

Wireless Black Box Using MEMS Accelerometer for Vehicle Accidental Monitoring

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ABSTRACT: In this work wireless black box with Micro Electro Mechanical System (MEMS) accelerometer for accidental vehicle monitoring is developed. The system consists of Micro Electro Mechanical System (MEMS) accelerometer, microcontroller unit and Global System for Mobile (GSM) module. Micro Electro Mechanical System (MEMS) is a high sensitive sensor and capable of detecting the tilts. In case of accident, Global System for Mobile (GSM) module will send short message to family member, emergency medical service (EMS) and nearest hospital for further care. Another important feature of our system is memory call back or crash recorder which records movement of vehicle before, during, after the crash. The threshold algorithm and speed of motorcycle are used to determine fall or accident in real-time. Compared with existing system, developed system is compact and easy to install.

KEYWORDS: Accident detection, Black box, GSM modem, MEMS accelerometer, Sensors.

I. INTRODUCTION

The term black box is a placeholder name used casually, often by journalists, to refer to a collection of several different recording devices used in transportation: the flight recorders (flight data recorder and cockpit voice recorder) in aircraft, the event recorder in railway diesel locomotives, the event data recorder in automobiles and the voyage data recorder in ships [1] [2]. When two cars collide on an isolated road, there may be more witnesses present than just the drivers and passengers. Silent and in most cases, unknown witnesses can lie within the cars themselves [3]. The same electronic sensor that triggers the deployment of a car's airbags can record and store information of a car's speed whether the seatbelts are fastened, and whether the driver hit the brakes before a collision. The device is known as an event data recorder (EDR) or simply a "black box," because it serves a similar function to a flight data recorder in an aircraft.

The information the black boxes record includes:

- the car's speed;
- the engine's speed;
- whether the brakes are applied;

Because the memory of the black box is limited, it only retains this information for a few seconds. After a collision, the black box contains a record of what was happening in the last seconds before the impact. The EDR was originally intended as a diagnostic tool to determine what caused a car's air bag to activate, but now insurance agents and police can use a car's black box to reconstruct what happened before an accident [4]. The numbers of death and disability are very high because of late assistance to people who got the accident. These cause huge social and economic burden to people involved. Therefore, several research group and major motorcycle manufacturers have developed safety devices to protect riders from accidental injuries. Alternatively, intelligence schemes such as fall or incident detection with tracking system have also recently been devised to notify the accident to related people so that quickest assistance can reach people who got the accident[5]. Thus, fall detection and accident alarm system for motorcycle has recently gained attention because these systems are expected to save life by helping riders to get medical treatment on time. In this work, wireless black box using MEMS accelerometer is developed for accidental

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monitoring. In the event of accident, this wireless device will send mobile phone short message to family member, emergency medical service (EMS) and nearest hospital so that they can provide ambulance and prepare treatment for the patients

II. SYSTEM OVERVIEW

The main objective of this work is to reduce the human death rate in road accident. The paper proposed a system to give quick assistance to the people who got the accident. The fall detection and reporting system for the vehicle can gain the attention because the system will save the life and give medical treatment on time. The system consist MEMS accelerometer, GSM module, and Temperature sensor, break sensor, steering sensor, accelerator sensor. An Accelerometer is used to detect the acceleration. It is the main sensor used to detect the accident. Once the accident is detected, controller gives this information to GSM module. By using GSM module we can send the message to family members. A 8 bit microcontroller unit is used to process and store real time signal from the accelerometer and various sensor. Through Temperature sensor we can measure temperature in vehicle and which is display on LCD continuously. Break sensor is used to sense amount of break applied. Steering sensor used to check the position of steering. Accelerator sensor used to sense the acceleration. All the information stored in memory card for analysis of accident cause.

