers



The obtained drowsiness and heart beat rate detection output is used to make a decision on the driver’s abnormal situation. This is done based on the practical threshold ratings.

Parameters	Normal	Abnormal
Head motions(counts)	Less than or equal to5	More than 5
Heart beat	More than 60 Less than 100	Less than 60 More than100

Table 2: Threshold ratings of proposed system.

III.EXPERIMENTAL RESULTS

The simulation results of drowsiness detections shown below, it shows the process of heart beat detection using the pulse rate sensor.

```
Heart-Beat Found BPM: 122
Heart-Beat Found BPM: 128
Heart-Beat Found BPM: 134
Heart-Beat Found BPM: 142
Heart-Beat Found BPM: 150
Heart-Beat Found BPM: 160
Heart-Beat Found BPM: 170
Heart-Beat Found BPM: 182
Heart-Beat Found BPM: 234
Heart-Beat Found BPM: 235
Heart-Beat Found BPM: 235
Heart-Beat Found BPM: 236
Heart-Beat Found BPM: 235
Heart-Beat Found BPM: 234
Heart-Beat Found BPM: 234
Heart-Beat Found BPM: 228
Heart-Beat Found BPM: 229
Heart-Beat Found BPM: 91
Heart-Beat Found BPM: 91
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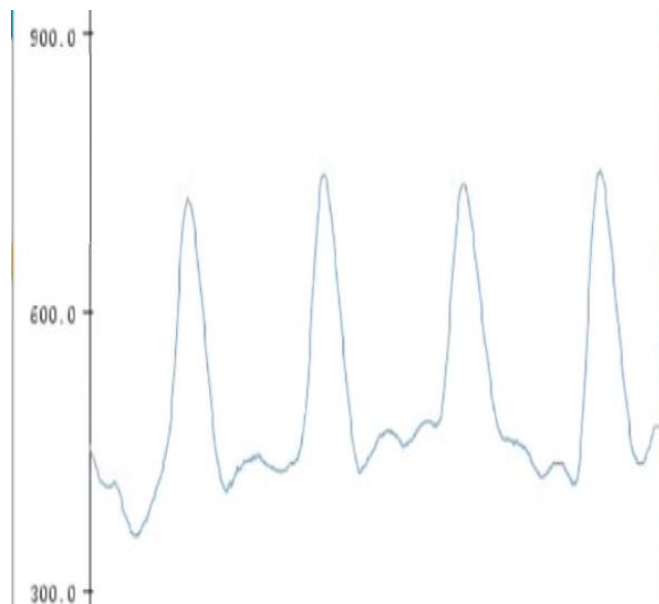


Fig. 6: Simulation Results Of The Heart Rate Detection On Serial Monitor And Serial Plotter.

As we put our figure tip on the pulse rate sensor it shows the heart beat in BPM. We have compare these values with the threshold value as describe above. When the heart beat observed less than threshold value then the driver is said to be drowsy.

The simulation results of the process of head motion detection using the IR sensor.

```
no interrupt  
no interrupt  
no interrupt  
no interrupt  
no interrupt  
no interrupt  
no interrupt  
no interrupt  
no interrupt  
no interrupt  
no interrupt  
no interrupt  
no interrupt  
no interrupt  
no interrupt  
interrupt  
no interrupt  
no interrupt  
no interrupt  
no interrupt  
interrupt  
no interrupt
```

Fig.7 :Simulation Results Of The Head Motion Detection

For detecting the head motion we use IR sensors. As shown in image, when our head is steady then 'No Interrupt' print on the screen. When the head is not steady then it print 'Interrupt' on the screen. We count the no. of interrupt and compare the value with the threshold value as describe above. When the count is greater than the threshold value then the driver is said to be drowsy.

IV.CONCLUSION

Due to the driver's error's while driving, accident rates have been increased and also there safety related concern for the driver and passenger. Hence through continuously monitoring and analysing the driver by detecting drowsiness and pulse rates and also alerting him when he is deviating from his normal circumstance like getting drowsy, accidents rates can be minimized. One of the efficient methods used for this are motion detection for drowsiness prediction to count pulse rate. For illustrating the driver's state, an example is taken for the simulation purpose. The results obtained can be implemented for developing an intelligent automobile system which can detect the driver drowsiness, thus increasing safety and security of the driver, correspondingly the accident rates may be decreased.

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