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Black Box for Automobiles with Speed Control System for Collision Avoidance

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Abstract— **The objective of this project is to design a black box for automobiles, which is responsible for preventing the collision by limiting the speed of the vehicle, in the areas, prone to accident along with recording audio and video. In case of accident, with help of GSM & GPS modules, location and time sent through message to pre-stored number. It may be hospital or police station. It is helpful for immediate rescue process and for treatment. Data collected from audio and video recorders are used for further inquiries like forensics and causes of accident and provide ideas for improvement. so the aim is to develop an device named black box which is consist of microcontroller, power supply, GSM & GPS modules and sensors.**

Index Terms— **automobiles, black box, GSM & GPS technology, speed control.**

I. INTRODUCTION

Report from Ministry of Road Transport and Highways, more than 1, 42,485 people are dies each year because of transportation-related accidents [1].In other world, one death in every 3.7 minutes as shown in table 1. 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 [5]. It records all the information, like speed & temperature of the cabin/engine, time and location, before and after the accidents so that it can be used to analyze the accident accordingly. It consists of web camera; microphone and other components are controlled by microprocessor with embedded software and fully self contained in a tiny, rugged black box that installs unobtrusively on the dash board [2].

Year	Number of accident	Number of person killed
2006	4,60,920	1,05,749
2007	4,79,216	1,14,444
2008	4,84,704	1,19,860
2009	4,86,384	1,25,660
2010	4,99,628	1,34,513
2011	4,97,686	1,42,485

Table 1.Number of accident and person involve.

Benefits customers receive are accurate, real time, easy to interpret data, a tamperproof system, and additional security. Other benefits include being able to see the condition of driver when accident occurs. A green indicator light shows that the system is armed and ready to capture an event [2]. As soon as a collision is detected automatically, the indicator light will turn red and start recording all the relevant data during a pre-defined period before and after the accident. The black-box is modified accordingly so that the system is triggered automatically as soon as abnormal readings are detected by the sensors and is prioritized as shown in Table 2. Collection of audio and video can take place by a camera which can be easily stored in a flash memory/SD card. Audio and video data captured can be downloading. Events can be displayed immediately on a television or camcorder, thus offering great ease for viewing recorded information. For more efficiency, the data recorded will get refreshed on every start of the vehicle for managing the limited data storage capacity, unless an accident has taken place.

Priority	Event
1	Crash
2	Erratic driving
3	Manual button

Table 2. Priority order for triggering of black box.

The applications of Car Black-box include:

1. Better crash research that may produce improved driver education programs, safer road designs and improve highway safety.
2. Collision data for research, data to improve vehicle design internally and externally.
3. To not only record the relevant data, but also try and prevent a possible collision by limiting the speed of the vehicle in accident-prone areas.
4. Wireless communication by transmission of alert message in the event of a collision along with the time and location co-ordinates through GSM.

II. BLACK BOX SYSTEM ARCHITECTURE

Black box for automobiles consists of a Microcontroller 89S52 core of the family 8051 embedded system used widely in the industry with an ARM processor. A web camera and a microphone are present for video and audio recording. The GSM/GPS module is also connected to the processor. Figure 1 shows the entire architecture of the Car Black-box [3].
The data from infrared sensors are given to an encoder converting it from parallel to serial and transmitted wirelessly via a transmitter module. Inside the car, the data is received by a receiver module and a decoder converts it back again from serial to parallel to give it to the microcontroller. The accident

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switch is a circuitry which senses abnormal readings and triggers the system. Various sensors such as the temperature and speed sensor are converted from analog to digital and given to the microcontroller. Depending on various inputs given and bi-directional connectivity with the ARM processor, the 89S52 controller takes decisions and varies output given to the motor driver assembly which is in direct contact with the motors of the car. The microcontroller not only recognizes the crash through the interrupt pin connected with the accident switch when car collision is detected, but also moves the data of the memory buffer to the SD card. The GPS (Global Positioning System) continuously tracks the vehicle's position and keeps record of accurate time. The SD card used was selected keeping in mind newly emerging audio video consumer electronic devices. It can support easy interface allowing a PC to be connected without any special devices making it more portable [4].

