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IoT BASED DRIVER DROWSINESS DETECTION AND SAFETY MONITORING SYSTEM USING RASPBERRY PI

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Abstract **:** Nowadays, drowsy driving has become one of the major issue of the traffic collision. Based on the statistical data, many road accidents occur due to the drowsiness of the driver which results in a great loss of life. To overcome this problem,many systems have been designed to detect the fatigue or the drowsiness of the driver and alert him beforehand, thus preventing the damage or loss of life. Previously, psychological measures were used to detect the drowsiness while driving. The major drawback of this system was that the electrodes were required to be placed on the head and the body. Still many other advanced researches are going on this topic. Our proposed system is IoT based real time system which is incorporated using Raspberry Pi and also it is connected to many sensors like alcohol detection sensor to detect the level of alcohol in drunken drivers. The seat belt Sensor can also be connected to detect the passenger's seating position and determine if they're wearing a seat belt. Ultrasonic sensor can also be connected which emits sound waves at a frequency too high for the humans to hear. It is a radio wave which returns after hitting an object. The Drowsiness Detection sensor is used to detect the drowsiness of the driver. The Eye Aspect Ratio is used as an input parameter and this input is compared with the standard ratio. If the input deteriorates from the standard ratio then the driver is alerted using some alert signal or buzzer. The Pi camera is used to capture the images of the driver's eye constantly and is compared with the standard ratio. The whole system aims at detecting the drowsiness or fatigue of the driver and serves as a safety measure with the usage of additional sensors thus reducing the road accidents.

Keywords: Raspberry Pi, alcohol detection Sensor, seat belt sensor, Eye Aspect Ratio

1. INTRODUCTION

There are many issues which concerns about the traffic accidents in this busy world and drowsy driving is one of the major issue [1]. According to statistics, many accidents occur due to this drowsy driving. This mainly occurs when the driver is not alert while driving. Drowsiness occurs when the driver has no sufficient sleep or if he had some medications which make him feel drowsy. At sometimes, the driver may also fall asleep [2].

Many attempts are been taken to detect the drowsiness of the driver using different parameters. As we know, existing methods use different sensors which are being mounted on various components of the vehicle [3,4] . These sensors are usually placed on the pedal, wheel etc to detect the intensity of the drowsiness. Some psychological measures are also used to detect the drowsiness of the driver. One advantage of using psychological measures is that it gives us evaluations with better accuracy since these signals represent the cognitive activities of the brain. But the

major drawback of this technique is that, it should be fitted on driver's body to collect the data [5-7]. Therefore it makes the driver uncomfortable and also it can divert his attention while driving. The existing research provides the tracking of the eye state and analyzing it. This approach provides with high accuracy rate with less errors. But here also there is a drawback which requires high computing requirements [8].

With reference to previous issues, we have proposed a method which is mainly based on the eye closure ratio which acts as a input parameter for detecting the drowsiness of the driver. It monitors the eye blinking pattern, Eye closure, yawning and also facial movements by an external camera. It serves as a non intrusive technique as we don't place any sensors on the driver's body and also the driver will not be distracted while driving [9].

2. PROPOSED SYSTEM

In our proposed system, the driver's face will be recorded continuously and the eye movements are also captured using a Raspberry Pi camera. This Pi camera is mounted on a vehicle dashboard with a distance of about 20cm from the driver's face[10,11]. The camera is connected with a Raspberry Pi with a cable and Raspberry Pi itself. The Eye regions of the driver's face are being extracted to measure the eye closure ratio. If this ratio deteriorates from the standard ratio then we are alerted with a buzzer sound. To make this more effective we can also send an email to the owner of the vehicle if the driver is not taking proper measures for clearing his drowsiness [12]. The whole system is integrated with a Raspberry Pi and a camera for detecting the eye movement. The below block diagram shows the Flowchart of our proposed system.

