

SMART MONITORING OF THE TRAIN AND TRAIN TRACKS TO PREVENT RAILWAY HAZARDS

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ABSTRACT

Smart monitoring of the train and train track is very important in the Indian railway to prevent accidents. Especially in India it is very important. The Indian railway system is lagging regarding smart monitoring of train with the other countries. By smart monitoring of the train, it can find breakage of train track it can prevent accident between two train if two train is on the same track due to miss matching of signal, it can find whether there is any obstacle present in railway track, it can also detect whether two coaches of the train get separated during the motion of the train due to manufacturing defect. It helps to detect fire in the pantry car . Smart monitoring of the Indian railway help to monitor the train and its track in a very effective way .It can implement in Indian railway that helps to avoid the accident and save lots of people's life

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INTRODUCTION AND LITERATURE SURVEY

The first train in India ran between Bori Bonder and thane on 16 April 1853 which is run on a steam engine .It was the first passenger train in India from there lots of development has taken place. At that time there is no ac coach in that train but now both ac and sleeper coaches are there . Besides all these development , lots of development are needed for the Indian railway which will help the Indian railway a lot .Indian railway not only act as a mode of transportation for people it will also help in transporting goods from one place to another so for all these things smart monitoring of train is very important that will reduce the risk of an accident K. Gayathiri al.[1] in their work they use the seismic sensor to detect vibration the level of vibration will be high or low depending upon the direction of acceleration if the vibration value is not normal then there must be a defect in the track . Abhi Ladola al.[2] in their work to prevent an accident of train they built a device that can detect the crack in railway track using Infrared sensor and charge the battery of the Arduino with the help solar panel cell. C. Narendra Singh al.[3]in their project they use magnetic penetration to detect the crack by using the hall sensors .Wong Wei qing[4] in his project used an ultrasonic sensor to detect the object and use LED to show whether the obstacle is present or not. Muhamad Nizam Bin Mustapha [5] built a fast track quality measurement using a gyro sensor.Mohaiminul Islam.[6]Khan.in his thesis show how to keep a track on the train by using the GSM module and also describe how to send the current location of the train by using the GPS module.To charge an Arduino by solar cell [2]only work in some restricted area such as Karnataka, Tamilnadu, charging of the solar panel will not take place during the monsoon season and that place where there is cloudy weather. So for that, we have to look at some other form of energy that can charge our Arduino Using vibration sensor to detect the crack present in train track [1] it is sensitivity to higher frequency noise but some time due to some external factor the railway track get the same vibration as that of passing a train through the track then at that time it will not be going to work

METHODOLOGY

(1) To detect a crack in railway track IR sensor is used for detecting the breakage and cracks in railway track by sending and receiving IR signal. If a crack is found in railway track then by using GPS, the latitude and longitude coordinates will be sent to railway authority by using GSM Module after sending message to railway authority they compare this location to the location where crack is intensely there to prevent thermal expansion.

