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SMART BLACK BOX SYSTEM USING IOT

R. Shankari[1], Rajeswari A[2], Srivaisnavi G[3], Shanofar Nisha M[4], Sunmathi A[5]

[1]Assistant Professor I[1,] Department of ECE, Velammal Engineering College, Chennai
[2-5]Students, Department of ECE, Velammal Engineering College, Chennai

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ABSTRACT: Automotive electronics plays and a massive role within the industry and provides luxurious features and more importantly addresses the security and security concerns. This paper aims at providing an economical solution to the planning and development of an occasion data recorder that has been adopted from the aviation sector considering the need and the correlated benefits. The paper presents an integrated design of the recorder with the essential features of the info recorder which might be very useful for domestic vehicles and at the same time it also hosts several additional features that would assist in mitigating the number of accidents, or at the bare minimum, will function an analysis tool to stop future accidents by analyzing the previous accidents. The recorder provides an automatic accident notification system that helps in informing the hospital or the traffic authority by providing not only the coordinates of the accident but also the precise physical address for immediate medical attention which may save several lives a day. Thus, the general cost is very optimized by integrating such multiple features.

KEYWORDS

Automobile, Event Data Recorder, Arduino, Accident Analysis, IOT, gas sensor, ultrasonic sensor, Crash sensor, GSM, PLX DAQ

1. INTRODUCTION

A black box, or an Event Data Recorder (EDR), is a device found in most modern vehicles that are used to record information about that car's driving records, especially as it relates to accidents. After the car accident, it's important to determine how the crash was caused and what are the factors that influenced the crash. This information taken from the black box helps to prove liability after an accident, which makes it easier for any injured individuals to fight for the compensation they're rightfully given. A black box can be an instrument in this process and can effectively help with an investigation involving a car accident accountable. Black boxes were originally used in aircraft to track their functions and identify any potential problems. As a part of the investigation process, it is extremely important to obtain the black box data from each of the vehicles involved in thecrash. Black boxes can be installed in an automobile, including commercial vehicles like semi-trucks. The information collected from black boxes can be instrumental in obtaining compensation and justice after a motor vehicle accident, especially in proving liability. Professionals can analyze the data collected from the black box and use that information to the state in court as an expert witness.

2. REGULAR AUTOMOTIVES

This system does not involve in any sort of analysis of the event neither records the data. The automotive vehicles don't have a black box system.The accident data is not stored in any place.It is difficult to identify the accident that occurred to the vehicle.

3. BLACK BOX PROTYPED SYSTEM

In the advanced technology, each vehicle is monitored and the data are stored in memory.

The data are continuously uploaded to the cloud.

The advantages are less time consuming, trouble-free to use and high accuracy.

4. WORKING PRINCIPLE

In this system, we use ARDUINO MEGA (ATmega2560) microcontroller which acts as the brain of the system, because of the entire system program instruction stored in it. Here we have used ultrasonic sensor, gas sensor and temperature sensor to know the status of vehicle and driver like the level of fuel, detection of alcohol and temperature inside the vehicle respectively. The data keep on reading from the vehicle using the sensors mentioned above and only the detection of crash sensor triggers to store all the data read by the sensor store to PLX DAQ. The GSM module we use here to inform the respective person

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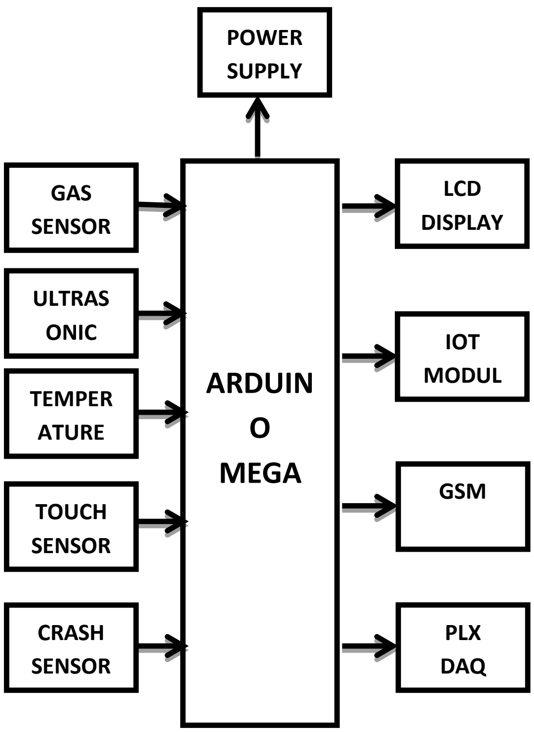
and public service organization. All the data are updated to the cloud so that the system operation is either controlled or monitored using IoT.