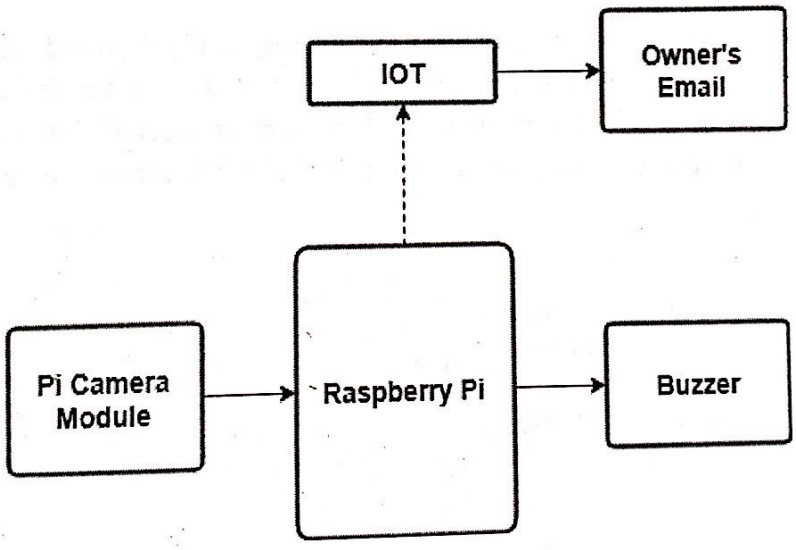

Fig. 1: Block Diagram of the System

Figure 1 explains the block diagram of the system where Raspberry Pi acts as a microcontroller in which the modules Pi camera and buzzer are fitted.

Figure 2 explains about the flow process of the system in which it contains the process blocks and decision blocks.

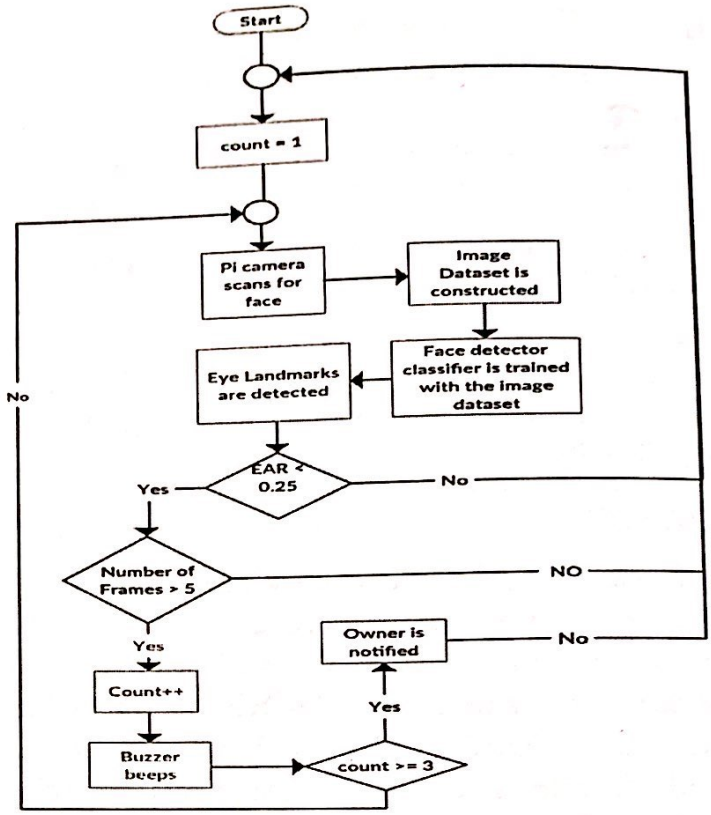

Fig. 2: Flowchart of the Process

3. COMPONENTS

3.1 Raspberry Pi

The Raspberry Pi is a Microprocessor which is mainly designed for the Linux Operating system. In this proposed system, Raspberry Pi 4 is used with Raspbian OS integrated in it. Figure 3 is a Raspberry Pi module which consists of HDMI ports, USB ports, GPIO pins etc.It acts as a microcontroller device for the whole system.

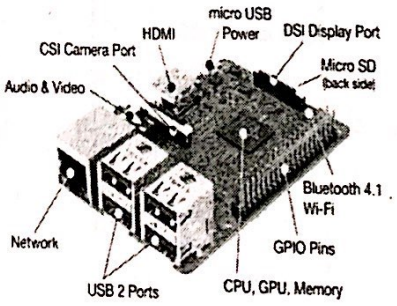

Fig. 3: Raspberry Pi Module

3.2 Pi Camera Module

This Pi camera Module can take videos of high definition along with pictures and also can support many formats.

Fig. 4: Pi Camera Module

Figure 4 is a Pi camera module which is used to capture the videos or images of the driver to detect his drowsiness level.

3.3 Buzzer

The buzzer is mainly used for generating beep sound or some alert signal when some voltage is applied. In our proposed system, the buzzer is used as an alert to generate beep sounds continuously when the driver is found drowsy.

