

Implementation of Car Black-Box using ARM

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Abstract: This paper is proposed to develop the module which provides the solution to the existing accidental issues. As here the title indicates the paper is about advanced technologies in car for making it more interactive for the collision avoidance and for the purpose of analysing the accident detail to solve accidental cases. In this design ARM7(LPC2129) is used as an embedded controller. As soon as the accident occurs the message will be sent to the nearest emergency medical service or to the respective family member. Various sensors are used to record different parameters that determines the vehicle status at real time. These measured values will be stored in memory(black box) such as vehicles engine temperature, vehicle distance from obstacle, vehicle speed, carbon dioxide content in smoke, alcohol content, fuel level in tank. The main components of the system consists of the real time sensors like gas sensor, float sensor, accident detection sensor, alcohol sensor, ultrasonic sensor and real time clock buzzer, GSM and module, DC motor.

Keywords: *Black box, GSM and GPS module, DC motor, Collision avoidance, Sensors.*

I. INTRODUCTION

In this fast moving and insecure world there is a necessity and the accidents and look after one's own safety. The accidents are increasing day by day due to driver's behaviour while driving such as drunk driving, driving with insufficient sleep, may be due to unwanted interruptions, or may be due over driving sleep of the vehicle. The death rate is increasing mainly because the information about the accident is not informed to emergency medical service. The driver usually maintain safety distance from the adjacent vehicle but sometimes even though the driver is in alert he/she can't get control over their vehicle because suddenly brake may be applied by other vehicle, so by using ultrasonic sensor which detects object by measuring distance and by using front end collision alertness unit is developed to prevent vehicle from the accident.

If accident has occurred, while solving disputes many accidental cases remains pending this is mainly due to unknown reason of the accident. So to overcome such problems black box is used. Black box is the digital electronic recording device which records the relevant data about the vehicle status in real time by using different sensors. This information helps to identify the reason for the accident and to

solve the disputes related to vehicle accident such as crash litigation, insurance settlements.

This collected information can be used not only to solve accidental cases but also to improve the automobile design, roadway design and emergency medical service by automakers, government and hospital.

II. METHODOLOGY

The prototype model of automatic vehicle accident detection and messaging using GSM and GPS modem using ARM7 working will be made in the following manner:

- Complete layout of the whole set up will be drawn in form of a block diagram.
- Initially designed module will be fixed inside the vehicle.
- A accident detection sensor or the accident switches used will first sense the occurrence of an accident and give its output to the microcontroller.
- The various sensors connected will sense for the different parameters and give its output to microcontroller and this information from sensors will be recorded and stored in the memory.
- The GPS detects the latitude and longitudinal position of a vehicle where exactly the accident occurred and this information is sent through GSM to the pre-saved numbers so that they can take an immediate action to provide rapid service for treatment and rescue.
- If any of the sensor values varies the threshold values, then driver is alerted by the buzzer and parameter values will be displayed on LCD.
- Later the stored information from black box can be used for replay of the accident and analysis.

