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Research Paper

Intelligent vehicle black box using IoT

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Abstract

Millions of people die due to the accidents. The main purpose of this paper is to provide vehicle safety and a solution that automatically alert the driver to be cautious. In this paper we continuously monitor the vehicle performance using sensors and the behavior of driver with the use of IoT Technology. The Vehicle black box receives the information from various sensors like the breath analyzer, acceleration and the distance of surrounding vehicles along with push and panic button. When the driver alcohol consumption reaches maximum limit, the messages are sent to emergency contacts. If the accident occurs, by using GSM and GPS the vehicle location is traced and the information is sent to local hospital and police. With the IoT Technology, this location is always traced in the cloud platform service. The push and panic button is used to alert the 24/7 Governance to call out for emergency help.

Keywords: Vehicle Black Box, Sensors, Cloud, IoT Technology.

1. Introduction

1.1 Concept Orientation

IoT is an emerging technology in the field of communication. IoT devices are connected to the internet, through various wireless communication protocols. These devices are served Machine to Machine. With the developing IoT Technology, the devices are made to work in real time environment such as Home automation, Smart grids etc. To develop the huge platform the potential business is needed for the growth and improvement of the technology.

1.2 Motivations

According to the World Health Organization, million number of people are dying everyday due to accidents [1]. To solve the problem in many countries, where solution is being a raised with the help of vehicle Black Box. Despite of several campaigns the problem is still increasing day by day, such cases are drunk and drive, speed driving and insufficient sleep. Due to the constant work in recent times the automation must improve using IoT. This article will provide the visual data, and the cloud monitors it with the help of low power microcontroller. The article of this paper maintains two rules, first rule is to visualize data by detecting the sensors and the second is to present the data to the end users by simple method. The automation industry mainly levels the technology in the vehicles through high range with low power [2]. Vehicle black box update the data recording position tracking and the collision data always when the vehicle is in the active mode. So, in this way the crash collisions of the vehicles can be easily identified which is possible to help the victims from the governments or hospitals.
In India, according to Indian express the country recorded at least 4,80,652 accidents in 2016, leading to 1,50,785 deaths. The number suggests that at least 413 people died every day in 1,317 road accidents. Further breaking down the statistics, the data reveals that at least 17 deaths occurred in road accidents in 55 accidents every hour in the given time. The data analysis of accidents occurred in 2017 is given below in the Fig. 1.

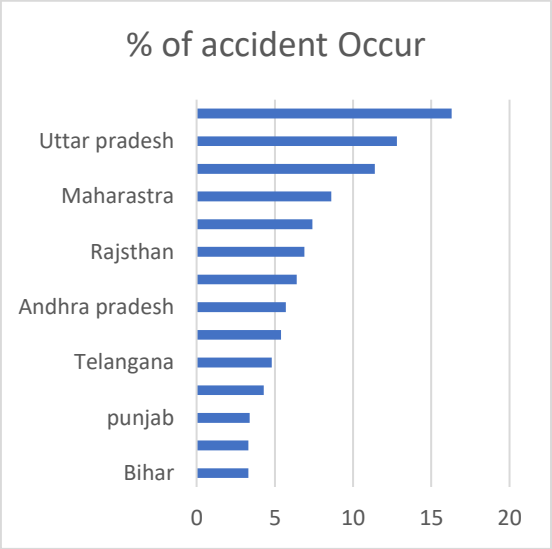


Fig. 1. Data analysis of accidents occur in 2017

2. Intelligent Vehicle Black Box system

2.1 Working principle

Most of the applications in the real time failed due to the over power consumption. In this Intelligent Vehicle Black Box using IoT, the controller for processing the sensors is consuming low power which opts for the real time applications [3]. Different sensors are used for the safety of the driver and merchants are breath analyzer, accelerometer and ultrasonic sensor. When the driver exceeds his levels

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of alcohol consumption, immediately the message is sent to the owner or the contact of vehicle authority. Using the system, the driver will be alert condition, not performing such activities. The ultrasonic sensor records the distance of the surrounding vehicles alert the driver, when it is about to collide. After the collision, the accelerometer simultaneously knows the tilt values and send the message along with the location using GSM and GPS. Push button is used to call out for help from the governance and the panic button is used to call help from the emergency contacts. The sensor values and location are sent to the cloud for the tracing purpose.

