International Journal of Scientific Research in Science, Engineering and Technology
Print ISSN: 2395-1990 | Online ISSN : 2394-4099 (www.ijsrset.com)
doi : https://doi.org/10.32628/IJSRSET218416

Car Black Box System for Accident Analysis Using IoT

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Article Info
Volume 8, Issue 4
Page Number: 56-63

Publication Issue :
July-August-2021

Article History
Accepted : 02 July 2021
Published: 09 July2021

ABSTRACT

The car black box is used to analyse the cause of accidents like an airplane black box. This paper proposes a model of a car black box system which can be installed in the cars. The aim of this paper is to achieve accident analysis by tracking the working process of vehicles. In addition to this, the car black box system sends an alert message to the user mobile which is connected through Bluetooth module. The black box system also uses GPS sensor to collect the data location. The car black box system mainly helps the insurance companies to do car crash investigations and to record the road status to prevent or decrease death rates. This paper proposes a technique to monitor the vehicle performance and the behaviour of the driver using sensors with the use of IoT technology.
Keywords : Car black box, GPS sensor, Bluetooth module, ThingSpeak

I. INTRODUCTION

The World Health Organization (WHO) says that every year millions of people demise due to vehicle accidents. To prevent this, the car black box system is introduced. Like black box in flight, the car black box technology can play a vital role in vehicle crash investigations. Hence it is significant to have recorders which will track all the activity in vehicles during and after accident or crash. This car black box system is mainly classified into two sections. First section detects and collects the information from the vehicle, and it is implemented using various type of sensors [1]. Second section presents the data to the user in simplified way, and it is implemented by using the Node microcontroller (MCU) which is programmed to record the data and to retrieve the data from the Node MCU. If any vehicle crashes, the geographical co-ordinates or location is sent to the pre-stored mobile number to seek help [2]. The investigators can use this recorded data obtained from the car black box to identify the actual reason of the accident.

The black box will give the input about soundness of vehicle and accidents/mishaps and information including the vehicle's mechanical and electrical status [3]. The black box will give the moment criticism for any physical oddities and will provide the war room access to the information on the black box. The black box can be utilized by Field Technician Soldiers, and Command Centre specialist to analyse and fix any issues that may emerge while out on the field or at command post [4]. A data investigator can utilize the black box to decide the reason for the mishap and give approaches to forestall a future mishap.

Field professionals and travellers in the vehicle can utilize the black box on the field to decide vehicle status[5]. At the command centre, mechanics and investigators will utilize the black box to recognize any irregularities with the vehicle, to record ordinary activity information, and to decide the reasons for mishaps if any ought to happen[6].

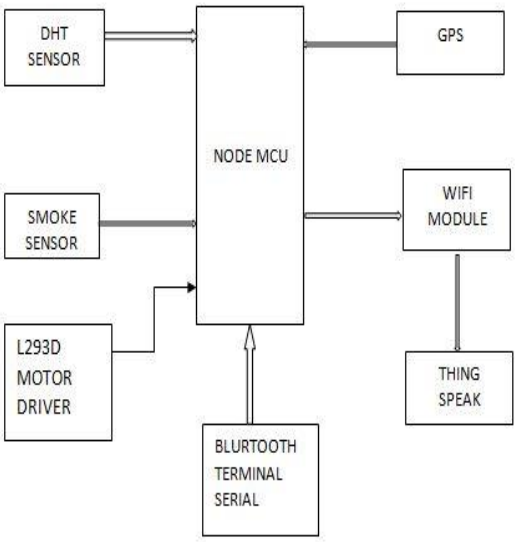

Fig.1 Block diagram of car block box system

II. PROPOSED SYSTEM

In the car black box system, mainly three sensors are used, viz., temperature sensor, humidity sensor and smoke sensor. The input to the microcontroller is analog data and the fundamental capacity of the microcontroller program is to take input tests from various ports. These inputs can be taken from the sensors introduced in the vehicle. To control all the inputs of the sensor, digital process is introduced[7]. After that, every sensor test is spared into the microcontroller's EEPROM. This data is converted by the microcontroller to the digital format and then this data is shown on the android phone via Bluetooth module. Fig.1 Shows the block diagram of a car block box system.

The GPS (Global Positioning System) is a fast-growing technology, which provides flexibility to positioning of surveying and navigation of data captured. The GPS provides continuous positioning of the data throughout the day. Once the position of the user is determined, the GPS calculate other useful data such as speed, trip distance, distance to the destination etc. When any accident occurs, the GSM will send SMS on the mobile number which was stored earlier. Fig.2 Shows the flow chart for the car block box system.