5. BLOCK DIAGRAM



6. SOFTWARE COMPONENTS

S.NO	SOFTWARE	SPECIFICATION
1.	ARDUINO IDE	For programming and dumping the Arduino code into the development board.
2.	EMBEDDED C	Programming for performing specific function by the processor.

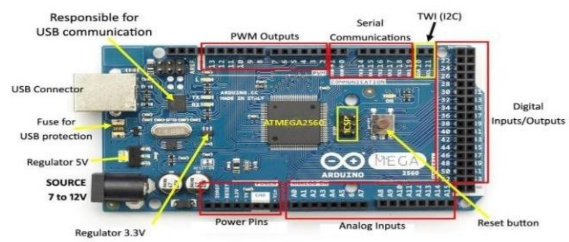
7. HARDWARE COMPONENTS

7.1 ARDUINO

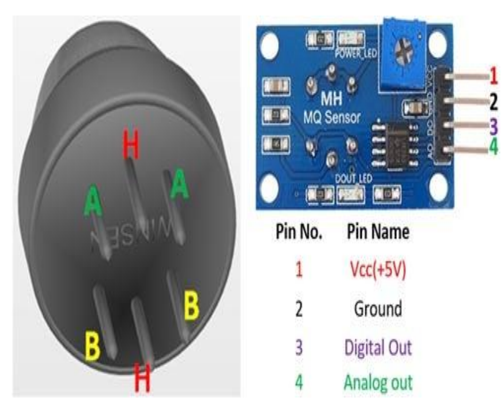
Arduino is open-source hardware, which acts as a microcontroller which is the brain of the system. they're pre-programmed with a boot loader that simplifies uploading of programs to the on-chip nonvolatile storage. The Mega 2560 board is programmed with the Arduino Software (IDE). The ATmega2560 has 256 KB of nonvolatile storage for storing code where 8 KB is employed for the bootloader, 8 KB of Static RAM and 4 KB of EEPROM.

7.2 GAS SENSOR

The MQ2 has an electrochemical sensor, whose resistance changes for different concentrations of various gasses. The voltage divider circuit is designed by connecting the sensor in series with the voltage resistor



and the variable resistor is used to change sensitivity. The sensor's resistance changes when one of the above gaseous elements comes in contact with the sensor after heating, the sensor's resistance change. The microcontroller reads the voltage from the change in the resistance changes the voltage across the sensor. By knowing the reference voltage, the voltage value can be used to find the resistance of the sensor. Using an MQ sensor the detection of gas is very obvious. You can use one of the digital pin or the analog pin to accomplish

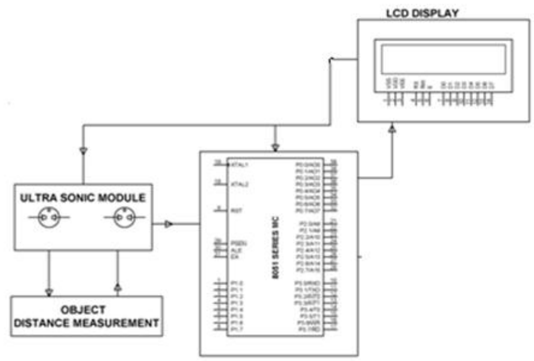


this function. Apply 5-volt power to the module and you will notice that the LED module will glow and if no gas is detected then the output of the LED module will be at 0 volts. Before you can work with it, these sensors have to be kept on for pre-heating time. When the sensor is introduced to the gas you want to detect and you should see the output LED to go high along with the digital pin, if not use the potentiometer until the output gets high. Now every time your sensor gets introduced to this gas at this appropriate concentration the digital pin will go high (5 Volt) else it will remain low (0 Volt). You can also use the analog pin to accomplish the same thing. Observe the analog values (0-5 V) using a microcontroller, this value is going to be directly proportional to the concentration of the gas to which the sensor detects.

