Automobile Black Box System for Accident Analysis

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Abstract– Automobiles and computing technologies are creating a new level of data services in vehicles. The Automobile Black Box has functions similar to an airplane black box. It is used to analyze the cause of vehicular accidents and prevent the loss of life and property arising from vehicle accidents. This paper proposes a prototype of an Automobile Black Box System that can be installed into vehicles. The system aims to achieve accident analysis by objectively tracking what occurs in vehicles. The system also involves enhancement of security by preventing tampering of the Black Box data. In addition, the Black Box sends an alert message to a pre-stored mobile number via Short Message Service (SMS) in the case of occurrence of an accident.

The proposed system makes use of 4 sensors to record the various driving data parameters. The Raspberry Pi controller (RPi) and Atmega controllers are used to regulate these sensors. The data received from the sensors are stored on the SD card mounted on RPi for retrieval after the accident and at the same time the values are uploaded to the cloud. The system uses external sensors Global Positioning System (GPS) to collect location data.

Keywords – Black Box, Microcontroller, Global Positioning System (GPS), Global System for Mobile Communication (GSM)

I. INTRODUCTION

According to the World Health Organization (WHO), more than a million people in the world are losing their life each year because of transportation-related accidents [1]. To address this problem black box takes on the role of the investigator to determine the cause, thereby helping to propose measures to protect lives. The system also assists the insurance companies with their claim settlements [2]. The importance of such system drove the European Union (EU) to establish a policy that makes it mandatory for all vehicles to be equipped with black boxes [3]. The Automobile Black Box exists partially in the form of Event Data Recorders (EDRs) and black boxes [4][5][6][7]. It is difficult to establish the exact cause of an accident from these [1]. To overcome this shortcoming, an Automobile Black Box system that combines both of these aspects is proposed.

Apart from the accident analysis by objectively tracking what occurs in vehicles, the proposed system sends short message indicating the position of vehicle by GPS system to family member, emergency medical service (EMS) and nearest hospital so that first aid can be provided as early as possible [8].

The proposed system also incorporates a security module, which employs data encryption to secure the stored data on the SD card [9]. The system aims to achieve accident analysis by strategically placed sensors, in and around the vehicle.

II.OVERVIEW

The schematic of the Automobile Black Box System is shown in Figure 1.In this system the EDR measures the various parameters of the vehicle and security system provides an alert message inaddition it gives the location of the car to central unit.The central unit receives these values and upload to the cloud. The central unit is a raspberry pi which collects the values from event data recorder and security system and upload these values to cloud in real time.

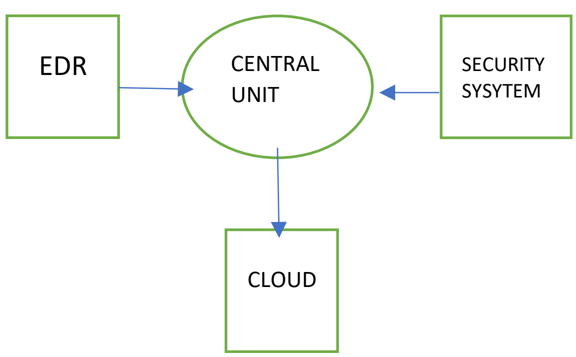

Figure1:Schematic diagram of automobile blackbox

The Block diagram of the Automobile Black Box System is shown in Figure 2. Raspberry Pi,Atmega32A and Arduino controllers are the main components of the system. They regulate the various sensors interfaced to them.