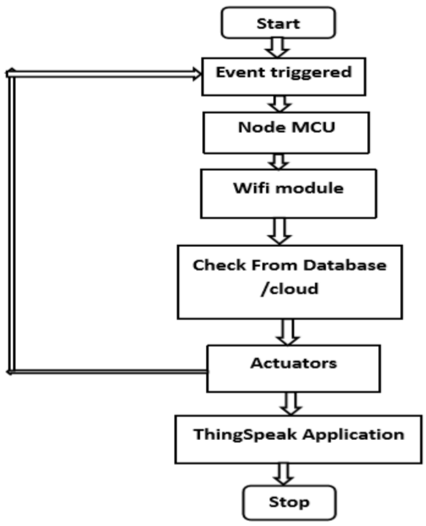

Fig.2 Flow chart for the car block box system

III. SENSORS IN CAR BLOCK BOX SYSTEM

The temperature of the vehicle can be detected using the temperature sensor. This sensor mainly detects two types of temperatures such as: abnormal temperature and engine temperature. L293d Motor Driver works on the concept of H-bridge. H-bridge is a circuit which enables the voltage to be flown in either direction.

The proposed system uses sensors to collect the data of the parameters which is required to analyse the accident. The important parameters are temperature, humidity, location i.e., latitude and longitude, and smoke sensor. The sensors used are:

3.1 DHT11 SENSOR:

The DHT11 temperature and humidity sensor is shown in Fig.3. and it has calibrated digital signal output with the temperature and humidity sensor complex. Its technology ensures the high reliability and excellent long-term stability. A high-performance 8-bit microcontroller is connected. This sensor includes a resistive element and a sense of wet NTC temperature measuring devices. It has excellent quality, fast response, anti-interference ability and high-cost performance advantages.

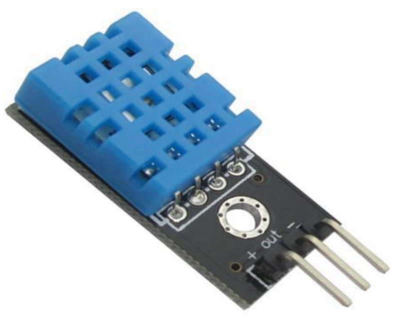

Fig.3 DHT11 sensor

Each DHT11 sensors features extremely accurate calibration of humidity calibration chamber. The single-wire serial interface system is integrated to become quick and easy. Small size, low power, signal transmission distance up to 20 meters, making it a variety of applications and even the most demanding applications. The product is 4-pin single row pin package. Convenient connection, special packages can be provided according to users need.

Table1. Sensor specifications

Specifications	Ranges
Supply Voltage	+5 V
Temperature range	0-50 °C error of ± 2 °C
Humidity	20-90% RH ± 5% RH error
Interface	Digital

3.2 GPS:

The GPS consists of a collection of 24 satellites which carry atomic clocks that are synchronized to each other and to ground clocks. Any change in time maintained on the ground is corrected at regular intervals of time. Likewise, the locations of the satellites are monitored precisely. GPS receivers also have—however, they are not synchronized with true time, and are less stable.

GPS satellites transmit their current time and position continuously. A GPS receiver monitors a minimum of 4 satellites and solves equations to locate the receiver and its deviation from true time. Each GPS satellite continuously broadcasts a signal (carrier frequency with modulation) that includes:

A pseudorandom code (sequence of ones and zeros) that is known to the receiver.By time-aligning a receiver-generated version and the receiver-measured version of the code, the time of arrival (TOA) of a defined point in the code sequence, Called an epoch, can be found in the receiver clock time scale.

A message that includes the time of transmission (TOT) of the code epoch (in GPS system time scale) and the satellite position at that time.

3.3 SMOKE SENSOR (MQ-135):

Air quality sensor for detecting a wide range of gases, including NH3, NOx, alcohol, benzene, smoke and C02. This is ideal for use in office or factory. MQ135 (Fig.4) gas sensor has high sensitivity to ammonia, sulphide, and benzene steam, also sensitive to smoke and other harmful gasses. It is with low cost and particularly suitable for air quality monitoring applications.

Fig.4 MQ-135

3.4 SENDING SENSOR DATA TO CLOUD VIA WIFI MODULE

The next step is interfacing of wifi module with the Arduino. This is done to access the sensed data from the sensors to the cloud. ESP2866 wifi module is low cost standalone wireless transceiver that can be used for end-point IoT developments. ESP8266 WiFi module enables internet connectivity to embedded applications. It uses TCP/UDP communication protocol to connect with server/client. Microcontroller communicates with the module using a set of AT commands. Microcontroller communicates with ESP8266-01 WiFi module using UART having specified Baud rate. ThingSpeak is a software that can monitor the data and can control the system over the Internet from anywhere, using the Channels and webpages provided by ThingSpeak.