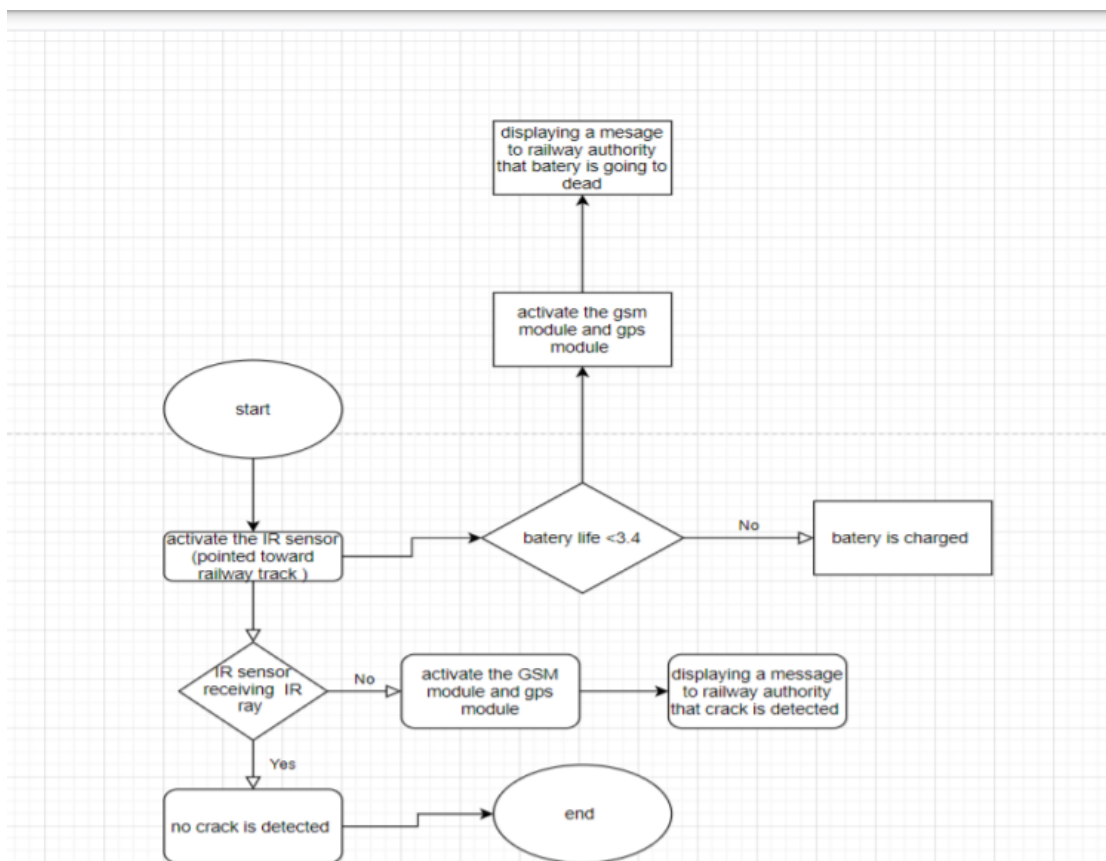


Fig 1 : flow chart to detect the crack in train track

ARDUINO CODE

```
int IR = 2; // connect ir sensor to arduino pin 2
```

```
#include <TinyGPS.h>
```

```
#include <SoftwareSerial.h>
```

```
SoftwareSerial SIM900(7, 8);
```

```
TinyGPS gps;
```

```
void setup()
```

```
{
```

```
    pinMode (IR, INPUT); // sensor pin INPUT
```

```
}
```

```
void loop()
```

```
{
```

```
    //int statusSensor = digitalRead (IRSensor);
```

```
    if (digitalRead(IR) == 1){
```

```
        bool newData = false;
```

```
        unsigned long chars;
```

unsigned short sentences, failed;

```
// For one second we parse GPS data and report some key values
for (unsigned long start = millis(); millis() - start < 1000;)
{
    while (Serial.available())
    {
        char c = Serial.read();
        //Serial.print(c);
        if (gps.encode(c))
            newData = true;
    }
}

if (newData)          //If newData is true
{
    float flat, flon;
    unsigned long age;
    gps.f_get_position(&flat, &flon, &age);
    SIM900.print("AT+CMGF=1\r");
    delay(400);

    SIM900.println("AT + CMGS = \"+91xxxxxxxxxx\"CRACK DETECTED");// recipient's mobile number
with country code
    delay(300);
    SIM900.print("Latitude = ");
    SIM900.print(flat == TinyGPS::GPS_INVALID_F_ANGLE ? 0.0 : flat, 6);
    SIM900.print(" Longitude = ");
    SIM900.print(flou == TinyGPS::GPS_INVALID_F_ANGLE ? 0.0 : flon, 6);
    delay(200);
}
```



```
SIM900.println((char)26); // End AT command with a ^Z, ASCII code 26  
delay(200);  
SIM900.println();
```

```
}
```

```
Serial.println(failed);  
// if (chars == 0)  
// Serial.println("** No characters received from GPS: check wiring **");
```

```
}
```

```
}
```

(2)To prevent separation of train Compartment due to manufacturing defect Connect one ultrasonic sensor between two compartment that maintains a constant distance between them if the distance will increases then with the help of the attached GSM module Arduino will send a notification to the train driver that Compartment is going to be separated then he will stop the train and inform railway authority that particular train Compartment is going to be separated