7.3 ULTRASONIC SENSOR

When an electrical pulse of high voltage is applied to the inaudible electrical device it vibrates across a particular spectrum of frequencies and generates a burst of sound waves. Whenever any obstacle comes before the noiseless device the sound waves can replicate back within the sort of echo and generates an electrical pulse. It calculates the time taken between causing sound waves and receiving the echo. The echo patterns are compared with the patterns of sound waves to work out the detected signal's condition. Here this method is employed to point the stockpile within the vehicle thereby recording and making an alert indicating low fuel convenience when AN electrical pulse of high voltage is applied to the inaudible electrical device it vibrates across a particular spectrum of frequencies and generates a burst of sound waves. Whenever any obstacle comes before the noiseless device the sound waves can replicate back within the sort of echo and generates an electrical pulse. It calculates the time taken between causing sound waves and receiving the echo. The echo patterns are compared with the patterns of sound waves to work out the detected signal's condition. Here this method is employed to point the stockpile within the vehicle thereby recording and making an alert indicating low fuel convenience

The working principle of this module is simple. It sends an ultrasonic pulse out which travels through the air at 40 kHz and if there is an obstacle or object, it will bounce back to the sensor. By calculating the travel time and the speed of sound, the distance can be calculated easily.

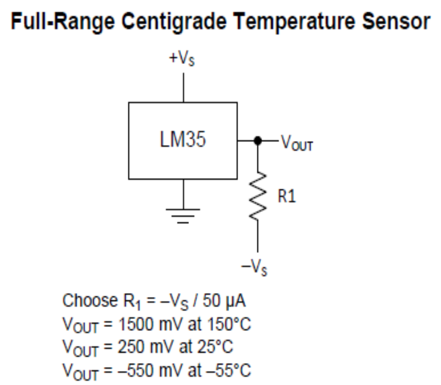


ULTRASONIC DISTANCE SENSOR CIRCUIT

7.4 TEMPERATURE SENSOR

The configuration we can utilize all the sensor resources and may measure the full range temperature from -55 degree Celsius to 150 degree Celsius. This configuration is small complex but yields high results. We have to attach an external resistor during this case to change the extent of negative voltage upwards. The external resistor value can be calculated from the formula given below the configuration circuit. In the features of lm35 it is given to be +10 mV per degree centigrade. It means with an increase in output of 10 mills volt by the sensor Vout pin the temperature value increases by one. As an example, if the sensor is outputting 100 mills volt at Vout pin the temperature in centigrade will be 10 degrees centigrade. The identical goes for the negative temperature reading. If the sensor is outputting -100 mV the temperature will be -10 degrees Celsius.

Pin Number	Pin Name	Description
1	Vcc	Input voltage is +5V for typical applications
2	Analog Out	There will be increase in 10mV for raise of every 1°C. Can range from -1V(-55°C) to 6V(150°C)
3	Ground	Connected to ground of circuit



The temperature-sensing part is then buffered by Associate in Nursing electronic equipment and provided to the VOUT pin. The electronic equipment incorporates a straightforward category A output stage with typical zero.5-Ω output ohmic resistance as shown among the practical diagram. Therefore, the LM35 will solely supply current and its sinking capability is taboo to one.

7.5 CRASH SENSOR

This is a little small switch device designed for the Arduino. It might be directly connected to the IO enlargement protect. It integrates the pull-up resistance and therefore the standing indicator light-emitting diode aboard. that produces it easier for testing. The miniature snap-action small switch with roller lever build it appropriate for a lot of completely different setting application.