ThingSpeak 'Collects' the data from the sensors, 'Analyze and Visualize'the data and 'Acts' bytriggering a reaction. This project is based on serial communication for fetching data from the sensors. First Arduino sends a start signal to sensor and then it gives a response signal with containing data. Arduino collects and extracts the data and then send it to 16x2 LCD and ThingSpeak server. ThingSpeak displays the data in the form of graph.

IV. THINGSPEAK CLOUD FOR CAR BLOCK BOX SYSTEM

ThingSpeak (Fig. 5) is an internet of things (IOT) platform that lets you collect and store sensor data in the cloud and develop IOT applications. ThingSpeak IOT platform provides apps that analyse and visualize data in MATLAB, and acts on it. Internet of things (IOT) describes an emerging trend where many embedded devices (things) are connected to the internet. These connected devices communicate with people and other things and often provide sensor data to cloud storage and cloud computing resources where the data is processed and analyzed to gain important insights. Cheap cloud computing power and increased device connectivity is enabling this trend.

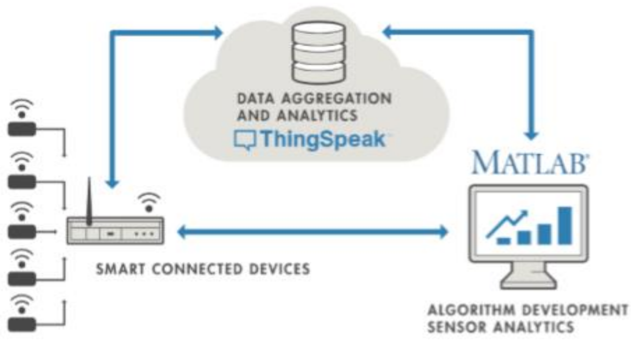

Fig.5 Thingspeak Cloud

IoT solutions are built for many vertical applications such as environmental monitoring and control, health monitoring, vehicle fleet monitoring, industrial monitoring and control, and home automation.

At a high level, many IoT systems can be described using the diagram below:

The smart devices like the “things” in IoT that live at the edge of the network. These devices collect data and include things like wearable devices, wireless temperatures sensors, heart rate monitors, and hydraulic pressure sensors, and machines on the factory floor.

In the middle, the cloud where data from many sources is aggregated and analyzed in real time, often by an IoT analytics platform designed for this purpose. The right side of the diagram depicts the algorithm development associated with the IoT application. Here an engineer or data scientist tries to gain insight into the collected data by performing historical analysis on the data.

In this case, the data is pulled from the IoT platform into a desktop software environment to enable the engineer or scientist to prototype algorithms that may eventually execute in the cloud or on the smart device itself. An IoT system includes all these elements. ThingSpeak fits in the cloud part of the diagram and provides a platform to quickly collect and analyze data from internet connected sensors.

V. HARDWARE REQUIREMENTS

5.1 L2935 MOTOR DRIVER

A dual H-bridge motor driver integrated circuit (IC L293D) is shown in Fig.6. Motor drivers act as current amplifiers since it’s input is a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors.

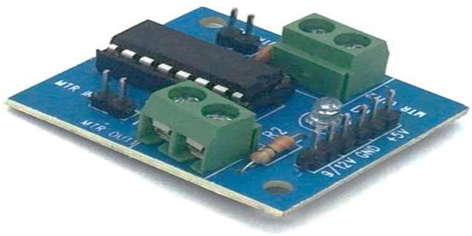

Fig.6 L2935 Motor driver

L293D contains two inbuilt H-bridge driver circuits. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction. The motor operations of two motors can be controlled by input logic at pins 2 & 7 and 10 & 15. Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively.

Enable pins 1 and 9 (corresponding to the two motors) must be high for motors to start operating. When an enable input is high, the associated driver gets enabled. As a result, the outputs become active and work in phase with their inputs. Similarly, when the enable input is low, that driver is disabled, and their outputs are off and in the high-impedance.

Most GPS receivers have an antenna built into them. The two most popular types of antennas used in GPS receivers are "patch" and "quadrifilar helix" or "quad helix" for short. This page addresses external GPS antennas which are normally used when stronger satellite signals are needed. Many models are mounted magnetically to the roof of a vehicle. Models that are made for buildings are often mast-mounted. Most models are available with a wide range of connectors for all the various GPS receiver antenna jacks.

5.2 GPS SMART ANTENNA

Fig.7 GPS Smart Antenna

The necessity of an external GPS antenna includes the use in a vehicle where the GPS receiver cannot or will not be placed near a window, when vehicle is hiking under heavy tree cover or in canyons and to use in urban canyons (tall buildings). To minimize temporary loss of signal when in a vehicle in motion and to maintain the best possible accuracy by having a lock on the greatest number of satellites the GPS can be used.

