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Design and Validation of IOT Device for Driver Drowsiness and High Stress Detection

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ABSTRACT

Our safety is the first priority while travelling or driving. One mistake of the driver can lead to severe physical injuries, deaths and significant economic losses. Nowadays there are many systems available in market like navigation systems, various sensors etc. to make driver's work easy. There are various reasons especially human errors which gives rises to the road accidents. Reports say that there is a huge increment in the road accidents in our country since last few years. The main reason occurring from the highway accidents is the drowsiness and sleepiness of driver while driving. It is a necessary step to come with an efficient technique to detect drowsiness as soon as driver feels sleepy. This could save large number of accidents to occur. We conduct the survey on various designs on drowsiness detection methods to reduce the accidents. This paper presents the review of existed drowsiness detection techniques and stress detection techniques that will be used in this system like self-powered IRIS scanner using camera based on raspberry pi, alarm, etc.. We also use the different sensor's like heartbeat sensor, temperature sensors to verify the human health for emergency situation.

Index Terms—Drowsy driving, machine learning, IOT, face detection, eye detection, image processing, heart-beat sensor, temperature sensor, open computer vision (Open-CV).

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I. INTRODUCTION

The increasing number of traffic accidents due to a driver's diminished vigilance level has become a serious problem for society. Some of these accidents are the result of the driver's medical condition. However, a majority of these accidents are related to driver fatigue, drowsiness of drivers. Car accidents associated with driver fatigue are more likely to be serious, leading to serious injuries and deaths. It is estimated that 40-60 percent of all traffic accidents have been caused by drowsiness. It was demonstrated that driving performance deteriorates with increased drowsiness with resulting crashes constituting more than 30 percent of all vehicle accidents.

One can use a number of different techniques for analyzing driver's drowsiness and stress detection. These techniques are Image Processing based techniques, artificial neural network based techniques, Vehicular based techniques, heart-beat and temperature based techniques. And image processing based techniques can be divided in three categories. These categories are template matching technique, eye blinking technique, yawning based technique. These techniques are based on com- puter vision using image processing. In the computer vision technique, facial expressions of the driver like eyes blinking and head movements are generally used by the researchers to detect driver drowsiness. Drowsiness detection techniques and stress detection technique researched are discussed in this paper.

II. PROBLEM STATEMENT

Drowsy driving is a major problem in every country. This usually happens when a driver has not slept enough, but it can also happen due to untreated sleep disorders, medications, drinking alcohol, shift work or long late-night drives, so mostly accident will happen.

So, we develop the desire system to reduce the above problem using the different sensors, to overcome this problem.

III. LITERATURE REVIEW

1. Now a days, there is increasing research interest on developing remote access model for driver drowsiness detection and health monitoring parameters. Previous works investigated the reasons of fatigue.

2. Thomas Kundinger, Research on "Assessment of the Potential of Wrist-Worn Wearable Sensors for Driver Drowsiness Detection". The paper [1] address the development of system that is able to deal with a stress detection scheme to be used in real life. In this they use Emphatic E4 devices and ML algorithm. They achieved maximum 97.92 percent accuracy.

3. Jaeik Jo, Ho Gi Jung, Kang Ryoung, Jaihie Kim, "Vision based method for detecting driver drowsiness and distraction in driver monitoring system", The paper [2] presents a driver- monitoring system that contains both drowsiness detection method and distraction detection method. Drowsiness involves a driver closing his eyes because of fatigue, and distraction involves a driver not paying sufficient attention to the road despite the presence of obstacles or people. Here an eye- detection algorithm is designed which combines adaptive boosting, adaptive template matching, and blob detection with eye validation. Also, a novel eye state–detection algorithm that combines two techniques PCA and LDA is used.

4. In the research: "A smartphone-based driver safety mon- itoring system using data fusion sensors", Lee and Chung

[3] propose a method to monitor driver safety levels using a data fusion approach such as: eye characteristics, variation of biological signals, temperature inside the vehicle and vehicle speed. This system is developed as an application for an Android-based smartphone, where measuring security-related data that does not require additional costs or additional equip- ment. The system has an efficiency of 96 percent to detect that the driver is awake and 97 percent to detect that he is asleep. This information allows knowing the signs that shows a sleepy driver.

5. Research paper on "IOT Based Driver Drowsiness Detec- tion and Health Monitoring System". This paper [4] is for heart beat sensor they use optical power variation and for temperature sensor they use DHT11. They use separate USB camera.in this Heart beat sensor and temperature sensor are taken as an input to raspberry pi-3. The whole setup is done in IOT with 93.37 percent accuracy.

6.A Jesudoss, Muthuram. B.O, Lourdson Emmanuel. A, "SAFE DRIVING USING IOT SENSOR", The main concept of this paper [5] is to prevent the road accident so to prevent the road accident we are using alcohol detection sensor, eye blink sensor, over speed control sensor. The alcohol sensors are used to detect the driver is drunk or not. The eye blink sensors are used to check the driver is sleepy or not with the help of the eyeball movement of the driver, if the driver is sleepy means it will trigger the alarm to conscious the driver. The over speed controller sensors are used to check the car is over speed or not and if the car is over speed means it will reduce the speed of the car and maintain the car speed into normal speed.