WORKING INDICATIONS:

 If a collision happens direct of wherever collision module is put in, the module outputs low-level signal; no collision outputs the high-level signal.

 Module reserves money supply mounting hole, convenient for fixation on an automotive.

With switch indicator light-weight, if there is a collision, light-weight is on; no collision, light-weight is off.

With switch indicator light, if there is a collision, light is on; no collision, light is off.

7.6 GLOBAL SYSTEM FOR MOBILE COMMUNICATION

Unlike mobile phones, GSM electronic equipment doesn't have a data input device and a show to move with. It simply accepts sure commands through a serial interface and acknowledges those. These commands are referred to as AT commands. There's a listing of AT commands to instruct the electronic equipment to perform its functions. each command starts with "AT". That's why they're referred to as AT commands. AT stands for attention. In our easy project, the program waits for the mobile range to be entered through the keyboard. once a ten-digit mobile range is provided, the program instructs the electronic equipment to send the text message employing a sequence of AT commands.

AT COMMANDS

- Set the SIM900 to text mode: AT+CMGF=1\r.
- Send SMS to a number: AT+CMGS=PHONE_NUMBER (in international format).
- Read the first SMS from the inbox: AT+CMGR=1\r.
- Read the second SMS from the inbox: AT+CMGR=2\r.
- Read all SMS from the inbox: AT+CMGR=ALL\r.
- Call to a number: ATDP+PHONE_NUMBER (in international format).
- Hang up a call: ATH.
- Receive an incoming call: ATA.

7.7 IOT MODULE

The ESP8266 itself is a self-contained Wi-Fi networking solution offering as a bridge from the existing microcontroller to Wi-Fi and is also capable of running self-contained applications. This module comes with a built-in USB connector and a rich collection of pin-outs. With a micro USB cable, you can connect the NodeMCUdev kit to the laptop and flash it without any issues, just like Arduino. It is also immediately breadboarding friendly. Here it is used to manage the updating process to PLX DAQ and saving it to the cloud interface.