III. BLOCK DIAGRAM

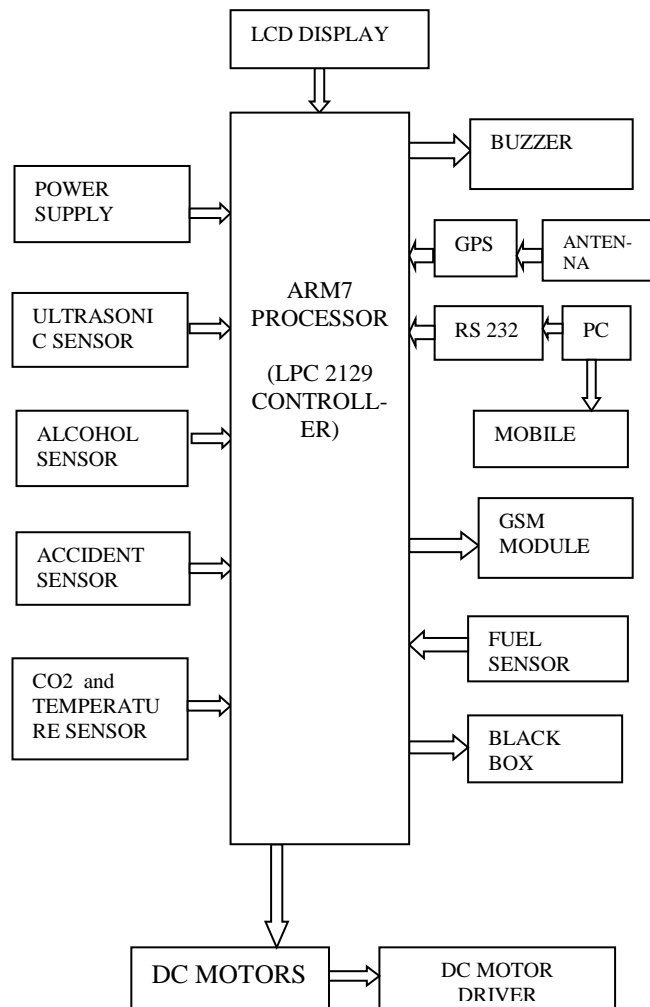


Fig. 1. Block diagram of the car black box

Here the ARM7(LPC2129) is the main controlling unit of this module. The 7805 voltage regulator is used to operate the system, here it is step down to required operating voltages for different operating units. This design also includes the various sensors such as alcohol sensor, ultrasonic sensor, temperature sensor, float sensor, accident detection sensor, CO2 sensor. Here buzzer is used to alert the driver and finally DC motor circuit(L293D) to drive the DC motors. GSM module for sending information to relative person/emergency medical service about the occurrence of accident and GPS for the detecting the exact position where the accident took place in terms of latitude and longitude values.

IV. WORKING OF THE SYSTEM

Initially the designed module is fit inside the vehicle. When driver starts the vehicle, even this module is made on to perform automated operation. Car Black box is the digital electronic recording device which records the data before and after the accident.

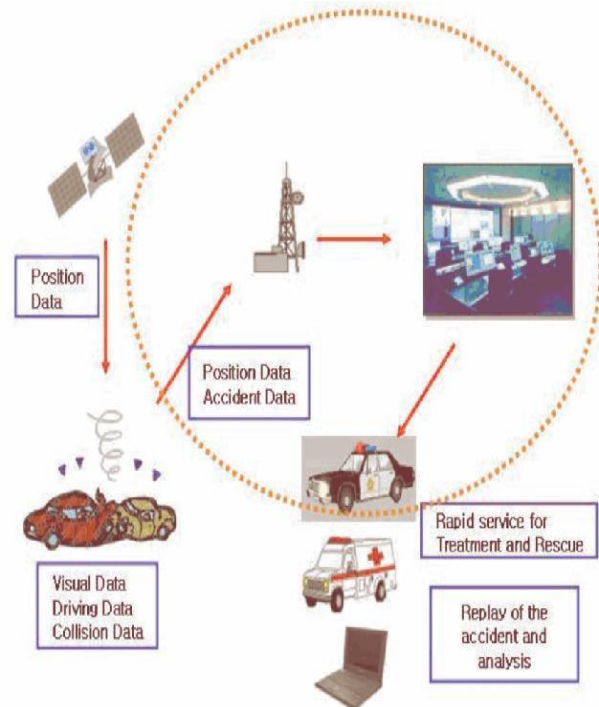


Fig. 1. Concept of the car black-box with collision avoidance system

Car black box records three different things i.e. information about the driving data, collision data and the position data. Driving data includes status of the vehicle while driving by various sensors and stores in its memory. Collision data includes the date and time when the collision has occurred with the help of real time clock and the recordance of the vehicles speed. Position data includes the exact location in terms of latitude and longitude values where the vehicle met with accident with the help of GPS module, This driving data and collision data is sent wirelessly to the nearest emergency medical service/ relatives through GSM module.

The ultrasonic sensor which is placed at the front part of the vehicle continuously scans the lane for detecting the obstacle or vehicle. If such an obstacle is found, the system determines whether the vehicle is in danger of crashing, and if so, a collision warning is given to the driver. It is constructing with help of Ultrasonic Sensors which measures the distance between the vehicles. The sensor determines distance between vehicles continuously and displays the measured value on a LCD.