2.2 Hardware Development

With the development of the IoT Technology, the hardware is incorporated in the vehicles. The sensors used in these vehicles collect the data and send to the micro controlling unit. Whenever the accident occurs, or the driver consumes alcohol, immediately the message will be sent to the emergency contacts. In the vehicles, the energy consumption is very high, for this purpose, STM32 is used to serve the application for longer run [4]. The Methodology for Intelligent Vehicle Black Box using IoT is shown in the Fig. 2.

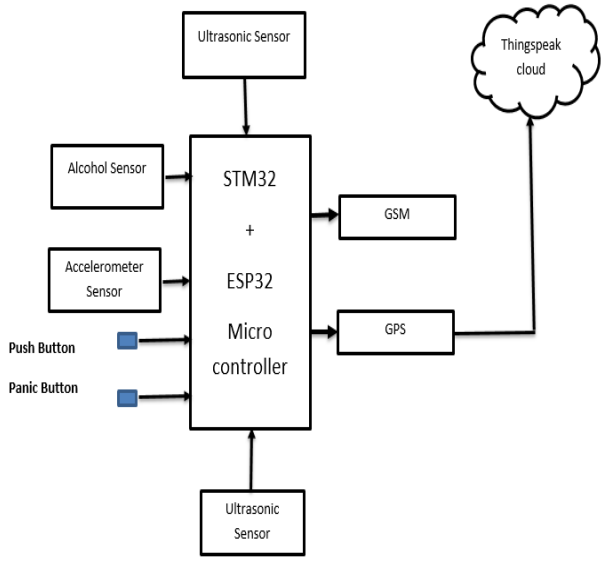


Fig. 2. System Design for Intelligent Vehicle Black Box using IoT

The description of various hardware components used in the Intelligent Vehicle Black Box using IoT are

A) Micro Controller:

STM32 is a 32bit RISC microcontroller used for this application. The STM32F103VET6 is a low power microcontroller with low - cost and strong performance used in most of the real time applications [5]. It works under the frequency of 72Mhz, the processor includes 64K SRAM, 512K FLASH. This micro controller can communicate by using five serial ports which contain a USB2.0 mode and an ethernet interface and a CAN bus. Using the temporary storage, the large number of data is collected with the SPI bus interface. Further, this processor analog to Digital converter(ADC) with 12-bit resolution and perform fast conversion full on up to 3.6V.

Using this Micro controller, additional Sensors are added to work with low power in the Real Time Applications are given below in the Fig. 3. With STM32 to send the data to the cloud ESP32[6] Micro controller is interfaced the Transmitter and Receiver of STM32.

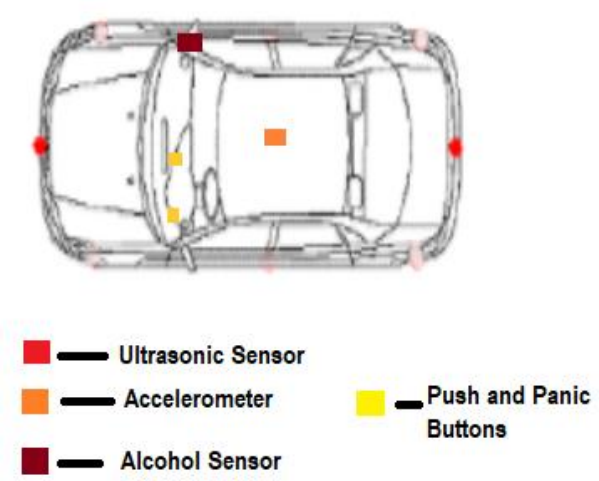


Fig. 3. Sensors used in the Vehicle

B) Ultrasonic sensor:

Ultrasonic sensor is designed for measuring the distance of certain obstacle that interrupts with the sonic sound. The senses convert the ultrasound waves to electrical signals and vice versa. The device gets evaluating values based on the target obstacle by receiving the Echo signals from sound waves. The transreceiver vibrate and process the ultrasonic waves that is transmitter continuously until it hits an object and those rays are reflected to the receiver. The distance or the interval between the signals sent and received is referred as time of flight(ToF).