8. SOFTWARE DESCRIPTION

8.1 ARDUINO SOFTWARE IDE

The sketching for the controller operation is as below

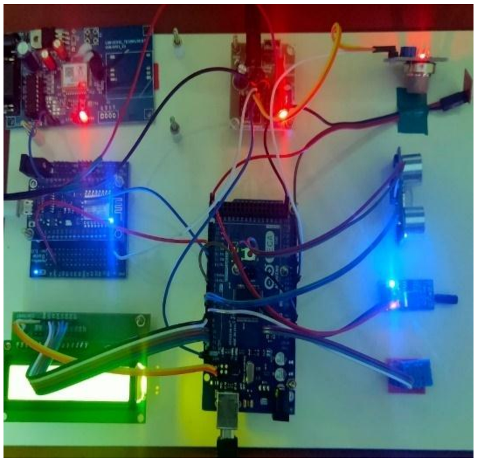
```
/////IOT BASED BLACK-BOX SYSTEM//////////

#include<LiquidCrystal.h>                //header file for LCD
LiquidCrystallcd (8, 9, 10, 11, 12, 13);    //RS=8, EN=9, D4=10, D5=11, D6=12, D7=13
#include "DHT.h"

#define DHTPIN 7     // what pin we're connected to the controller
#define DHTTYPE DHT11   // DHT 11

void iot(String stringdata);              //Initializing IOT function
void message(String data);             //message

unsigned int crash = 2;
unsigned int touch = A4;
unsigned int gas = A7;
unsigned int trig = 5;
unsigned int echo = 6;
unsigned int flag = 0;
long dur;
unsigned int distance;
int p, a;

// Initialize DHT sensor
DHT dht(DHTPIN, DHTTYPE);

void setup()
{
lcd.begin(16, 2);
Serial.begin(9600);      //plx-daq
Serial.println("CLEARDATA");
Serial.println("LABEL, Time,Temperature,FuelLevel,No. of. person,Alcohol");
Serial2.begin(9600);     //iot
Serial3.begin(9600);     //gsm
dht.begin();
pinMode(touch, INPUT);    //touch sensor as input
pinMode(gas, INPUT);     //gas sensor as input
pinMode(trig, OUTPUT);    //ultrasonic sensor as fuel level check
pinMode(echo, INPUT);
pinMode(crash, INPUT);  //crash sensor as input
attachInterrupt(digitalPinToInterrupt(crash),        vib, FALLING);
lcd.clear();
lcd.setCursor(0, 0);
lcd.print("IOT BASED SMART");
lcd.setCursor(0, 1);
lcd.print("BLACK BOX SYSTEM");
delay(3000);
lcd.clear();
}

void loop()
{
Serial.print("DATA,TIME,");
distance = 0;            //checking fuel level
dur = 0;
digitalWrite(trig, LOW);
delay(10);
digitalWrite(trig, HIGH);
delay(10);
digitalWrite(trig, LOW);
dur = pulseIn(echo, HIGH);
distance = ((dur * 0.034 ) / 2); //cm

float t = dht.readTemperature();  //checking temperature

p = digitalRead(touch);      //no of person
a = digitalRead(gas);       //checking alcohol

if (flag == 1)
```

```
{
lcd.clear();
lcd.setCursor(0, 0);
lcd.print("ACCIDENT");
lcd.setCursor(4, 1);
lcd.print("DETECTED");
iot("*ACCIDENT DETECTED#");
message("ACCIDENT DETECTED");
lcd.clear();
lcd.setCursor(0, 0);
lcd.print("MESSAGE SENT");
delay(2000);
while (1);
flag = 0;
}

lcd.clear();
lcd.setCursor(0, 0);
lcd.print("TEMP:");

lcd.print(t);
lcd.print(" C");
Serial.print(t);
Serial.print(",");

lcd.setCursor(0, 1);
lcd.print("FUEL LEVEL:");
lcd.print(distance);
lcd.print("cm");
Serial.print(distance);
Serial.print(",");
delay(1500);

lcd.clear();
lcd.setCursor(0, 0);
lcd.print("NO. OF. PERSON: ");
lcd.setCursor(0, 1);
lcd.print(p);
Serial.print(p);
Serial.print(",");
delay(1500);

if (a == 0)
{
lcd.clear();
lcd.setCursor(3, 0);
lcd.print("ALCOHOL");
lcd.setCursor(5, 1);
lcd.print("CONSUMED");
iot("*ALCOHOL CONSUMED#");
message("ALCOHOL CONSUMED");
Serial.println("YES");
delay(1500);
}
else
{
lcd.clear();
lcd.setCursor(3, 0);
lcd.print("NO ALCOHOL");
lcd.setCursor(5, 1);
lcd.print("CONSUMED");
Serial.println("NO");
delay(1500);
}
delay(500);
}

void vib()
{
flag = 1;
}

void message(String data)
{
Serial3.println("AT");
delay(1000);
Serial3.println("AT+CMGF=1");
delay(1000);
Serial3.println("AT+CMGS=\"+919710860381\"\r");
delay(1000);
Serial3.println(data);
delay(1000);
Serial3.println((char)26);
delay(5000);
}

void iot(String stringdata)
{
for (int i = 0; i<stringdata.length(); i++)
{
Serial2.write(stringdata[i]);
}
delay(4000);
}
```

9. RESULTS

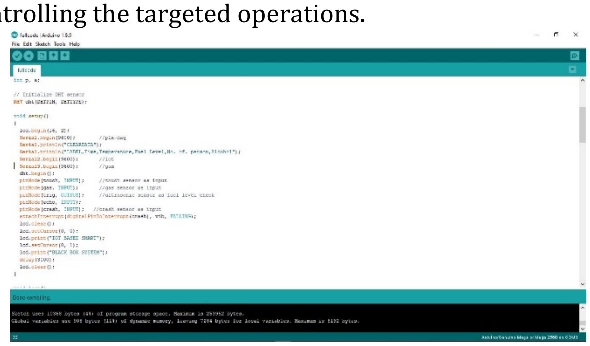
HARDWARE SETUP

The hardware connections are done and verified by obtaining the records of the vehicle in the LCD screen