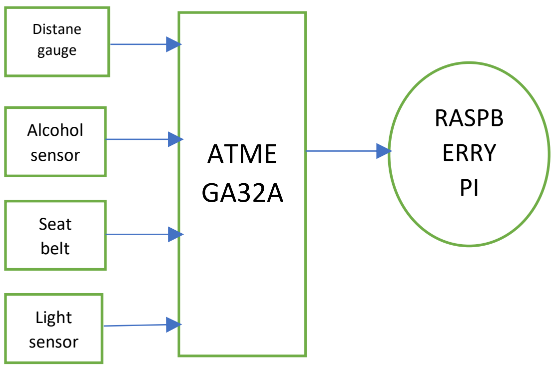

Figure2.1:EDR

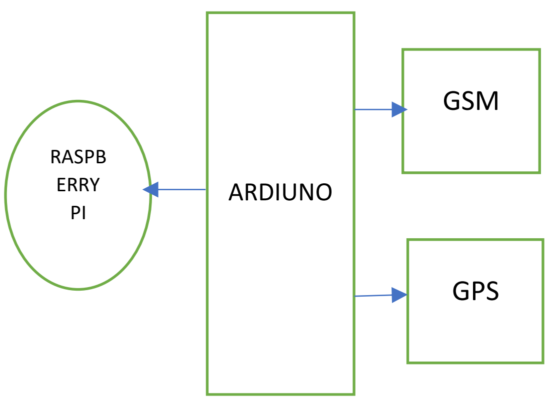

Figure2.2:Security System

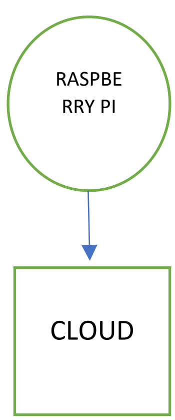

Figure2.3:Cloud section

The important lights in a vehicle are the flashers, the brake lights, headlights and the rear lights. Light Dependent Resistors (LDRs) are used to detect whether these lights were functioning properly during the crash. A push button is used to determine whether the driver wore the seat belt at the time of crash.

Various warnings are given to the driver using a range of sensors. An alcohol sensor module consisting of MQ3 gas sensor is used to warn the driver when he/she is high on alcohol. An Ultrasonic Ranging Module HC-SR04 is used for distance gauge. The driver is provided warning if the vehicle approaches too close to the vehicle in front or rear. A GPS system is used to determine the co-ordinates of the accident location in order to send it along with an alert message to pre-stored numbers using a GSM module. The GPS module is interfaced to Arduino using UART protocol.

The Analog to Digital Convertor (ADC) in Atmega32a controller is used to convert analog sensor values to digital values. The analog sensors used are distance gauge sensor, alcohol sensor, LDRs. The output from serial pins of Atmega is communicated to Raspberry Pi controller using USB. Raspberry Pi stores these values and saves it as a .txt file in a Secured Digital (SD) card which can be read after the accident to determine the cause of the crash. The GSM module is interfaced to Ardiuno using serial communication. It is used to send the GPS data and an alert message to pre-stored numbers in the Subscriber Identity Number (SIM) card. Inaddition,,raspberry pi upload these values to the cloud real time.

III. METHODOLOGY ADOPTED

The Arduino Integrated Development Environment (IDE) is utilized for programming the Arduino board. Arduino programs are written in C language. The setup () function is made use of at the start of the program to initialize settings like the pinmode of the digital pins, serial baud rate. The loop() function runs forever and it has the functions to monitor the GPS.The GSM is connected to ardiuno for providing an alert message inase is there any accident occurs.The serial port is made use of to communicate to the Raspberry Pi for storage.

Atmel studio 6.0 is used to program atmega32a which continuously monitor the various sensors and send this values serially to Rpi.

Python language is used for programming the Raspberry Pi board. Threading is used in python programming to run Data Recording and Video Recording functions.

The algorithm followed in this system are:

- ATMEGA

STEP 1:START
STEP 2:Intialize all the necessary variables and registers with correct values.
STEP 3:Enable the trigger pin of the ultrasonic sensor for a short period.
STEP 4:Then read echo input of the ultrasonic sensor and with this value we calculate the distance.
STEP 5:Check the analog pin and read the analog values of mq3,light sensor and seat belt.
STEP 6:Compare each analog value with a thershold value.
STEP 7:If the input value greater than the thershold value then put one condition otherwise we move on to another condition.
STEP 8:This recorded values are then serially transmitted to raspberry pi.
STEP 9:Move to step 3.
STEP10:STOP.

- ARDIUNO

STEP 1:Start
STEP 2:Intialize all the necessary variables and registers with correct values.
STEP 3:Set the baud rate for hardware an software serial communication.
STEP 4:Read the values from the GPS module using hardware serial communication.
STEP 5:Compare the value from the GPS module with GPGGA,if it match then goto next step otherwise goto step 4.
STEP 6:Then we store the entire string to a temporary variable .
STEP 7:From that we extract the values of longitude and latitude to the variables.
STEP 8:Read the input pin of the vibrate sensor and if it is high then goto next step otherwise goto step12.
STEP 9:Send a AT command to the GSM modem to enable it in a text mode through software serial.
STEP10:Then specifies the no. to which the message will send.