C) Accelerometer:

Accelerometer is an electro mechanical device used to measure the acceleration of the object,it is the measurement of change in the velocity or speed divided by time [8]. In this application the accelerometer serves with a small device which is placed on the cars in its base position, if the vehicle tilt from its axis the accelerometer detects that the collision is occurred. This sensor always keeps on noticing the 3-axis x, y, z by the vehicle is shown in the Fig. 4.

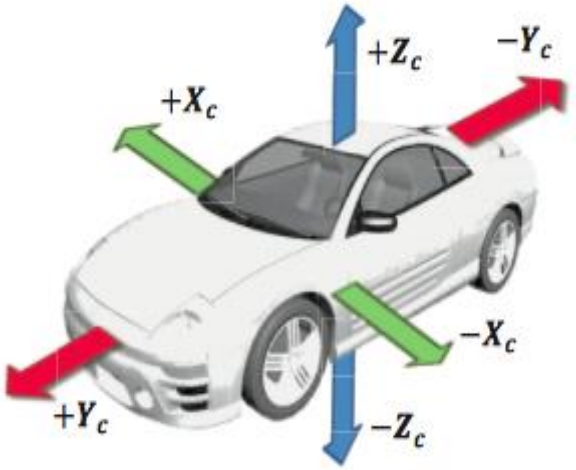


Fig. 4. Accelerometer axis in the Vehicle

D) Alcohol sensor:

Alcohol sensor is completely analog sensor which can detect the presence of alcohol gases with the concentration amount from 0.05 mg/L to 10 mg/L. The conductivity increases with the increase in the concentration of gases. Mq3 is the best module for detecting the alcohol glasses with low power and can easily interface with microcontroller, Arduino and Raspberry Pi. This sensor is commonly recognized as breath analyzer in our system.

E) Switch:

In this application we are using two switches, Push button and Panic button. The Push button is used to call the governance for the health purpose and the Panic button is used to send the messages and the location to the emergency contacts for that instant notification.

F) GPS:
GPS is the Global Positioning system used for location tracing commonly in real time applications [9]. The GPS consists of 4 pins in which two are for providing the power and the rest of the two pins are receiver and transmitter. The GPS module continuously receive the data from the satellite and transmits data correspondingly. This model can support up to 55 channels and works on the principle of triangulation method. In our application, the GPS tracks the latitude and longitude of the vehicle and sent to the cloud for ease tracking.

G) GSM:
Global system for mobile communication is a device used to send messages via SIM. GSM module consists of GSM/GPRS modem assembled together with the power supply and the communication interfaces. The working of the GSM module is purely on AT Commands. The MODEM is the soul of such modules. +When the GSM is connected to the microcontroller, the logical function of the sensors reaches the upper limit then the GSM activates to send the messages for the emergency contacts.

3. Operational Flow Design

The Operational Flow design is shown in the Fig. 5. and various states in which the system transition takes place, while performing the desired operation are described in following steps:

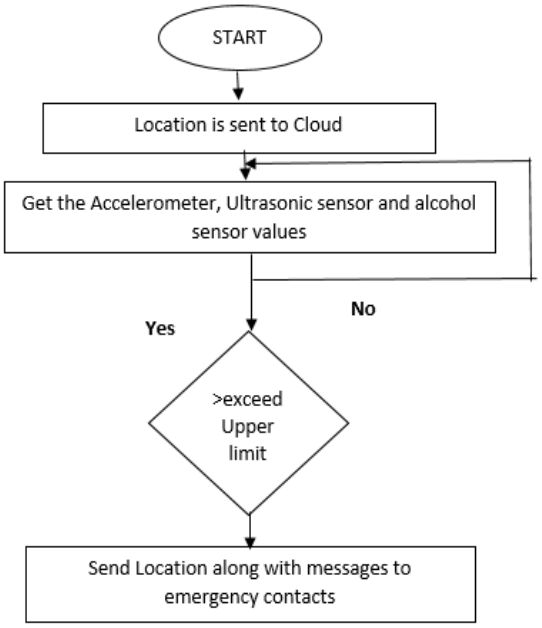


Fig. 5. Operational Flow chart for Intelligent Vehicle Black Box using IoT

Step-1: After the power supply provided in the system, the sensors starts initializing such as alcohol sensor, ultrasonic sensors and accelerometer.