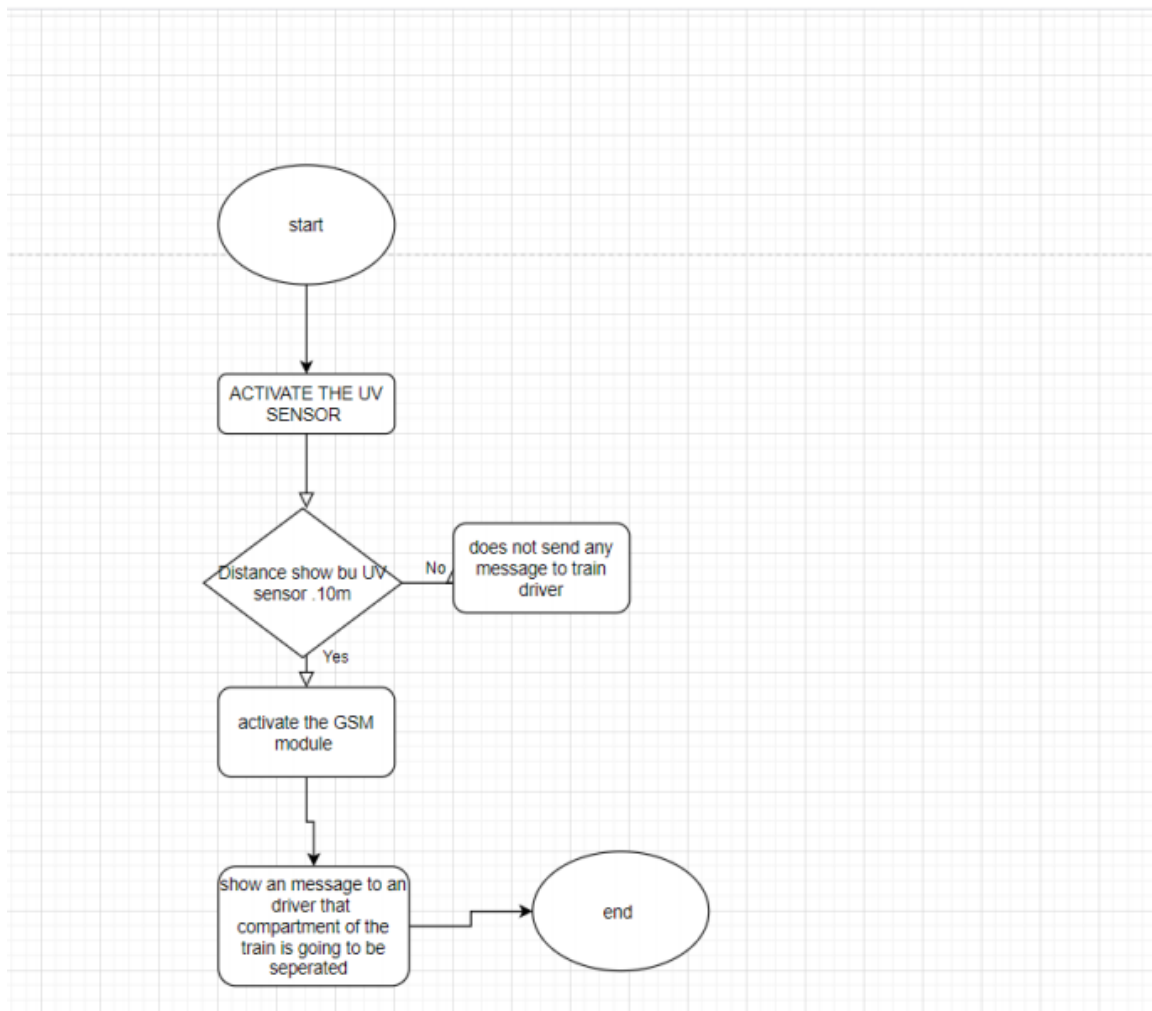


Fig 2: flow chart to To prevent separation of train Compartment due to manufacturing defect

ARDUINO CODE

```
const int echoPin = 2; // Echo Pin of Ultrasonic Sensor
const int pingPin = 3; // Trigger Pin of Ultrasonic Sensor

#include <TinyGPS.h>

#include <SoftwareSerial.h>

SoftwareSerial SIM900(7, 8);

TinyGPS gps;

void setup()
{
    Serial.begin(9600); // Starting Serial Communication
    SIM900.begin(9600);
    pinMode(pingPin, OUTPUT); // initialising pin 3 as output
    pinMode(echoPin, INPUT); // initialising pin 2 as input
}

void loop()
{
    long duration, inches, cm;

    digitalWrite(pingPin, LOW);
    delayMicroseconds(2);

    digitalWrite(pingPin, HIGH);
```

```
delayMicroseconds(10);
```

```
digitalWrite(pingPin, LOW);
```

```
duration = pulseIn(echoPin, HIGH); // using pulsin function to determine total time
```

```
cm = microsecondsToCentimeters(duration); // calling method
```

```
Serial.print(cm);
```

```
Serial.print("cm");
```

```
Serial.println();
```

```
delay(100);
```

```
if(cm==313)
```

```
{
```

```
    bool newData = false;
```

```
    unsigned long chars;
```

```
    unsigned short sentences, failed;
```

```
// For one second we parse GPS data and report some key values
```

```
for (unsigned long start = millis(); millis() - start < 1000;)
```

```
{
```

```
    while (Serial.available())
```

```
    {
```

```
        char c = Serial.read();
```

```
        //Serial.print(c);
```

```
        if (gps.encode(c))
```

```

        newData = true;
    }
}

if (newData)          //If newData is true
{
    float flat, flon;
    unsigned long age;
    gps.f_get_position(&flat, &flon, &age);
    SIM900.print("AT+CMGF=1\r");
    delay(400);

    SIM900.println("AT + CMGS = \"+91xxxxxxxxxx\" coaches get seperated");// recipient's mobile
number with country code

    delay(300);
    SIM900.print("Latitude = ");
    SIM900.print(flat == TinyGPS::GPS_INVALID_F_ANGLE ? 0.0 : flat, 6);
    SIM900.print(" Longitude = ");
    SIM900.print(flou == TinyGPS::GPS_INVALID_F_ANGLE ? 0.0 : flon, 6);
    delay(200);
    SIM900.println((char)26); // End AT command with a ^Z, ASCII code 26
    delay(200);
    SIM900.println();

}

Serial.println(failed);

// if (chars == 0)

    // Serial.println("*** No characters received from GPS: check wiring ***");

```

```
}  
}
```

```
long microsecondsToInches(long microseconds) // method to covert microsec to inches
```

```
{  
    return microseconds / 74 / 2;  
}
```

```
long microsecondsToCentimeters(long microseconds) // method to covert microsec to centimeters
```

```
{  
    return microseconds / 29 / 2;  
}
```

(3)To prevent the collision between two train when the tracks of the train are straight When two trains are on the same track(due to mismatching of the signal or fault in signaling process) for example train A and train B is on the same track train A is ahead of train B then train B will send laser light toward the back of the train B. when laser light of train A hit the photodiode of train B then Arduino of train B will send a message to railway authority that train A is on my track then railway authority alert the train A driver