IV. EXPERIMENTAL RESULTS

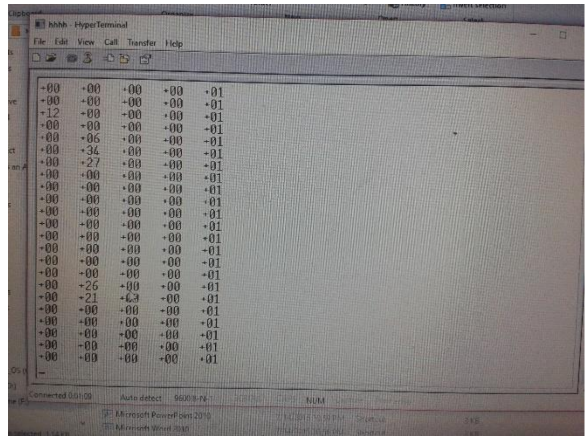

Figure4.1:Results from atmega32a

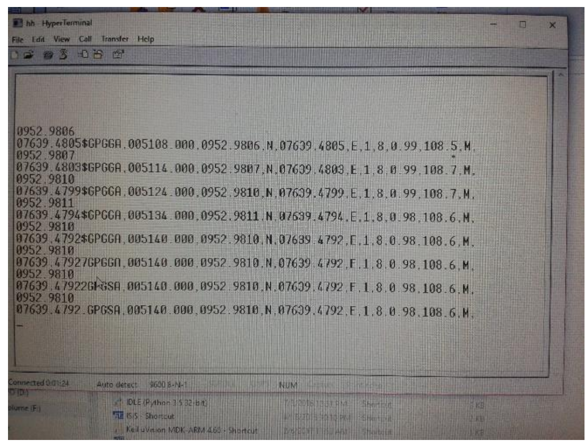

Figure4.2:Results from ardiuno

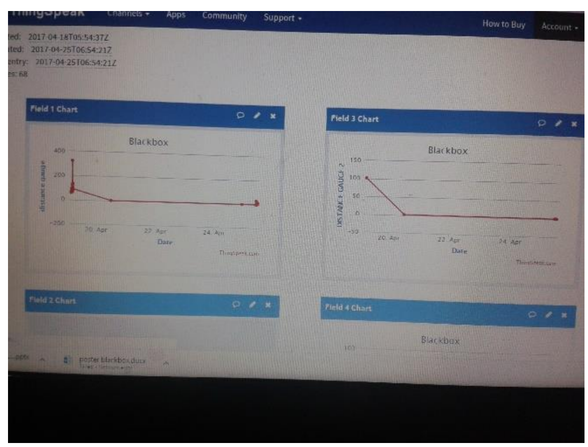

Figure4.3:Values showed in the cloud

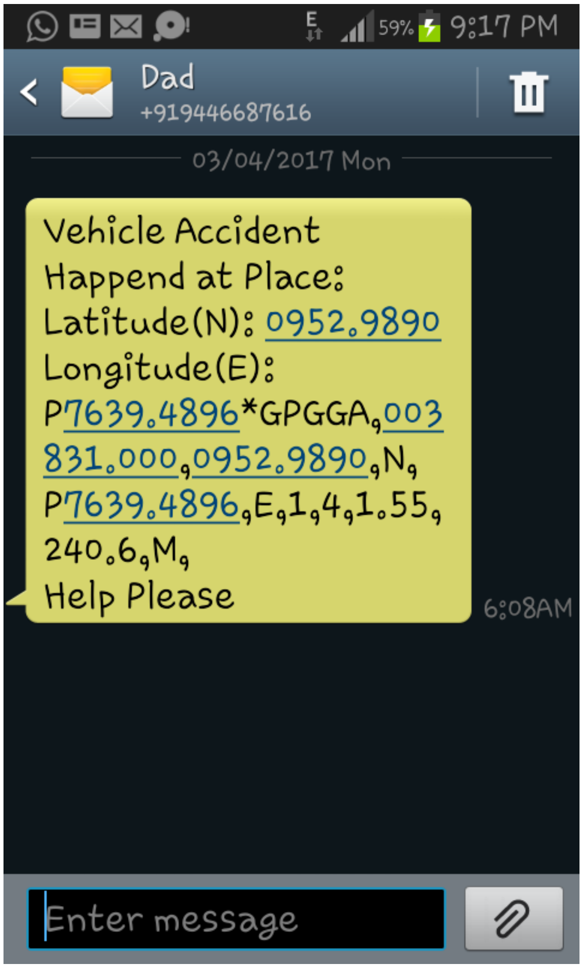

Figure4.4:Result from GSM

V. CONCLUSION

A prototype of the Automobile Black Box System was designed and implemented successfully. The designed system comprises of 4 sensors, which were placed in and around the automobile. Each of the sensors was tested and found to give desired output. These outputs were communicated to the Atmega and ardiuno controller. The data retrieved from the sensors are stored on the SD card successfully and can be fully retrieved when required.And at the same time the values were successfully upload to the cloud.

The designed system also incorporates an emergency help module which automatically alerts the medical services, police and relatives about the accident along with the GPS co-ordinates. It also has a security module which will encrypt the data stored to avoid tampering. A help SMS is sent to the pre-stored number as soon as a crash is detected. The encryption is successfully carried out and decryption of the encrypted file is accomplished to retrieve the original file.

VI. FUTURE SCOPE

The system can be improved by including a face recognition algorithm focusing on the eye to continuously monitor consciousness of the driver. The designed system is implemented in a modeled vehicle; the same can be interfaced to a real-time vehicle to gather real-time data. The system can be made crash proof by providing casing to the sensors so that the impact is less when an accident occurs. The material used to protect the car battery can be made use of for the casing.

VII. REFERENCES

[1] Abdallah Kassem, Rabih Jabr, Ghady Salamouni, Ziad Khairallah Maalouf, "Vehicle Black Box System", Proceedings of the 2nd Annual IEEE System Conference, IEEE 2008, pp. 1-6.
