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Black Box For Automobiles

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Abstract - *Vehicular accidents are on the surge in a developing country such as ours. Majority of these accidents happen due to carelessness of the driver while checking the car statistics, or not checking them entirely. Also a lot of accident cases are open ended, as the justice architecture can't find the root cause of the accident. The system proposed here acts as a black box for automobiles. Black box is a device commonly used in airplanes for accident analysis and safety measure purposes.*

The black box prototyped in this research paper is a modified version of the tradition black box. It doesn't only store event data in the light of a fatality or an accident but also provides with live statistics of the car details through an application interface on a mobile phone. A traditional black box system requires a box with all the sensors physically connected to car, but by using the OBD-II technology, we overcome the problem of fitting every car with new sensors and can directly use the technology present in one's car.

Outcome of this research is a physical box which can store data up to 10 minutes before an accident to analyze what went wrong as well as an application which provides live updates to the driver if there's any issue with the automobile which in case can avoid any fatal accidents with live GPS tracking.

Key Words: Automobiles, Black Box, Live Tracking, Application interface, OBD- II

1.INTRODUCTION

Each year, 1.35 million people are killed on roadways around the world [4275]. Some of these accidents can be prevented by just being more cautious while driving. Also these accidents cause various roadblocks in the way of insurance companies legalizing the case and deciding whose fault the accident actually was. Police investigation also sometimes takes a while in finding the root cause of the problem.

The system proposed in this research paper solves majority of these problems. As automobiles aren't as complicated as airplanes, detecting flaws in automobiles is much more easier than finding flaws in an airplane crash. The system proposed doesn't only act as an event data recorder but also as a live feedback information system providing information regarding various stats of the car provided by the OBD (On-Board Diagnostics) port. As OBD port is a built-in feature in cars, this system is much more widely approachable as it can be used in already existing cars as well as newer models. The police as well as the insurance companies can use the black box as potential evidence for the investigation of crashes.

The live car updates are provided to the user through an application built for that specific use case. We also have a built in GPS module which gives the accurate location of the car and updates the application with live location.

A microcontroller is used as the system to process and display the data, as OBD port is only used for scanning the data present as well as read the GPS module and store the information in the memory card. A memory card is used for storing the data in case of an unexpected event or a crash.

The proposed block diagram here gives us a rough idea of the components used in the system as well as the general flow of the system. The GPS module sends data to the Arduino (Microcontroller), there's a complete duplex solution between the OBD port and the Arduino. The data is sent to the server so that it can send the live data to the application and is sent to the memory card to store the data when the system is being used as an event data recorder.

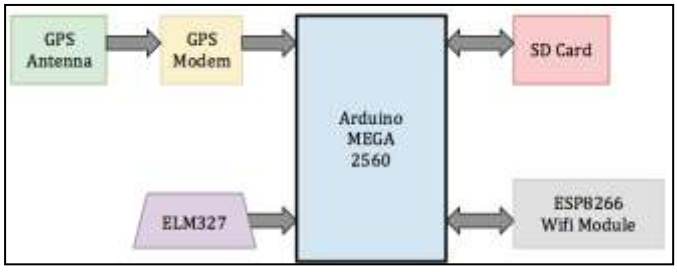

Fig - 1: Proposed Block Diagram

2. HARDWARE RESOURCES

This section shows the various hardware components used in the system. The block diagram shows all the system flow of various components, to the centre microcontroller which is arduino mega. The various components used are as follows:

2.1 Microcontroller (Arduino Mega)

The Arduino mega is the bigger version of Arduino UNO. It is a microcontroller based on At Mega 2560. It is designed for projects requiring more I/O lines, more RAM and more sketch memory. This microcontroller is used as the central hub in the system as it interacts with every component of the system. To describe the system circuit, the GPS module uses 4 lines, the Bluetooth chip uses 5 lines, the SD card reader uses 6 lines and the Wi-Fi module uses 8 lines.

Fig- 2: Arduino Mega 2560

2.2 ELM327 OBD Bluetooth Adapter

ELM327 is a Bluetooth device, which uses the OBD port present in the car as the input device and scans all the present data of the given automobile. The ELM327 adapter connects with the microcontroller with help of Bluetooth and transmits the given data to the microcontroller, which further works on the data. This Bluetooth adapter converts the known OBD-2 protocols into a serial data communication, which communicates with the Arduino.