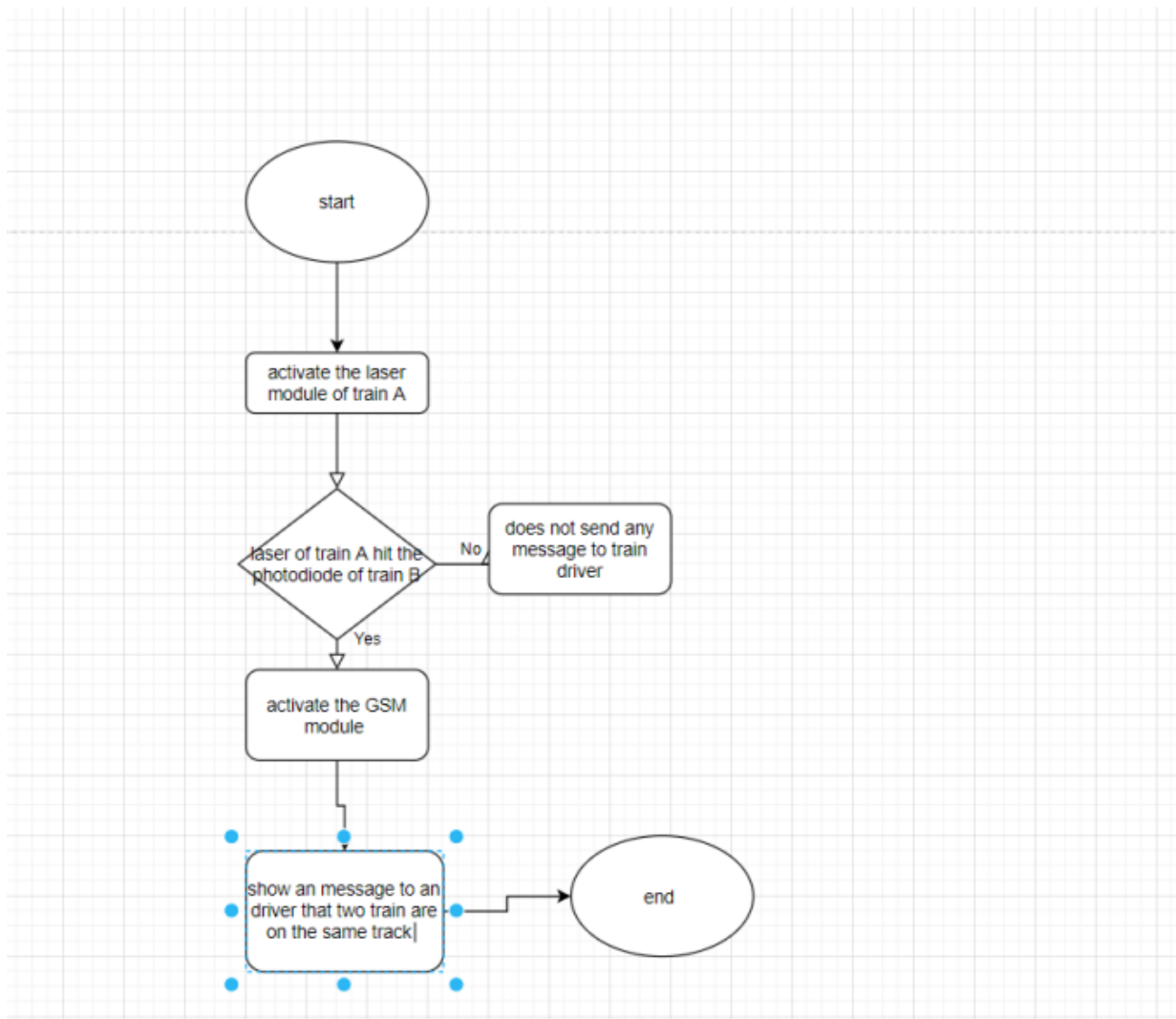


Fig 3:flow chart To prevent the collision between two train when they are on same tracks

ARDUINO CODE

/*

AnalogReadSerial

Reads an analog input on pin 0, prints the result to the Serial Monitor.

Graphical representation is available using Serial Plotter (Tools > Serial Plotter menu).

Attach the center pin of a potentiometer to pin A0, and the outside pins to +5V and ground.

This example code is in the public domain.

<http://www.arduino.cc/en/Tutorial/AnalogReadSerial>

*/

// the setup routine runs once when you press reset:

int ldr=A0;

int val=0;

#include <SoftwareSerial.h>

SoftwareSerial SIM900(7, 8);

void setup() {

// initialize serial communication at 9600 bits per second:

Serial.begin(9600);

SIM900.begin(9600);

}


```

// the loop routine runs over and over again forever:

void loop() {

  // read the input on analog pin 0:
  val = analogRead(ldr);

  // print out the value you read:
  if(val==975){

    SIM900.print("AT+CMGF=1\r");// AT command to send SMS message

    Serial.print("AT+CMGF=1\r" );

    delay(100);

    SIM900.println("AT + CMGS = \"+919609022562\"");// recipient's mobile number, in
international format

    Serial.print("AT + CMGS = \"+919609022562\" ");

    delay(100);

    SIM900.println("two train on the same track.");          // message to send
    Serial.print("two trains are on same track  ." );
    delay(100);

    SIM900.println((char)26);// End AT command with a ^Z, ASCII code 26
    Serial.print((char)26);
    delay(100);

    SIM900.println();

    delay(5000);                                           // give module time to send SMS

    //do {} while (1);

  }

  //Serial.println(val);

  //delay(1);          // delay in between reads for stability
}