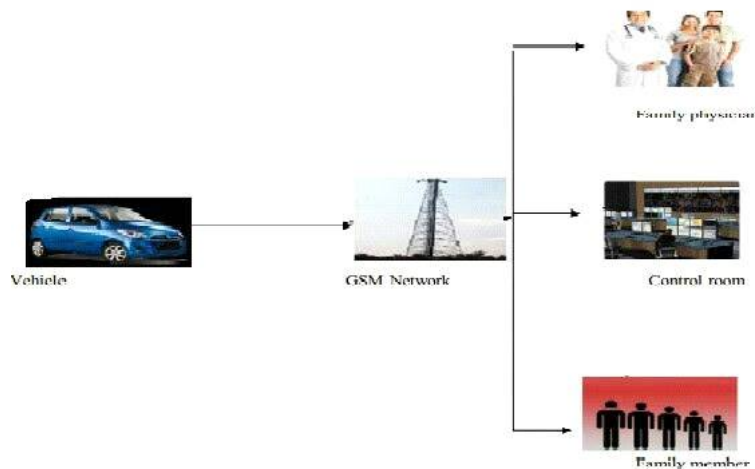


Figure 1: Overview of black box system

In figure1 we can see overview of black box system. When car accident is detected, then message is send to family member, emergency medical service (EMS) and nearest hospital through GSM module.

III. METHODOLOGY OF DETECTION

The basic concept of the proposed project is to detect car/motorcycle accident from car/motorcycle fall or from collision with another car/motorcycle. Car/motorcycle fall detection is based on tri-axial accelerometer. The MEMS accelerometer sensor is installed inside the car/motorcycle seat. The main principle involved in this project is the tilt and jerk detecting capability of the MEMS accelerometer. It has been in the technology world since some time and is making a large impact due to its unique properties. Whenever the accelerometer is tilted on any of its axis or accelerated in any direction it produces voltage outputs in accordance with it. Accelerometer basically detects the acceleration force and thus can detect any changes in velocity, orientations etc. Like MEMS accelerometer we are using four different sensors to sense different parameters of car like for steering we are using angular potentiometer, for brake and accelerometer we are using linear potentiometer and for temperature we are using thermistor. High performance 8 bit microcontroller 89s51 is chosen as a control unit which process real time car/motorcycle fall detection. There are

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four ports of microcontroller port0, port1, port2, port3. Port0 is used for LCD display, Port1 is used to give address lines to ADC, On port2 we have connected output of ADC, which is nothing but output of sensors and port3 pin (p3.0,p3.2) is connected to GSM module therefore it is used to send message if any accident occur . We have set a threshold level for MEMS accelerometer and for various sensor to determine whether voltage level of brake, steering, temperature , tilt or acceleration change of vehicle is enough or exceeding the safe value to cause an accident or not. For MEMS accelerometer if value of Z as shown in equation (1)

$$Z < 70 \&\& Z > 90 \tag{1}$$

Then collision will be detected .Similarly if brake and speed exceed the threshold value as shown in equation (2)

$$B > 200, A > 200 \tag{2}$$

Then message will be send to car owner that brake and accelerator is not working properly. Continuously output of all the sensors is given to ADC which will convert it into digital form. Now, this digitized value is compared with predefined value in microcontroller unit and if it exceed the predefined value then message will get send on registered mobile number through GSM module. Thus it helps us for maintenance of car and act as evidence after accident. Another important feature of our project is memory call back or crash recorder of a vehicle which record movement of car before, during and after the crash. Memory call back is graphical representation and through which we can reconstruct what happened at the time and who was responsible for accident.

IV. EXPERIMENTAL STATUS

The scenario of fall or accident in motorcycle is an mainly divided into groups including fall by themselves and crash by other object. Thus, the device may be tested with a, limited number of situation of accident .The motorcycle fall detection using MEMS accelerometer has been implemented and tested using prototype of black box .We have set threshold for sensor output is shown in table I

Table I: Range of sensor values

Type of Sensors	Normal	Exceeded
Brake Sensor	0	200
MEMS Accelerometer	70	90
Temperature Sensor	0	40
Accelerometer Sensor	0	200

In table1 represents range of various sensors, here range of brake sensor is,
 $0 < B < 200$

If it exceeds this range then message is send to registered mobile number indicating that there is problem in brake or brake is not workings properly. Similarly, range of MEMS accelerometer is,
 $70 < Z < 90$

If sensor value of accelerometer exceeds these ranges, then message is send to registered mobile that accident is detected.