Fig- 3 ELM 327

Fig- 4: SD Card Module

2.3 SD Card Module

The SD card module interacts with the Arduino to receive data and store the data in the SD card. It allows the Arduino to communicate with the SD card, as it is an important part of the system as it is crucial for the system to act as an event data recorder.

2.4 Bluetooth Module

The module HC-05 is used for the Bluetooth communication of the system as required by the ELM connector to transfer the signals via Bluetooth to the microcontroller. HC-05 supports full duplex communication to the system and add much functionality to the system. It has a 2.4 GHz radio transreciever and baseband.

Fig- 5: HC-05 Module

2.5 GPS Module

The NEO-6M GPS module used in the system is a global position system module, which provides accurate location of the system it is installed in. The GPS module in our system is interfaced with the Arduino microcontroller and provides real time location tracking to the board. Our system also has an antenna extender used in conjunction with the module to extend its signal.

Fig- 6: GPS Module

2.6 Wi-Fi Module

The ESP8266 is a low-cost Wi-Fi microchip, with a full TCP/IP stack and microcontroller capability. This Wi-Fi module is used in our system so that the microcontroller can interact with the servers, which sends the data to the host application.

Fig- 7: ESP8266 Wi-Fi

3. SOFTWARE RESOURCES

3.1 Arduino IDE

Arduino IDE is an open source IDE that is primarily used for writing and uploading codes on any Arduino certified board and can be used in various environments. We used this IDE to upload the final code on the Arduino mega microcontroller.

3.2 Android Studio

Android studio is the platform used here to develop an application for the live updates of the car sent by the microcontroller via Wi-Fi Module. Android studio is an open source platform and can be used by anyone to create an android application.

3.3 Firebase Database

The Firebase Real-time Database is a cloud-hosted NoSQL Database that lets you store and sync data between your users in real-time. This database is being used by us to store the data coming from the car, which is then extracted by the android application.

4. RESULTS

4.1 Hardware Implementation

By connecting all the hardware components we make the system function as required by us. The system can be encompassed in a 3D printed box in order to fit in a car. The picture depicted here, is of the circuit bare assembled without being assembled in the black box mould. The hardware has a SD card installed, which is used to store the information locally and can store up to 10 mins of previous data.

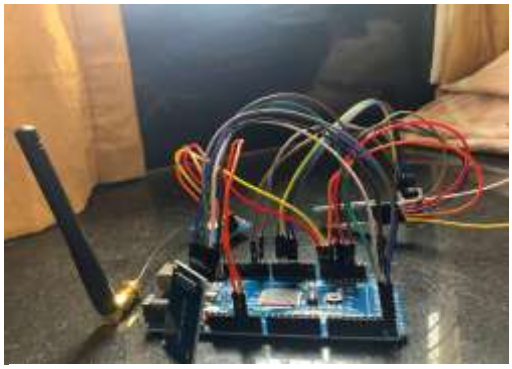

Fig- 8: Hardware Implementation (Black Box)

4.2 Application

The application presents the second aspect of the system: Live tracking. Once the information is stored in the SD card the Arduino uses the Wi-Fi module to transmit the data to the firebase server from where the info can be accessed by the application. The image shown here is of the application running on a mobile phone simulator.

5. CONCLUSIONS

The system is successfully implemented using a microcontroller and a universally accepted and already available protocol (OBD-2). One can easily get notified if anything is wrong with the vehicle itself as well as the system can be helpful in data recording in case of a tragic accident.

Black box (also called as EDR) has gained significance importance in aircrafts with its help in investigation of the accident. In its implementation of automobiles, by recording the events and actions of the driver including speed, braking, turning, etc. seconds before the collision, the car black box will undoubtedly help both the police and insurance companies in reconstruction of the events during the accident.

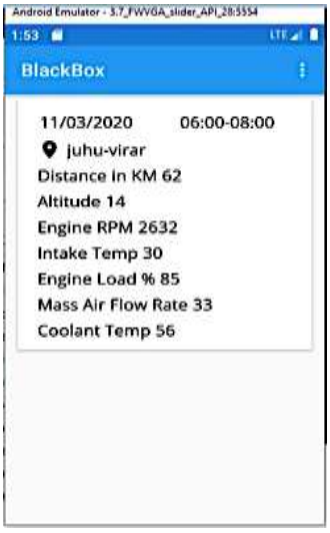

Fig- 9: Application Interface

This being a modified version of a black box, will also help us get live telemetric in daily use of the vehicle.

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