Here the accident sensor is vibration sensor. Usually when collision occurred some sort of vibrations will be experienced by the vehicle, so this vibration will be sensed this sensor and information will be sent saying accident has occurred. The 4 SPDT(single pole double throw)) switches which are placed at the 4 corners to know the direction of accident.If anyone of the switch has got pressed the GSM module sends the message to pre-saved number saying accident occurred. Alcohol sensor is highly sensitive to alcoholic smell. If the alcohol smell is detected in drivers cabin, the ignition is turned off and then signal is sent to microcontroller.

Temperature sensor(LM35) frequently monitors the engine temperature. If this temperature level exceeds the threshold values then the system alerts the driver by buzzer and off the

ignition system, and even the information about this engine temperature will be recorded. MQ7 gas sensor is highly sensitive to the content of CO₂. If the content of the variety of CO₂ from the smoke emitted exceeds the desired threshold levels then sends the signal to microcontroller. Vehicle speed is measured based on the rotation of the wheels in the designed module in terms of RPM. Float sensor is fixed inside the fuel tank. If the level of fuel decreases, driver will be intimated through buzzer. The information from every sensors will be recorded once in every 5 seconds. If these values varies the desired limit, then the driver is made alert through buzzer and by displaying information on LCD.

The vehicle which is fit with the gps tracker tracks the location of vehicle where the accident has occurred. This is done with the help of GPS satellite and GPS module fixed to the vehicle. The GPS antenna present in GPS module receives the information from GPS satellite and thus provides the position information in terms of latitude and longitude. This data is sent to the pre-saved number through the GSM module. Then the various parameters stored in the memory are useful to determine how the accident took place and helps to solve the accident cases. To get these values from black box, it should be connected to PC by using RS232 cable and then with the help of information viewed further action can be taken place.

V. SOFTWARE DESCRIPTION

The software selection is the backbone of the entire project. Software development includes programs written for the interfacing of the Microcontroller with LCD display, keyboard, ADC, Auto-dialling circuit and the mobile interface. The codes written for the Microcontroller are best explained with the help of the flow charts included in this chapter.

Having had a look at the software and hardware Fundamentals of the system, the next step is to understand the software programming incorporated in the microcontroller to achieve the given task. While performing its calculations and control, the microcontroller need to be human friendly both in terms of data input and display.

The software has been written in structured manner in which all the subroutines are linked to a single main program. Each subroutine is further divided into sub-sub routine as per the requirement. When complete PCB with assembling is finished it comes to software where both assembly and C language is used. ARM controller is programmed for performing various operations. Whole coding is divided into different modules. The main code consists of initialization of all ports. Then in sub modules LCD initialization, ADC initialization, writing into the memory and reading the memory is done.

VI. ADVANTAGES

- Security of vehicle.
- Analyze the accidents detail.
- Detect if the driver is drunk or not.
- Low power consumption with automated operation.

- Various difficult data like vibration can be measured.

VII. APPLICATIONS

A. For Personal Vehicle

If the vehicle is fitted with black box, and if suppose accident occurs immediate action for treatment can be provided on receiving the message.

B. Insurance Companies

Many times the accident is not true. So insurance companies can implement this designed module in the insured vehicle, so with the help of recorded data they can easily analyse the accident detail. So they can predict whether the accident had made purposely or occurred.

C. Research and Development of Vehicle

Here the engineers require various recorded parameters like speed of vehicle, temperature etc. So if they can use recorded information from this black box for the development purpose.

D. Military Applications

If military vehicles are fitted with black box, then if at sudden any militants had attacked or vehicle damage occurs, immediately SMS can be sent to authorized organization.

VIII. RESULT AND DISCUSSION

The designed module consists of various sensors which is capable of measuring different parameters like fuel content, alcohol detection, CO₂ content, accident detection and the engine temperature. The recorded sensor values are stored in memory which are very useful in post accident investigations. The stored values can be displayed on LCD.