So, we can conclude that if current value of any sensors exceeds the predefined value/range then message will be send to registered mobile number as shown in figure2.

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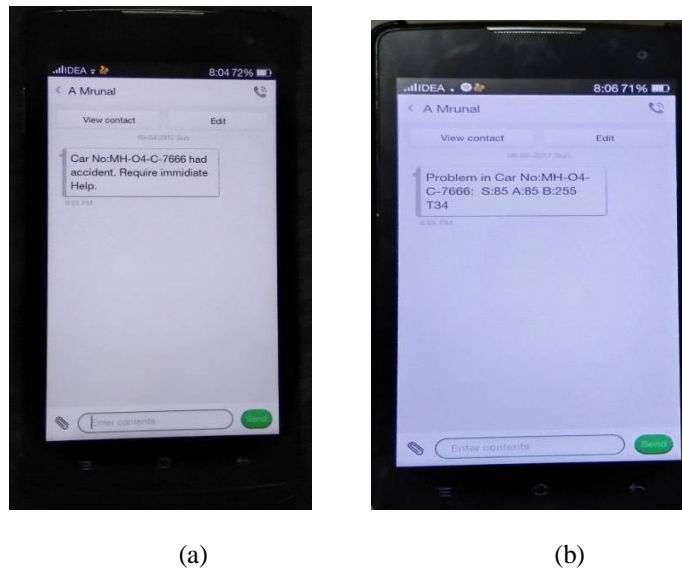
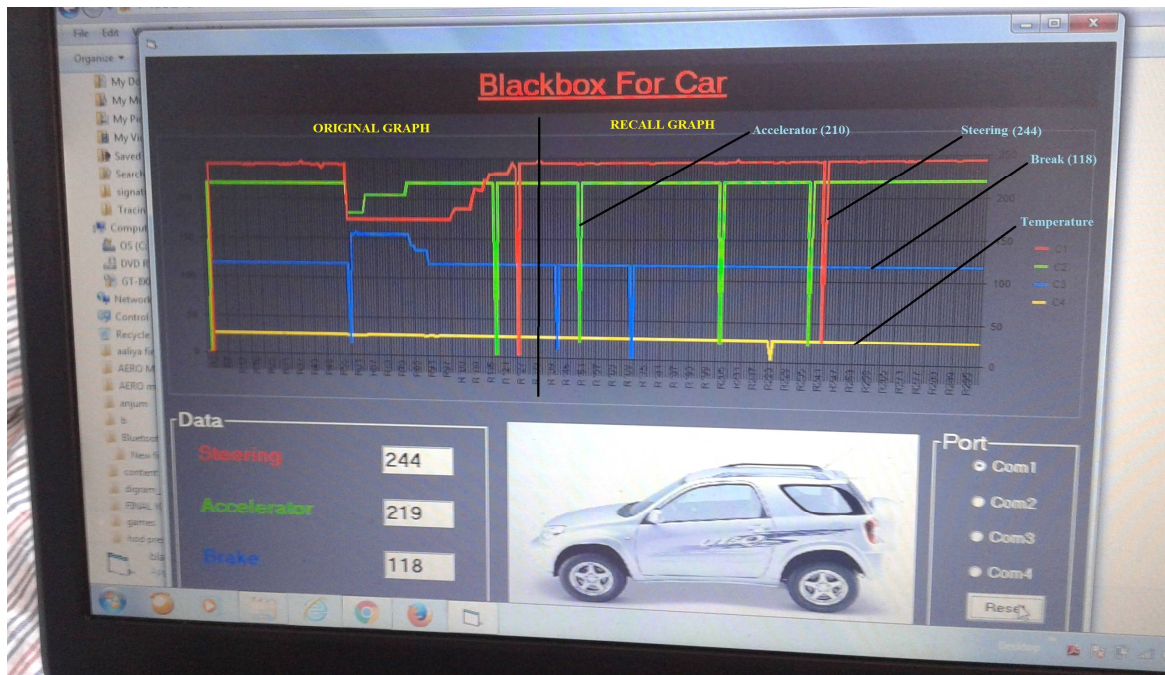