7. Deniz Ekiz, Research on "Continuous Stress Detection Using Wearable Sensors in Real Life", This paper [6] is based on detecting continuous stress using wearable sensors.In this they developed an continuous stress level detection scheme that uses physiological signals from wrist-worn devices. Our scheme can also be applied to daily life of individuals. In real-life settings, movements of individuals are unrestricted and artifacts occur because of that. In order for our system to be applicable in these settings, they applied several novel artifact detection and removal strategies. These artifact detec- tion algorithms are developed for specific sensors and their performances are scientifically proven. They further extracted features from heart activity, skin conductance, and accelerom- eter signals with tools. From these features, they classified the stress level of an individual by employing machine learning algorithms.

8. Mood-Scope [7] is a mobile application developed for the IOS operating system, which deduces the mood of the user based on the use of his cell phone, based on a statistical model that uses information from SMS, emails, phone calls, search engine Web and the location of the device. This application is transparent to the user, records the user's interaction with their cell phone, and stores the data on a server through a data connection or Wi-Fi.

9. Kohji Murata, Etsunori Fujita, Shigeyuki Kojima, Shini- tirou Maeda, Yumi Ogura, Tsutomu Kamei, Toshio Tsuji., "Non-invasive Biological Sensor System for Detection of Drunk Driving ", This paper [8] presents a non-invasive system to detect individuals driving under the influence of alcohol by measuring biological signals. We used the frequency time Series analysis to attempt to distinguish between normal and intoxicated states of a person as the basis of the sensing system.

10. "Detection of fatigue using Smartphone aims to use a smartphone (with Android operating system or IOS) to detect fatigue in the driver" [9] Roberson and others uses the front camera of the smartphone to capture images of the driver and then uses advanced algorithms of computer vision to detect his face and eyes. Rotation and tilting of the head and blinking of the eyes are detected as indicators of fatigue. The smartphones is used to assist driver using front and rear camera , for drowsy driving detection system, for the wavelet analysis of heart rate variability and a support vector machine classifier, and for identification of dangerous driving situations.

IV. MOTIVATION

The main aim and the motivation of this project is used to prevent drive from accident so that we are using eye blink technique Apart from eye blink technique, we also include heart beat sensors and temperature sensors. These eye blink technique will identify the driver is drowsy or not and the heart beat sensor and temperature sensor will check the heart rate and body temperature of the driver.

V. PROPOSED SYSTEM

The major cause of road accidents is happening due to the drunken drive, drowsiness and rash driving. To overcome these problems we go for efficient methods.

In this process, we are using different modules based on machine learning and IOT sensors. We are also using eye

blink techniques, image processing techniques, stress detection sensors, all these sensors and techniques are connected with the mobile app to alert to driver using machine learning and IOT.

Image processing based techniques as shown in fig. 1., drivers face images are used for processing so that one can find its states. From the face image one can see that driver is awake or sleeping. Using same images, they can define drowsiness of driver because in face image if driver is sleeping or dozing then his/her eyes are closed in image. And other symptoms of drowsiness can also detected from the face image. And for face detection we use fisher face algorithm. If the drowsiness occur then the techniques will trigger the alarm.

Fig. 1. Image Processing Technique.

The eye blink technique are connected to the camera. It will check the eyeball movement of the driver and clarify whether the driver is sleeping or not. If the eye blinks two seconds it knows the driver is not sleepy if the eyes of the driver are closed for 5 seconds the eye blink techniques will identify that the driver is sleeping and then the technique will trigger the alarm to make the driver conscious and the alarm will not stop until the driver became conscious.

Fig. 2. Eye Blink Technique.

For heart-beat sensor we used here infrared led diode and a photo transistor as shown in fig. 3. Heart beat sensor is designed to give digital output of heat beat when a finger is placed on it. When the heart beat detector is working, the beat IR LED flashes in accord with each heartbeat. This digital output can be connected to micro controller directly to measure the Beat Per Minute (BPM) rate. A fingertip placed over the sensor will act as a reflector of the incident light. The amount of light reflected from the fingertip is monitored by the photo- transistor. It works on the principle of light modulation by blood flow through finger at each pulse.

For temperature sensor we used here is LM35 as shown in fig. 4. We integrated this with the Microcontroller to measure the temperature. The micro controller will then read this measured value from the LM35 and translate into degrees Fahrenheit and Celsius, which we will be able to read from the Microcontroller to the LCD. The LM35 series are precision integrated-circuit temperature sensors, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature. The output of sensor converted to digital that easy connecting with micro controller.

Fig. 3. Heart-beat Sensor.