III. Working of Speed Control in Desired Area

The assembly for this section consists of IR sensors which immediately detect the entry of vehicle in an accident prone zone. As soon as the same happens they send a level high signal which is transmitted wirelessly via the transmitter module. In the next stage, via the receiver module, data are given to the AT89S52 microcontroller, which understands the presence of car in the accident zone and hence by pre defined logic it gives signal to the motor driver circuitry to control the speed of the vehicle at demarcated locations. As seen in Figure 2, as soon as the car enters a predefined zone, e.g. a school as shown, it gets detected by sensors (marked with red dots) and after immediate signal transmission to the microcontroller inside the car, the speed is instantly brought to a preset level, reducing the chances of any accidents taking place.

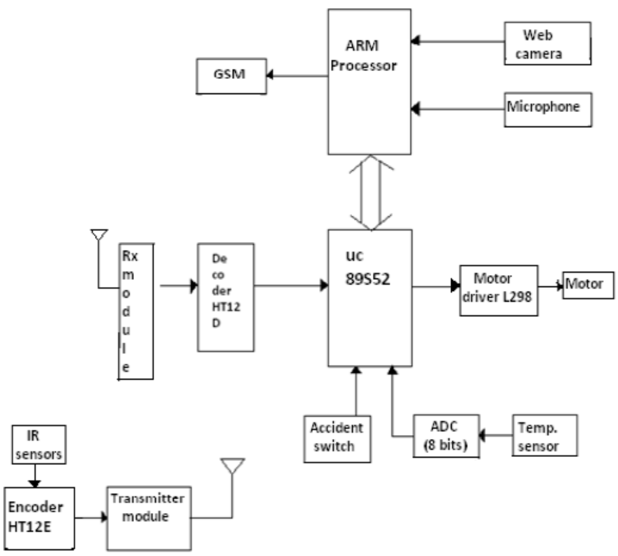


Figure 1.Block Diagram of Black Box

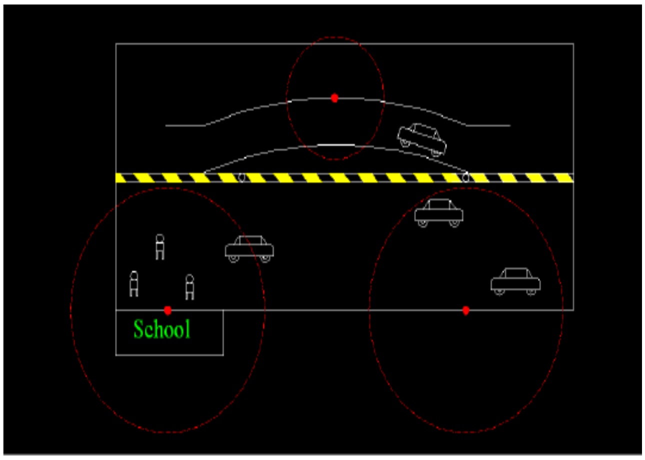


Figure2. Speed control dramatization

IV. Hardware Description

Hardware details are depicted in Figures 3-5. AT89S52 microcontroller is used in this project because of its low power consumption and high performance. It is also the most easily available one. The IR sensor unit comprises of IR LED's which emit high intensity red light out of the sensor unit. If the light finds an obstacle in its path it is reflected back and this light it is received by the photo transistor. The reflected signal falls on the photo transistor. This ray excites the base of the transistor and switches the transistor on.