```

(4) Fire detection in pantry car When pantry car is being got fired by accident then fire sensor will detect that fire and inform to the train driver then train driver then driver will open the nob of co2 gas

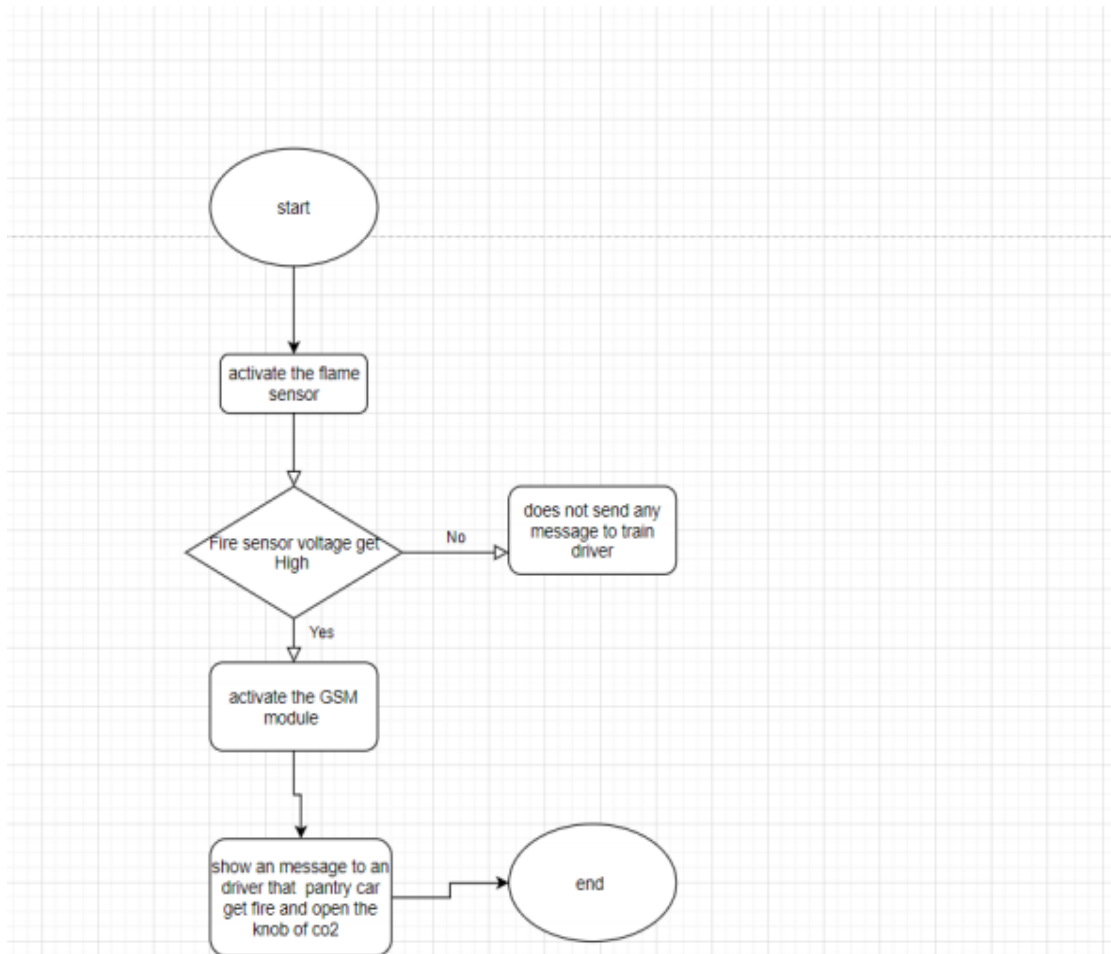


Fig 4:flow chart to detect fire in pantry car

ARDUINO CODE

```
#include <SoftwareSerial.h>
```

```
SoftwareSerial SIM900(2, 3);
```

```
int Flame = 6;
```

```
void setup() {
```

```
    Serial.begin(9600);
```

```
    pinMode(Flame, INPUT_PULLUP);
```

```
}
```

```
void loop() {
```

```
    if(digitalRead(Flame) == 1)
```

```
        SIM900.print("AT+CMGF=1\r");// AT command to send SMS message
```

```
        Serial.print("AT+CMGF=1\r" );
```

```
        delay(100);
```

```
        SIM900.println("AT + CMGS = \"+919609022562\"");// recipient's mobile number, in  
international format
```

```
        Serial.print("AT + CMGS = \"+919609022562\" ");
```

```
        delay(100);
```

```
        SIM900.println("fire detected.");           // message to send
```

```
        Serial.print("fire  detected." );
```

```
        delay(100);
```

```
SIM900.println((char)26);// End AT command with a ^Z, ASCII code 26
```

```
Serial.print((char)26);
```

```
delay(100);
```

```
SIM900.println();
```