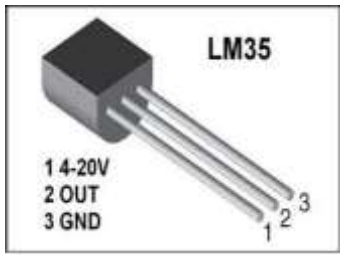

Fig. 4. Temperature Sensor.

VI. SYSTEM DESIGN

A. Algorithm for Driver Drowsiness

In this we using two algorithms, fisher face and convolution neural network (CNN). fisher face is used for face recognition and CNN is a deep learning algorithm which can take an input image and able to differentiate one from another. Here we use Python IDE which is an integrated development environment software used for coding tool and another one is Arduino IDE which is used to read input light on sensor and it gives output.

As shown in fig. 5. This module will aim at processing the acquired video images. The processing will target to detect the drivers face from the video stream; once the face is detected with the help of fisher face algorithm, the region of interest that is the eyes will then be located from the facial features. The state of the eye will then be computed using the pixel intensity difference and a threshold value. Then it detect drowsiness state like yawning, nodding, etc.. In this process if any drowsiness detection occur then it will immediately pass the buzzer.

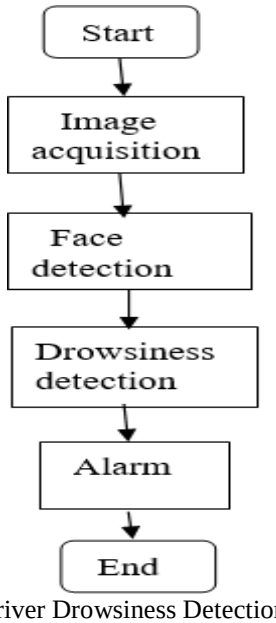

Fig. 5. Driver Drowsiness Detection Technique.

B. Algorithm for Stress Detection

In this we using two sensors as shown in fig. 6., heart beat sensor and temperature sensor. For heart beat sensor we use bright infrared led diode and a photo transistor to detect the pulse. For temperature sensor we use LM35 chip which is a temperature measuring device. Our normal temperature is 35 to 40 degree Celsius and heart beat is 60 to 90 beat per minute. So, here we set the normal and threshold value for both the sensors. The range of heart beat and temperature is up or down of that range then it will gives alert or buzzer to the driver. Both of this sensors are connected with arduino IDE. Here we also used ESP8266.

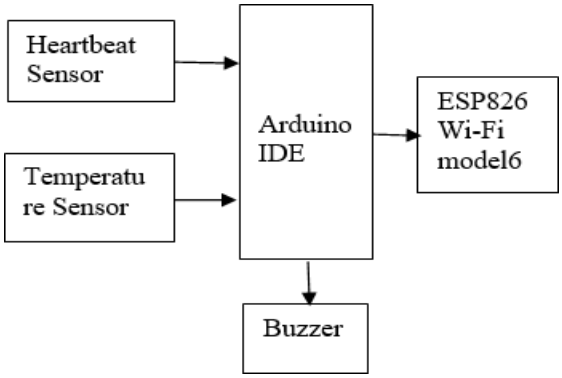

Fig. 6. Stress Detection Technique.

C. Buzzer

A buzzer or beeper is used for indicating drowsiness state to the driver. A buzzer is a signalling device, usually electronic, typically used in automobiles, household appliances such as a microwave oven, game show. The word ”buzzer” comes from the rasping noise that buzzers made when they were electromagnetically devices, operated from stepped down AC line voltage at 50 or 60 cycles. Other sounds commonly used to indicate that a button has been pressed are a ring or a beep.

VII. ADVANTAGES AND LIMITATIONS

System can be used in any type of vehicles to detect drowsiness of driver and to alert them. This system will help to prevent accidents and it will save many lives. Students can also use this system, while studying. Various organizations can use this system to keep watch on employees. For more accuracy, processor with higher processing power is required, which is costly, hence cost will be increase as accuracy increases. If multiple faces are detected by system, undesirable outputs are generated by system due to problem in detection of eyes.

VIII. RESULT

In this project we analysis experiment result based on the machine learning. The proposed framework gives more accuracy because of CNN i.e. convolutions neural network.

The CNN gives 90 percent and more accuracy for detecting of drowsiness detection. Also hardware setup analysis health measurement for detecting heartbeat and body temperature.

IX. CONCLUSION

About 20 percent of road accidents occur due to distraction of driver and health issues. Among that 30 percent is due to driver fatigue. There are many methods to monitor driver and there by alert him/her in case of distraction. This system is conducted to study various methods to detect the driver fatigue and to select an appropriate method to detect the causes of driver’s distraction. In order to reduce road accidents, we use the different sensor and buzzer to avoid the causes such as drowsiness, fatigue and heart problem to alert the driver.

As future work, we can use alarm, we can use automatic braking system which will reduce the speed of the vehicle. By using automatic braking system, first will reduce the speed of the vehicle and concurrently will turn on the parking lights. Using pressure sensor on the automatic braking system can be set in the case of drowsiness. Using CAN protocol if the vehicle is stopped in between it can be moved from one place to another.

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