After the accident is occurred then every details of sensors is calculated and stored in the memory. These values are very useful to know how the accident is occurred. The message is displayed in the phone after the accident is occurred to the vehicle. This is sent to the emergency numbers by the GSM module which is fixed in the vehicle. It even shows the date and time of the accident. The information is displayed on the phone once after the collision has occurred. The driver can be alerted in dangerous situations for example when the obstacle comes near to the vehicle, when the content of CO₂ is more than the desired level, or even when the level of fuel goes down, and even driver is intimated through buzzer when the engine temperature goes high. The GPS detects the latitude and longitudinal position of a vehicle where exactly the accident occurred and this information is sent through GSM to the pre-saved numbers so that they can take an immediate action to provide rapid service for treatment and rescue. Later the stored information from black box can be used for replay of the accident and analysis.

IX. FUTURE ENHANCEMENT

Web cameras can be placed inside the vehicle for drivers assistance.

Long range infrared sensors can be used to avoid accidental collisions.

Instead of microcontroller, CPLD chips can be used which has much more features than microcontroller.

Other sensors like seatbelt sensor, pressure sensor to know brake status can be used to know much more information about vehicle.

SNAP SHOTS



Fig. 3. VEHICLE SECTION

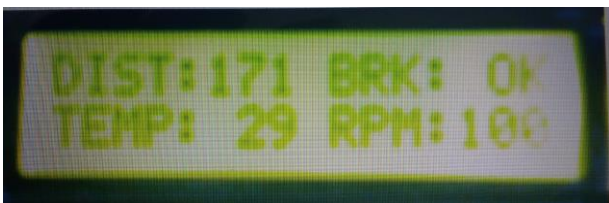


Fig. 4. Display of Distance, brake status, temperature and speed on LCD



Fig. 5. Display of CO2 content and alcohol content on LCD

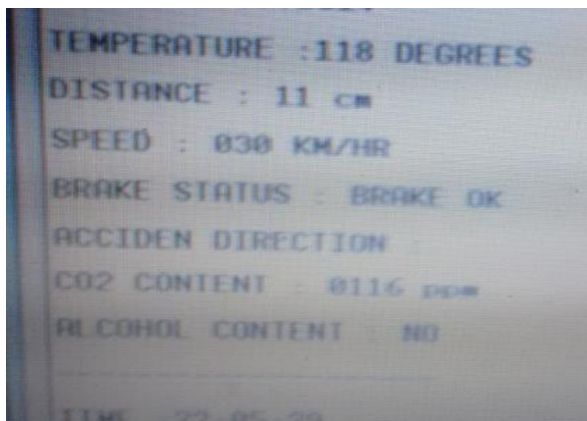


Fig. 6. Recorded data from Black box

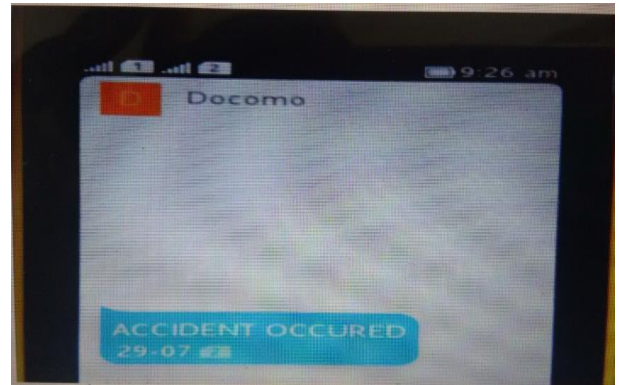


Fig. 7. Message indicating ACCIDENT occurred

X. CONCLUSION

The black box with collision avoidance can be fitted in any vehicles. Once immediately the driver starts the vehicle, the developed module with various sensors measures the different parameters in real time once in every 5 seconds and the information will be stored in the memory. As soon as the accident occurs the SMS will be sent to the pre-saved numbers so immediate action can be taken to provide treatments. If any of the sensor values varies the desired threshold levels, driver can be intimated through buzzer and even by displaying information on LCD. The information stored in black box can be used later for analysing the accident detail, and to solve disputes in insurance companies and this information can be even helpful in improvement of roadway design, vehicle designs.

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BIOGRAPHY



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