[2] Byung Yun Lee, Yong Yoon Shin, Hyun Joo Bae, " Development of Insurance Server System based on Vehicle Driving Information ", Proceedings of 7th IEEE International Conference on Computing and Convergence Technology (ICCCT), 2012, pp. 156 – 159.
[3] Sung-Hyun Baek, Hwa-Sun Kim, Da-Woon Jeong, MiJin Kim, You-Sin Park, Jong-Wook Jang, "Implementation Vehicle Driving State System with OBD-II, MOST network", Proceedings of the 17th Asia-Pacific Conference on Communications (APCC), IEEE 2011, pp. 709 – 714.
[4] Chien-Chuan Lin and Ming-Shi Wang, Department of Engineering Science, National Cheng Kung University, Tainan, Taiwan, "An Implementation of a Vehicular Digital Video Recorder System", Proceedings of 2010 IEEE/ACM International Conference on Green Computing and Communications & 2010 IEEE/ACM International Conference on Cyber, Physical and Social Computing, pp. 907 – 91.
[5] Milind Khanapurkar, Dr. Preeti Bajaj, Dakshata Gharode, "A Design Approach for Intelligent Vehicle Black Box System with Intra-vehicular communication using LIN/Flex-ray Protocols", Proceedings of 2008 IEEE International Conference on Industrial Technology IEEE 2008, pp. 1 – 6.
[6] Duy Le Nguyen, Myung-Eui Lee, and Artem Lensky," The Design and Implementation of New Vehicle Black Box Using The OBD Information", Proceedings of the 7th IEEE International Conference on Computing and Convergence Technology (ICCCT), IEEE 2012, pp. 1281 – 1284.
[7] XuHui, Li Jing-zhao and Yin Zhi-Xiang, Sun Xia, "Design of Vehicle Black Box based on Dual-core System and 3C/OS-II ", Proceedings of the International Conference on Industrial Control and

Electronics Engineering, IEEE 2012, pp. 763 – 766.
[8] Watthanawisuth, N., Lomas, T., and Tuantranont, A., "Wireless Black Box Using MEMS Accelerometer and GPS Tracking for Accidental Monitoring of Vehicles", Proceedings of IEEE-EMBS International Conference on Biomedical and Health Informatics (BHI), IEEE 2012, pp. 847 – 850.