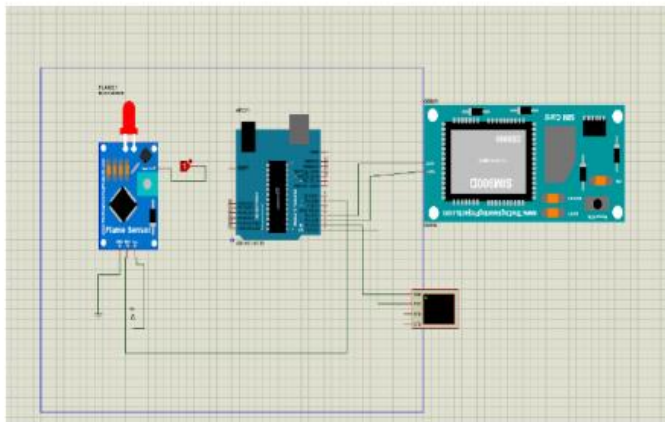
```
delay(5000); // give module time to send SMS
```

```
//do {} while (1
```

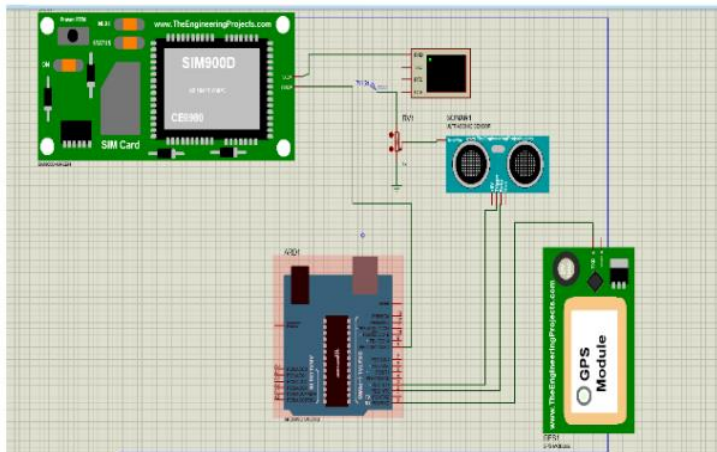
```
}
```

MODELING AND ANALYSIS

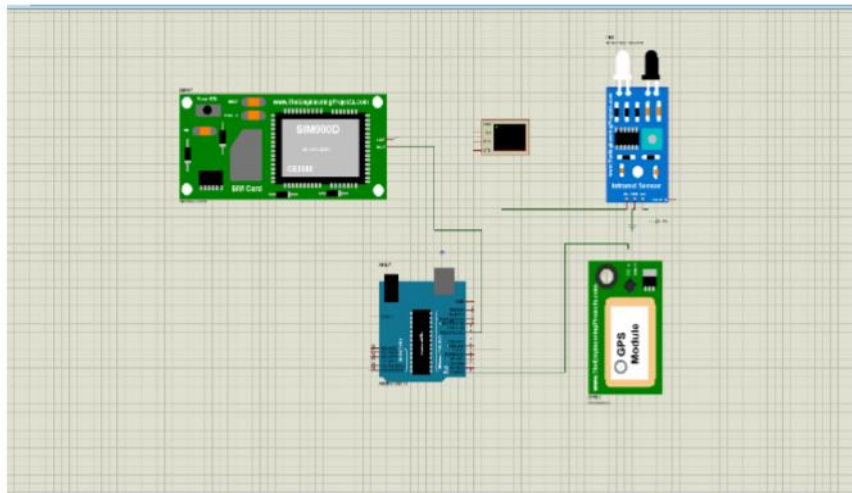
Model to detect Fire in pantry Car



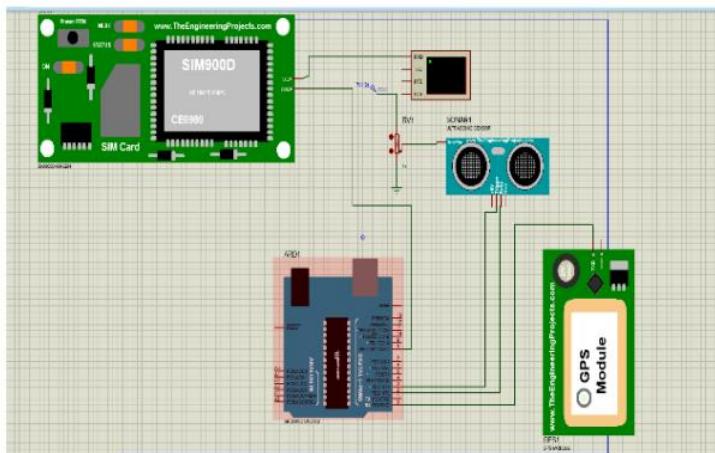
Model to Check the separation of two compartment of train