VI. RESULTS AND DISCUSSIONS:

The sensing part of all the car black box is being measured using appropriate sensors. The sensed data is being stored in the database using ThingSpeak software and also a comparative analysis is done on the parameters based on the sensor data.
The images obtained from car black box in ThingSpeak:

Fig. 8 gives the information about the temperature.

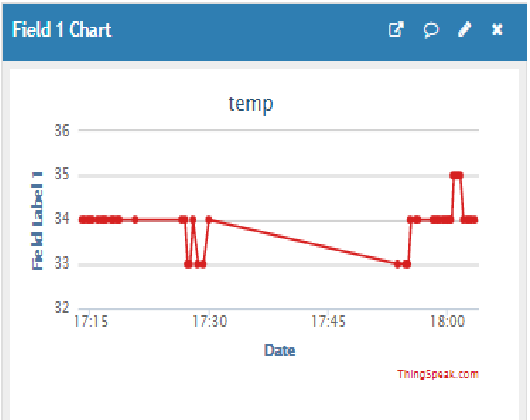

Fig.8 Temperature Reading

Fig. 9 gives the information about the humidity.

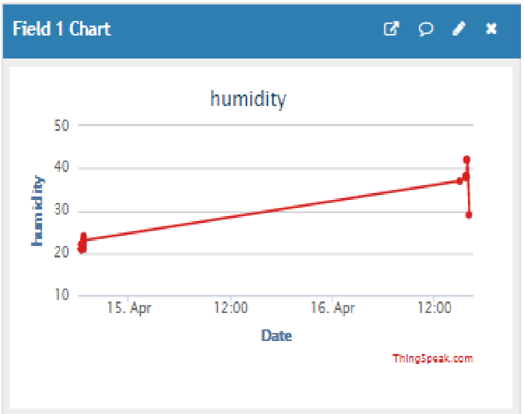

Fig.9 Humidity Reading

Fig. 10 Shows the working car model for car black box system.

Fig.10 Working Hardware Model

Fig. 11gives the information about sensors on a Bluetooth based application.

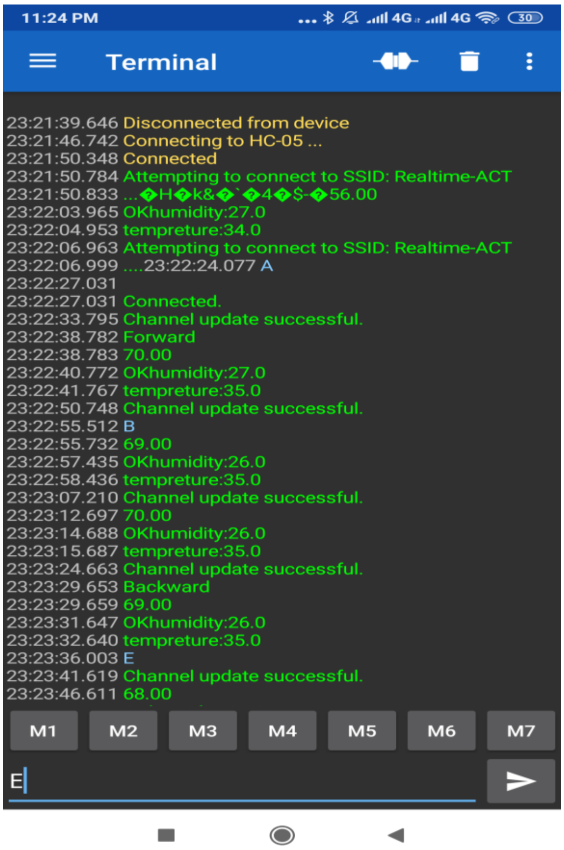

Fig.11 Bluetooth Terminal Output

VII. CONCLUSION

The proposed system will provide important information at the time of any accident. When any type of accident will occur due to any reason, the car black box system provides necessary data to generate the report of accident and its cause. This paper offers a user-friendly program to analyse the data of the accident. This car black box system can be implemented in any vehicle. As soon as the driver runs or start the vehicles the system will start collecting data from all the sensors along with date and time. The data stored in the memory can be retrieved after the accident using ThingSpeak cloud.

VIII. FUTURE SCOPE

The present framework can be improved to check different parameters like fuel level, tyre pressure and working of headlight before starting the vehicle. Also, basic parameters like camera on front and posterior which continue recording live pictures and storing them in the memory. This video data will be most valuable piece of information during accident examination.

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Cite this article as :

Karthika M, Anitha A, "Car Black Box System for Accident Analysis Using IoT", International Journal of Scientific Research in Science, Engineering and Technology (IJSRSET), Online ISSN : 2394-4099, Print ISSN : 2395-1990, Volume 8 Issue 4, pp. 56-63, July-August 2021. Available at doi : https://doi.org/10.32628/IJSRSET218416
Journal URL : https://ijsrset.com/IJSRSET218416