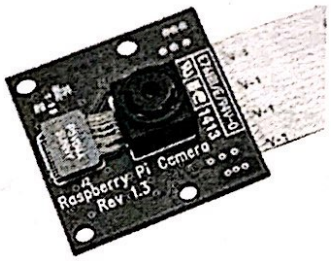

Fig. 5 :Buzzer

Figure 5 is used to alert the driver by giving beep sounds when the driver is found drowsy.

4. PROPOSEED METHODOLOGY

4.1 Face Detection

The Raspberry Pi is integrated with Pi camera module to scan the driver's face continuously. This detection and recognition is carried out in 2 stages:

(a) Construction of Image Dataset

To create an image dataset many videos are put into that dataset. It consists of different frames with a set of face images.The dataset is constructed based on EAR which consists of sample images with both open and closed eyes. It may consists of about 7500 images [13-15]. First the dataset is loaded with these many images as to train itself to identify the facial structure with closed and open eyes.

(b) Training the Dataset to Classify the Images

The background regions of the image are discarded. This is done by grouping all the features and applying them to the concept. If the image passes all the features then it is considered as a face region else it fails to detect the face region.

4.2 Determination of EAR (Eye Aspect Ratio)

The Eye Aspect Ratio is used to calculate the driver's drowsiness. When the face is detected the image of the face is first converted into grayscale format because the complexity of these grayscale images is lower than that of color images. After the face detection, the eye regions are extracted using (x, y) coordinates [16].

The Eye Aspect Ratio is used to compute the distances between the vertical eye landmarks and horizontal eye landmarks. The EAR determines the distance between the eyelids. If a person blinks the Eye Aspect Ratio is zero. The average duration of blink rate approximately ranges from 100 to 400ms. Therefore if a person has a blink rate of more than 400 ms then he is detected with drowsiness [17, 18]. Thus it is possible to distinguish the eye closure pattern between the eye blink and drowsy eyes.

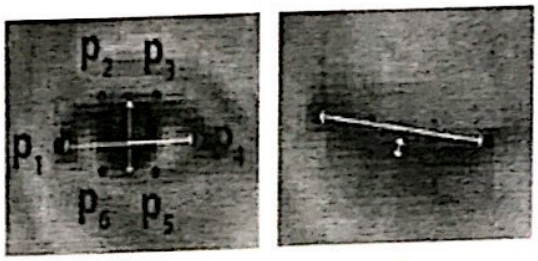

Fig. 6: Comparison of the Open and Closed eye

Figure 6 consists of the comparison of the open and closed eye and it has coordinates for calculation of Eye Aspect Ratio. If the eye is opened then the ratio is around 0.33 and if the eye is closed the ratio drops to zero.

4.3 Alarming of the Buzzer

The Eye Aspect Ratio is constant when the eyes are open and if eyes are closed its value becomes zero. The threshold value of the Eye Aspect Ratio is 0.25 and all the values above it is considered that the driver's eye is open [19]. If the EAR value drops below the threshold value, then it is considered that the driver's eyes are closed and it looks for the number of frames the person has his eyes closed. If the number of frames exceeds 4, then the buzzer is turned on with an alarming sound.

4.4 Sending of Notification Through Mail

If the driver falls asleep for more than 3 times then the system sends an email alert to the owner for further action to be taken since the driver cannot control his Drowsiness [20-22]. The subject along with the message content is entered in the system with the help of Python script. Simple Mail Transfer Protocol (SMTP) is used for sending mails [23]. Furthermore these messages can be sent securely [24,25] by including cryptographic techniques. Audio signals can also be sent.

5. CONCLUSION

The main motive of this research is to identify the driver's drowsiness in real time. Present techniques are very intrusive and our proposed system is a non intrusive one. The Eye Aspect Ratio concept is very important here and if this ratio value

decreases from the threshold value, the driver is immediately alerted and also if the driver's eye remains closed for too long, the alert sound is generated. Further a notification is sent to the owner of the vehicle through email when the driver is found drowsy. This method will be helpful for taxi cab drivers, truckers etc whose major problem is that sometimes due to tiredness they feel drowsy at night times.

6. FUTURE WORK

In future, we would like to improve our proposed system by setting a compact design and also making it capable to work in any kind of environment. Moreover we would like to recognize the sleep pattern of the driver and combine it with the eye closure pattern and therefore we can form a positive correlation between these two patterns which can help us design a perfect drowsy detection system.

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