Model to detect the present of crack in railway track

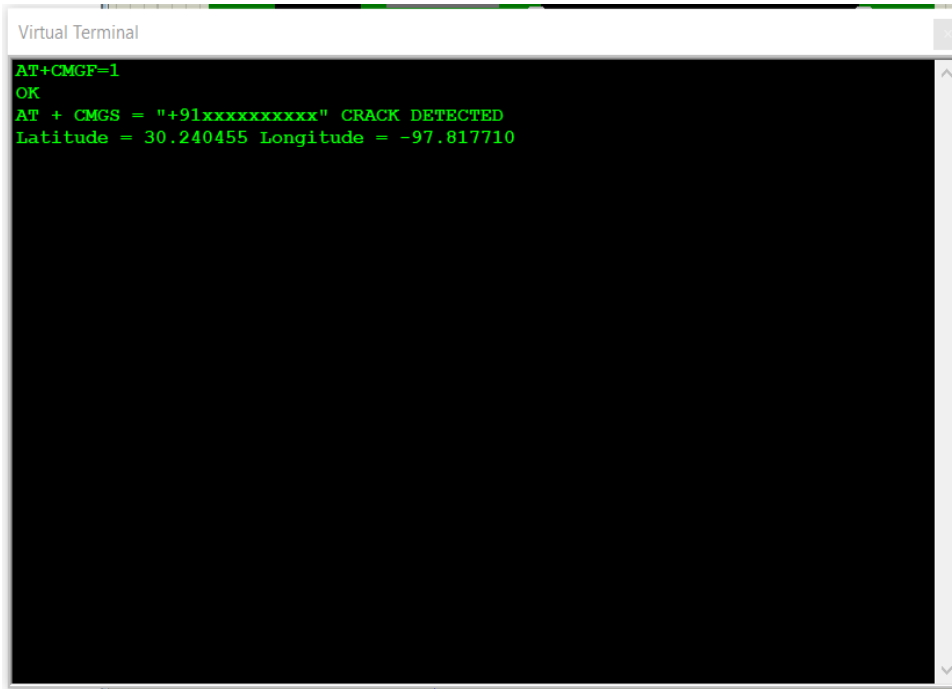


Model to Check the separation of two compartment of train



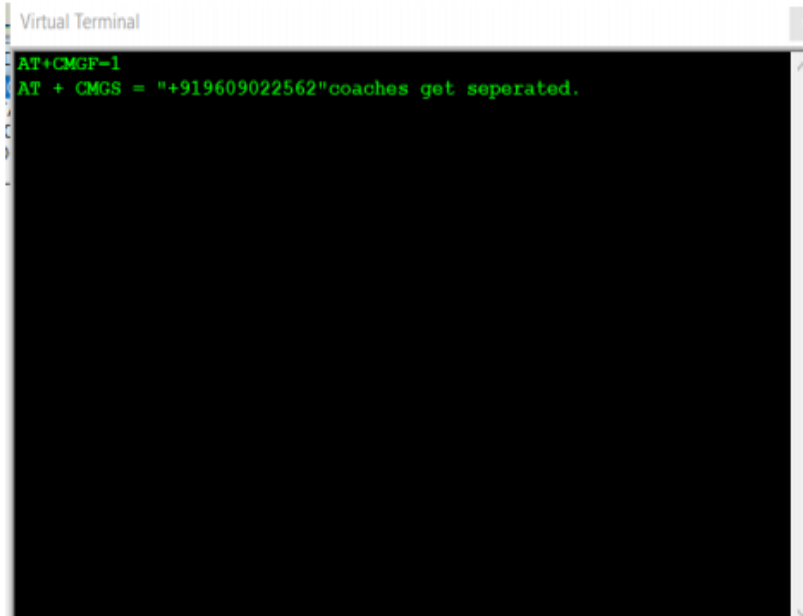
RESULT AND DISCUSSION

1)Crack Detection In crack detection if the crack is detected in the railway track then the robot which is checking the crack in railway track will send the message to railway authority that cracks is detected and value of longitude and latitude of that particular location is sent to the railway authority if two location are different then railway authority take necessary action



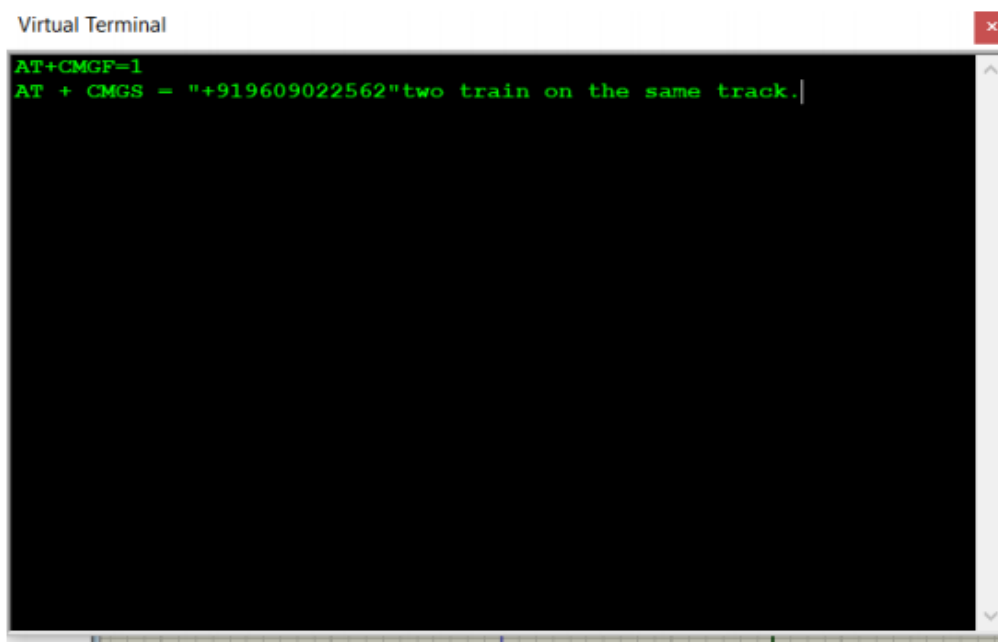
```
Virtual Terminal
AT+CMGF=1
OK
AT + CMGS = "+91xxxxxxxxxx" CRACK DETECTED
Latitude = 30.240455 Longitude = -97.817710
```

