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Black Box for Vehicle Dynamics - After Analysis App

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Abstract: *Across the world, Vehicle accidents are quite common on roads. It's just that they vary in numbers from place to place. Those who are involved in an accident might get into an argument and/or seek in-court settlements. There are many accidents that are left unjustified. Car Black Box has been proven indispensable in improving car safety, reliability. We are designing the flight data recorder for car accident mishap information in real time. This project brings in the scientific methodology and logs in the vehicle dynamics data in the black box. It is a system that continuously records all the parameters of cars working conditions and its environment and transfers the information into an SD card. The data also includes violations noticed by the signal pole. Apart from logging the data, this project also notifies Police about the vehicle information and a video recording containing the time of accident. In addition to this a java app is developed that performs an analysis on the accident involved data cards to figure out which events and violations have resulted in such accidents. The report could be used as credible proof in the court of law.*

***Keywords**: Iota, MQTT, Publisher, Subscriber, Dispatch*

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I. Introduction

Black Box- it's not something new to our ears. David warren has introduced this to us first in the year of 1985. And we've also been seeing its applications. Why did we choose this today? According to the World Health Organization, more than a million people in the world die each year because of transportation-related accidents. These accidents are occurring either with the knowledge of the driver or without the knowledge of the driver. In order to react to this situation, the black box system draws the first step to solve problem. Like flight data recorders in aircraft, Black Box technology can now play a key role in motor vehicle crash investigations. A significant number of vehicles currently on the roads contain electronic systems that record in the event of a crash. This system is mainly committed to two sections. The first one is how to detect and collect the information from the vehicle. The second is how to present the data to the user in a simplified way. To implement the first section many components and various types of sensors are used. The second section is implemented by using the Embedded C programming and java. The important data that is needed after the accident: Belt status, Lane detection, Driver's alertness, etc.

II. Proposed Project

The main idea of our project is to interface the sensors such as reed, distance, eye blink, magnetometer and impact to collect the specified readings from the vehicle which will be written onto the SD card simultaneously. The camera module runs in the background doing its work of clicking pictures and once the impact sensor detects abnormalities its value changes and at this stage the camera module transfers the picture onto the webpage alongside the SD card stops writing further information. The officials can then collect the Black Box and retrieve the data from the SD card. With the help of After analysis app the culprit can be found. Even the signal pole violation message will be sent to the car driver in case he violates a red signal using MQTT. The following block diagram depicts our project.

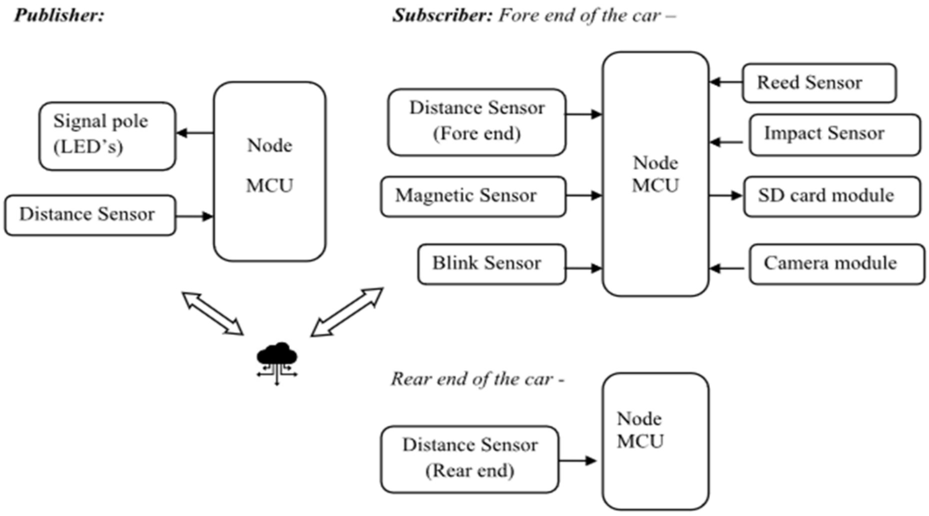

Fig: Block Diagram of Black Box designing

HARDWARE AND SOFTWARE RESOURCES

The hardware part consists of the components and the sensors used in the black box system. This part mainly collects the status of the sensors and stores it into SD card.

1. NodeMCU: NodeMCU is an open source IoTplatform.It includes firmware which runs on the ESP8266 Wi-Fi Source code from Espressif System and hardware which is based on the ESP-12 module.The term "NodeMCU" by default refers to the firmware rather than the dev kits. The firmware uses the Lau scripting language. It is based on the eLua project, and built on the Espressif Non-OS SDK for ESP8266. It uses many open source projects, such as lua-cjson, and spiffs.

Fig1.1 NodeMCU

Fig 1.2 Impact Sensor

2. Impact sensor: This sensor is used to detect a collision. They contain an object that will move, like a roller or a spring, and something that holds that object (somewhat weakly) in place, like a spring or a magnet. If the car suddenly stops, the roller or ball will keep going forward and contact a switch, which tells a computer, the airbag control module, to deploy the airbag. The spring or magnet holds the roller or ball back so that it doesn't activate the switch in normal deceleration situations – like when you hit your brakes hard.

3. Distance sensor: The ultrasonic sensor is to measure the minimum distance in front of the vehicle Ultrasonic sensors work on a principle similar to radar or sonar which evaluate attributes of a target by interpreting the echoes from radio or sound waves respectively. Ultrasonic sensors generate high frequency sound waves and evaluate the echo which is received back by the sensor.