Figure 2: short message from black box device. (a) detection of error in equipment of car
(b) detection of accident

Another important feature of proposed project is memory call back or crash recorder of a vehicle which records movement before, during and after a crash. Crash recorder just takes snapshot of the event and through graphical representation we can reconstruct what happened and who was responsible for the accident as shown in figure3.



Figure(3): Graphical representation of crash record

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In figure 3, we can see recall graph is similar to original graph, which represent that after accident when we study on black box we get to know about cause of accident, what happened at last moment before impact and who was responsible for it through graphical representation of crash recorder.

V. CONCLUSION

An innovative wireless black box using MEMS accelerometer with GSM module is developed for vehicle accidental monitoring. This system is designed as prototype black box function for recording the status of accelerometer which will be used in future for investigation purpose when met with an accident. The system detects type of accident from accelerometer signal using threshold algorithm, posture after crashing of vehicle. After accident is detected, short alarm message will be send via GSM network. The proposed system is there for use for prevention of accident occur and save the life of human.

REFERENCES

1. Kevin King, S.W. Yoon, N.C. Perkins, K. Najafi, "Wireless MEMS inertial sensor system for golf swing dynamics", Sensors and Actuators A: Physical, vol.141,pg 2, 2008.
- 2.Jorge Zaldivar, Carlos T. Calafate, Juan Carlos Cano,Pietro Manzoni" Providing Accident Detection in VehicularNetworks Through OBD-II Devices and Android-based Smartphones" in 5th IEEE Workshop On User MObility and Vehicular Networks 2011 pp no : 978-1- 61284-928- 7
3. Md. Syedul Amin, Jubayer Jalil, M. B. I. Reaz "AccidentDetection and Reporting System using GPS, GPRS and GSM Technology" in IEEE/OSA/IAPR International Conference on Informatics, Electronics & Vision in 2012 pp no : 978-1- 4673-1154- 0/12.
- 3.R. Rathinakumar and D. Manivannan "Wireless AccidentInformation System Using GSM and GPS" in ResearchJournal of Applied Sciences, Engineering and Technology 4(18): 3323-3326, 2012, ISSN: 2040-7467.
4. C.Vidya Lakshmi, J.R.Balakrishnan "Automatic Accident Detection via Embedded GSM message interface withSensor Technology" in International Journal of Scientific and Research Publications, Volume2,Issue1.
5. N.Watthanawisuth,T.LomasandA.Tuantranont, —Wireless Black Box Using MEMS Accelerometer and GPS Tracking for Accidental Monitoring of Vehicles || , Proceedings of the IEEE-EMBS International Conference on Biomedical and Health Informatics (BHI 2012) Hong Kong and Shenzhen, China, 2-7 Jan 2012.
6. Chulhwa Hong, Truong Le, Kangsuk Chae, and Souhwan Jung. —Evidence Collection from Car Black Boxes using Smartphone's || . 2011 IEEE, Annual IEEE Consumer Communications and Networking Conference
7. P Ajay Kumar Reddy , P Dileep Kumar , K Bhaskar Reddy, E Venkataramana , M Chandra sekhar Reddy , "BLACK BOX FOR VEHICLES"
- 8 .Hung-ChengChiu, Min-YuKu, Hung-Tsung, Chen Nat, "Motorcycle Detection and Tracking System with Occlusion Segmentation," Image Analysis for Multimedia Interactive Services. Santorini, vol. 2, pp. 32-32, June 2007.
9. M. Lu, W. chen, X. Shen, H.C. Lam and J. Liu, "Positioning andTracking construction vehicle in highly dense urban areas and buildingConstruction sites," Automation in Construction, vol. 16, issue5.pp.647- 656,August 2007.