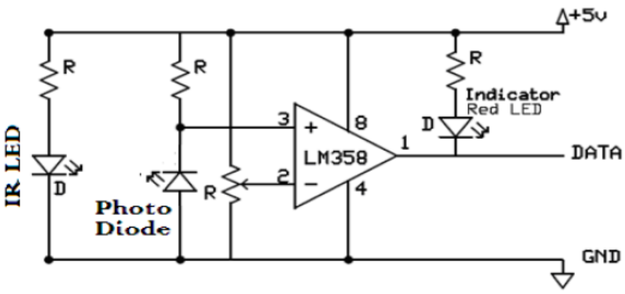


Figure3. Working logic of IR sensors

The comparator compares the two voltages and switches its output to indicate which is larger. We are using LM358 IC as a comparator. The non inverting input terminal of comparator is given an input signal detected by photo transistor while the inverting input terminal is given a reference voltage with the help of potentiometer. The comparator is used in non inverting mode i.e. when voltage falls below reference voltage, the output becomes low. On pin 3 i.e. non inverting terminal of comparator the voltage is maintained above the reference voltage. Due to which, the output is initially high. The light emitted by the LED falls on the photo diode. The voltage at pin 3 of Op-amp goes low. Hence the output will go low. When the sensor is on the white surface the photo diode receives light and turns on and voltage at non-inverting input terminal decreases. Hence the output becomes low. Whereas when the sensor is on the black surface no light is received by photo transistor and it remains off. So the voltage at non inverting input of op-amp is greater than that of reference voltage at inverting input. So the output of comparator goes high. The Encoder section is a series of CMOS LSIs for remote control system applications. They are used to encoding information and consist of two N address bits and data bits.

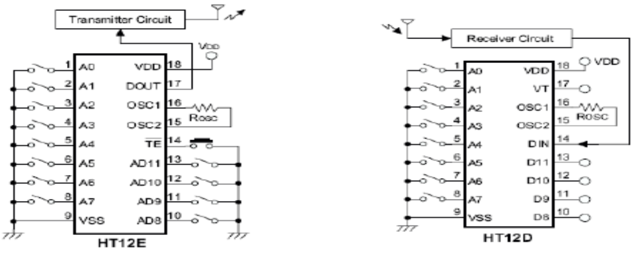


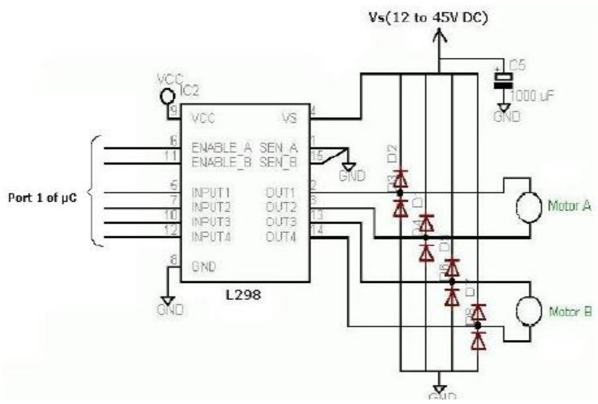
Figure4. Encoder and decoder assembly

The programmed data are transmitted with help of radio frequency and via infrared transmission medium. The capability to select a TE trigger on the HT12E or a DATA trigger on the HT12A further enhances the application flexibility of the 212 series of encoders. At receiving side, decoders receive data from programmed 212 series. [4]. which are used to compare the serial input data continuously with their local addresses. In case of unmatched codes, the input data codes are decoded and then transmitted to output pins.

The Microcontroller receives the code for left, right, up, down from ARM processor at port 1. It checks the code and accordingly provides the data on port 0 to motor of the car. To drive the motor we have used the L298 motor driver IC. Two motors on the left side of the car are connected in parallel combination & other two on the right side are connected in parallel combination with respect to the motor driver circuit. The L298 Motor Driver are used to control the motion of motor and two enables input which are used to on off the motor. Speed o f motor is controlled by pulse width modulation technique (PWM). Duty cycle of PWM are directly proportional to voltage between VS and GND.100% duty cycle corresponds to voltage equal to Vs, 50% corresponds to 0.5Vs and so on. The 1N4004 diodes are used to reduce the effect of back EMF of motor. Many circuits use L293D for motor control, L298 is chosen here as it has current capacity of 2A per channel at 45V compared to 0.6A at 36V of a L293D[1]. The Embedded software used is executed by 89S52. The software is designed in assembler by Keil software using C language in HEX [6]. The data recording starts as soon as the accident switch is triggered and the code is compiled to set the proper baud rate so that all the data is updated every second.

V. CONCLUSION

In this paper we present the design of a Car Black Box. We have successfully implemented the embedded system which gave good results and expected functioning. The data can be retrieved as required with great ease. The initial testing was done with connection to a PC instead of an ARM processor for simplicity on trial purposes and later on the actual platform.



Figur5. Working of motor driver L298

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