Step-2: Using GPS, the location is always sent to the cloud

Step-3: If the front and back ultrasonic sensor find the distance of the surrounding vehicles nearer, then the vehicle driver becomes alert with the help of buzzer.

Step-4: Now, when these sensors exceed limit go to STEP-4.If not again go to STEP-3.

Step-5: If the collision occurred is noticed by accelerometer, immediately the message along with the location is sent.

Step-6: This message is send to the controller then the controller does three tasks simultaneously

a. Message will send to the given mobile number with the help of GSM Module along with location.
b. This location is stored in the Cloud.

4. Experimental Results

The hardware and Experimental results of the Intelligent Vehicle Black Box using IoT is shown is the Fig. 6.

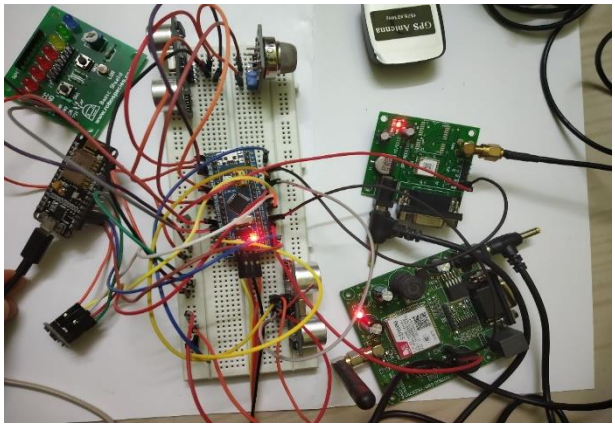


Fig .6. Hardware Setup of Vehicle Black Box

The data is sent to the Thing speak Cloud through the Serial monitor with the support of field data is shown in the Fig. 7., Fig. 8., and Fig. 9.



Fig. 7. Sensor Data in the Serial Monitor



Fig. 8.GPS Values are sent to the Cloud for tracing the location

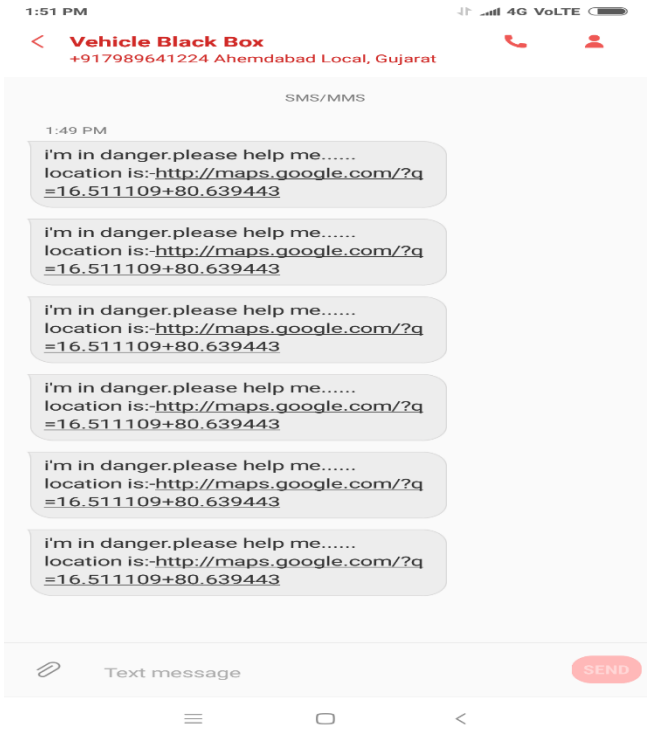


Fig. 9.SMS Sent along with the location

5. Conclusion and Future Scope

In this Modern era, IoT Technology is improving rapidly to help the issues mostly concern the world. This paper mainly focuses on alerting the driver from the Collision situations and using Cloud Computing Services, the location can be easily traced. Our contribution is that we proposed a low power micro-controller which can be used in the hardware implementation as its main controller in the automation of this device. with the meaningful support of the Embedded systems,IoT and Cloud computing, we strongly believe that Intelligent Vehicle Black Box using IoT will be reliable, power efficient in the real time applications.

In the Future scope the power can be almost decreased with the GPS and GSM modules which can easily integrated with the hardware along with a rechargeable battery and can serve the device in a longer period.

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