Fig 1.3 Distance Sensor

Fig 1.4 Magnetometer Sensor

4. Magnetometer sensor: HMC5883L is a 3-axis magnetometer which is used for measuring the direction and magnitude of the Earth's magnetic field. It is used for low cost compassing and magnetrometry. It measures the Earth's magnetic field value along the X, Y and Zaxes from milli-gauss to 8 gauss. It can be used to find the direction of heading of the device. It uses I2C protocol for communication with microcontroller.

5. Reed sensor: Reed switch is a kind of passive electronic switching component with contacts with a simple structure, small size and easy to control. It consists of a sealed glass envelope where there are two ferrous elastic reeds and is filled with inert gas called rhodium. Normally, the two reeds are separated in the envelope. When a magnetic substance approaches to the glass envelope, the reeds will come together due to the magnetic field thus completing an electric circuit. When the external magnetic field disappears, two reeds will be separated because of their elasticity, the circuit is also disconnected.

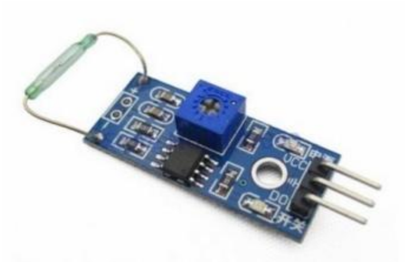

Fig 1.5 Reed Sensor

6. Blink Sensor: The Eye Blink sensor is IR based. The Variation across the eye will vary as per eye blink. If the eye is closed means the output is high otherwise output is low. This to know the eye is closing or opening position, this output is give to logic circuit to indicate the alarm. This can be used for projects involving controlling accident due to unconsciousness due to blinking of eyes.

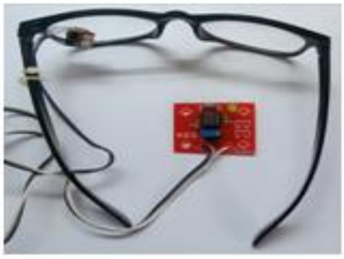

Fig 1.6 Eye Blink Sensor

Fig 1.7 Mini Spy Camera with Trigger

7. Camera Module: The Mini Spy Camera is smaller than a thumbnail with a high enough resolution to see people or whatever it is you're looking for. It's fairly high resolution (480p video and 1280x720 photo) module, with a driver board that is about 1 square inch in size, with a microSD card holder. The image module is about the size of a cell phone camera - the body being just 6.2mm x 6.2mm - and has a stick-on back so it's easy to mount in a doorbell or behind a teddy bear's eye (might as well be creative). There's a power LED and an 'activity' LED that lets us get to know what it's doing.

7. SD Card Module: The Arduino SD Card Shield is a simple solution for transferring data to and from a standard SD card. The pinout is directly compatible with Arduino, but can also be used with other microcontrollers. It allows you to add mass storage and data logging to your project. In this project we have two SD cards one for taking values from the sensors and the other for the camera which is capturing pictures and videos. In After analysis app these SD cards play a major role.

After the hardware part of the Black Box system, it is now time to look at the software details. For the software implementation, we deploy two software packages. First is the Arduino IDE 1.8.4. We use Embedded C to program and interface the NodeMCU with other hardware components. We used MQTT protocols for communication and information transfer. We often come across terms like publisher and subscriber while using MQTT. Publisher and subscriber are nothing but the hardware component arrangements made for Signal pole violation and the Black box system respectively. Signal pole and the vehicle| driver are connected to the same broker and topics. When a vehicle jumps a signal, the signal pole detects the violation and publishes messages. The subscriber that is the vehicle receives this message in the call back loop of the MQTT. The message is read from there and sent into the SD card.

III. Result

The sensors values are written onto the SD card until there is an accident. The camera continuously clicks the pictures and once the accident occurs it posts the last taken pictures onto the webpage which can be accessed by the police and hospital services. With the help of MQTT the driver gets alert messages if he has committed any red signal violation. The After analysis app helps in identifying the actual culprit of the accident by comparing the SD card values of both the vehicles.

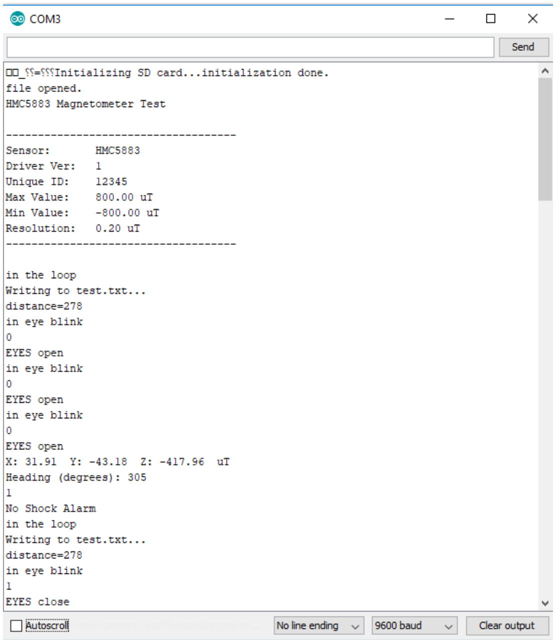

Fig 1.9: Information written onto SD card

IV. Conclusion

The main purpose of this paper is to develop a prototype of Black Box for vehicle diagnosis that can be installed into any vehicle. This can contribute to construct safer vehicles, improving the treatment for crash victims, helping insurance companies with their vehicle crash investigations, and enhancing road status in order to decrease the death rate. Use of GPS module with this system will be helpful in finding the accident location and take quick rescue operations. Another useful add-on to the present system could be the cameras on front and backsides which keep recording live images and videos storing them in memory would be able to transfer the whole video t the webpage.

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