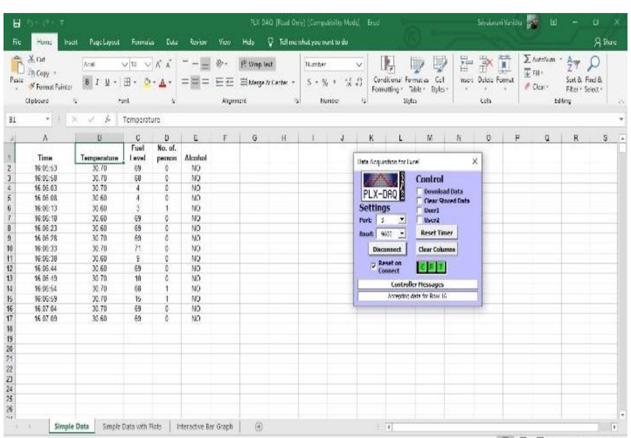
ARDUINO SKETCHING PAGE

The above developed code is updated to the controller controlling the targeted operations.



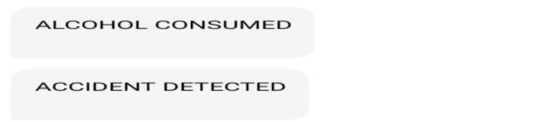
PLX DAQ EXCEL SHEET

This sheet collects the data collected by the black box and updates for every 5 seconds to the PLX DAQ sheet.



INTIMATION

Once the crash sensor is triggered the PLX DAQ stops updating the condition of the vehicle and the message is sent stating if the person has consumed alcohol or an accident has been met.



CONCLUSION

In science, computing, and engineering, a **black box** is a device, system or object which can be viewed in terms of its inputs and outputs (or transfer characteristics), without any knowledge of its internal workings. Its implementation is "opaque" (black). Efficient when used on large systems. Since the tester and developer are independent of each other, testing is balanced and unprejudiced. The tester can be non-technical. There is no need for the tester to have detailed functional knowledge of the system. Tests will be done from an end user's point of view because the end-user should accept the system. Thus using this system in an appropriate way the complete case history about an accident or relevant information can be obtained. This helps people to know things better and it also includes many preventive methods for a safe ride.

REFERENCES

[1] Design and Implementation of Real Time Wireless System for Vehicle Safety and Vehicle to Vehicle Communication, Mallikarjuna Gowda C P, Raju Hajare, C S Mala, 2017, ICEECCOT.

[2] C. N.Marimuthu, Dr. P. Thangaraj, Aswathy Ramesan, " Low power shift and add multiplier design", International Journal of Computer Science and Information Technology, June 2010, Vol. 2, Number 3.

[3] Novel Black-Box Arc Model Validated by High-Voltage Circuit Breaker Testing, Toshiya Ohtaka, Viktor Kertész, René Peter Paul Smeets, 2017, IEEE.

[4] C. Jaya Kumar, R. Saravanan, "VLSI Design for Low Power Multiplier using Full Adder", European Journal of Scientific Research, ISSN 1450-216X Vol.72 No.1 (2012), pp. 5-16

[5] Ravi Nirlakalla, Thota Subba Rao, Talari Jayachandra Prasad,"Performance Evaluation of High Speed Compressors for High SpeedMultipliers", Serbian Journal of Electrical Engineering, Vol. 8, No. 3,November 2011, 293-306

[6]DG2: A Faster and More Accurate Differential Grouping for Large-Scale Black-Box Optimization, Mohammad Nabi Omidvar, Ming Yang, Yi Mei, 2017, IEEE.

[7] Opening the Black Box: Hierarchical Sampling Optimization for Hand Pose Estimation, Dan hang Tang1, Qi Ye1, Shanxin Yuan, 2018, IEEE.

[8] Introducing Elitist Black-Box Models: When Does Elitist Behavior Weaken the Performance of Evolutionary Algorithms, Carola Doerr, Johannes Lengler, 2015, Massachusetts Institute of Technology.