(2) Separation of Compartment in train In Compartment separation, if the ultrasonic sensor shows a distance greater than the distance between the coaches then GSM module will send a message to the train driver that Compartment are going to be separated



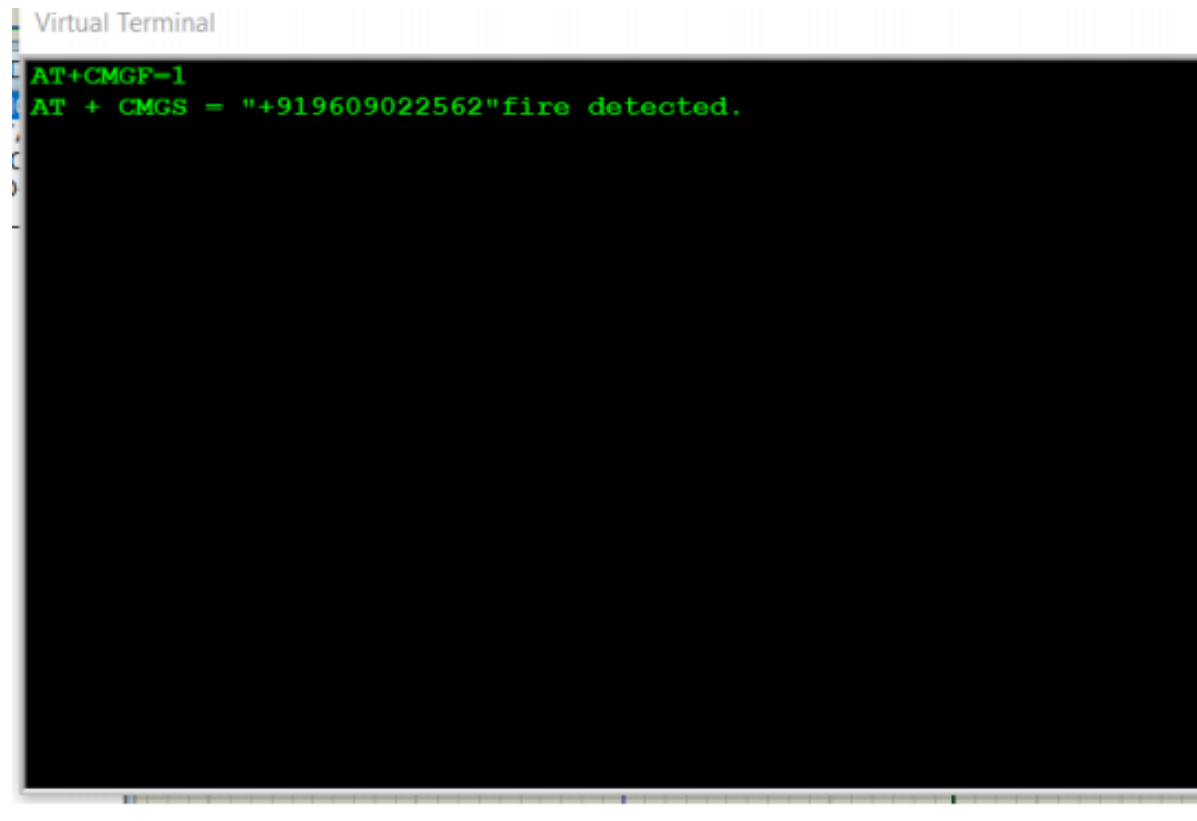
```
Virtual Terminal
AT+CMGF=1
AT + CMGS = "+919609022562"coaches get seperated.
```

(3) Collision between two trains who are on the same track In the prevention of collision between the two trains if there are two trains on the same track then train which is ahead of the other train get message that another train is on the same track on which it is running



```
Virtual Terminal
AT+CMGF=1
AT + CMGS = "+919609022562"two train on the same track.
```


(4)Fire detection In fire detection in the pantry car if, the fire sensor will detect the fire in the pantry car then Arduino will inform the train driver that the pantry car gets fire .

A screenshot of a 'Virtual Terminal' window. The window has a black background with green text. The text consists of two lines: 'AT+CMGF=1' on the first line and 'AT + CMGS = "+919609022562"fire detected.' on the second line. The window has a standard macOS-style title bar at the top with the text 'Virtual Terminal' and a scroll bar on the right side.

```
Virtual Terminal
AT+CMGF=1
AT + CMGS = "+919609022562"fire detected.
```

CONCLUSION

This project presents smart monitoring of the train and its track this project is divided into four-part the first part is to find the crack or breakage in a train track by using an infrared sensor and Arduino will check the battery life of robot who detecting the crack in the railway track . The second part of the project mitigates the problem of compartment separation due to manufacturing fault this can be achieved by an ultrasonic sensor that shows a constant distance between the Compartment if the distance measured by the ultrasonic sensor is increasing then Compartment of the train going to be separated before train compartment getting separated it will send a message to a driver that train compartment is going to be separated the third part of the project mitigate the problem of train collision between the train which is on the same track and the last one is to alert the train driver that pantry car gets fire .so that train driver can take necessary action to get control over fire .

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