

# AUTOMATIC RAILWAY TRACK CRACK DETECTION SYSTEM

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**Abstract** – The Indian Railways consists one of the largest railway networks in the whole world, crises-crossing over 1, 15,000 km in distance, all over India. However, with regard to reliability, dependability and passenger safety of Indian Railways is not up to the global standards. Among other factors, the cracks are developed on the railway tracks due to absence of the inefficient timely detection

Our work involves a project that aims of designing a railway crack detection system (RCDS) using Ultrasonic Sensor, The GSM (Global System for Mobile Communications), GPS (Global Positioning System) and Arduino based module whose implementation is an efficient method of detecting the cracks which is present in the tracks and thus avoiding derailment of the trains.

**Keywords:** GSM, GPS, Efficient, Detection, Derailment.

## 1. INTRODUCTION

Transport is a important key that allows production and consumption of products to occur at different locations. Transport involves the history of development to expansion as better transport leads to more trade. Economic prosperity has always been dependent on increasing the capacity and rationality of the transport. But the infrastructure and operation of transport includes a great impact on the land and it is the largest drainer of energy, making transport sustainability and safety a major issue. In India, we find that railway transport occupies a important position in providing the necessarily transport infrastructure to sustain and quench the never ending needs of a rapidly growing economy. Today, India consist the fourth largest railway network in the world. However, in terms of the reliability, dependability and safety parameters, we have not yet reached truly at the global standards. This is an era of automation which is broadly defined as replacement of manual effort by Electronics and robotization in all degrees of automation. The operation remains an essential part of the system although with changing demands of physical input as the degree of mechanization is increased.

Degrees of automation are of two types, viz.

- a. Full automation.
- b. Semi automation.

The semi automation involves a combination of manual effort and mechanical power which is required whereas in full automation human participation is very negligible. Our project is fully automated one.

## 1.1 PROBLEM IDENTIFICATION

The principal problem is the lack of cheap and efficient technology to detect problems in the rail tracks and of course, the lack of proper maintenance of rails which have resulted in the formation of cracks in the rails and other similar problems caused by antisocial elements which jeopardize the security of operation of rail transport. In the past, this problem has lead to a number of derailments resulting in a heavy loss of life and property. Cracks in rails have been identified to be the main cause of derailments in the past, yet there have been no cheap automated solutions available for testing purposes. Although, the railway has a maintenance department which consumes much of the manpower and money

## 1.2 PROPOSED SYSTEM

In this framework we are utilizing Arduino Nano, which goes about as controller of the framework. This microcontroller controls the circuit work. Different segments are interfaced with this microcontroller to perform wanted activity of the framework. The equipment parts utilized in this framework requires directed force flexibly for the activity. This force is given by the battery-powered battery of 12v associated in the framework. In this framework we have interfaced two bright sensors with the microcontroller for the separation and identification of the split present in the track of the railroad line. To impart they got data, we utilize a GSM modem. The GSM module is being utilized to send the information to the significant authority as a SMS and the GPS module is attached in order to define the position of the track where the crack is located so it makes process easy.

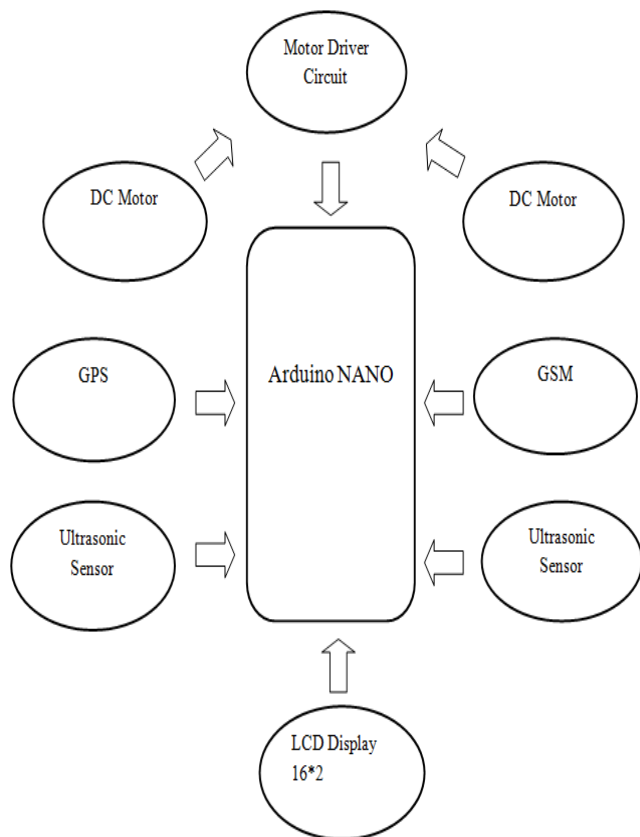


Figure 1. Block Diagram of Project

Two DC engines are utilized to move the robot forward way. These engines are interfaced and controlled through the microcontroller. To work these engines through a microcontroller a driver circuit is required for interfacing among microcontroller and engines. The engineering of the proposed framework likewise comprises of a 16x2 LCD show, interfaced with the microcontroller for the presentation reason. This LCD show will show the break identified by the framework.

2. OPERATION OF SYSTEM

In our project, there are two set of ultraviolet sensors units fitted to the front side of the vehicle. This unit is used to activate/deactivate GSM transmitter unit when it encounters any cracks in the track. The sensors in the circuit are used to sense the cracks which occur when the programmed value changes.

When the vehicle is Powered On, it moves along the model track. The sensors continuously monitor the Condition of the tracks. In normal condition the motor, transmission is in initial stage. When the battery power supplies the microcontroller then it starts the motor in forward direction and serial transmission is used to send the messages to the microcontroller. When the crack is detected by the UV sensors the vehicle stops at once and the GSM module sends the text message to the predefined number with the help of SIM card that is inserted into the

module and the position of the crack is sent along with the message comprising the GPS module hence this enables the operator locate the position of crack easily at the time of maintenance

- a. **At Normal Condition:** At normal condition the vehicle is continuously sensing the defined track and the vehicle is running continuously with the fine message on the LCD display
- b. **At Crack Condition:** As soon as the crack is detected by the system the UV sensor reflects the value equal to zero and the vehicle stops at once, The GSM module sends the text message to the predefined number with the help of SIM card that is inserted into the module to send the SMS and the GPS receiver triangulates the position of the vehicle to receive the Latitude and Longitude coordinates of the vehicle position, from satellites. The Latitude and Longitude coordinates received by GPS are converted into a text message which is done by microcontroller.

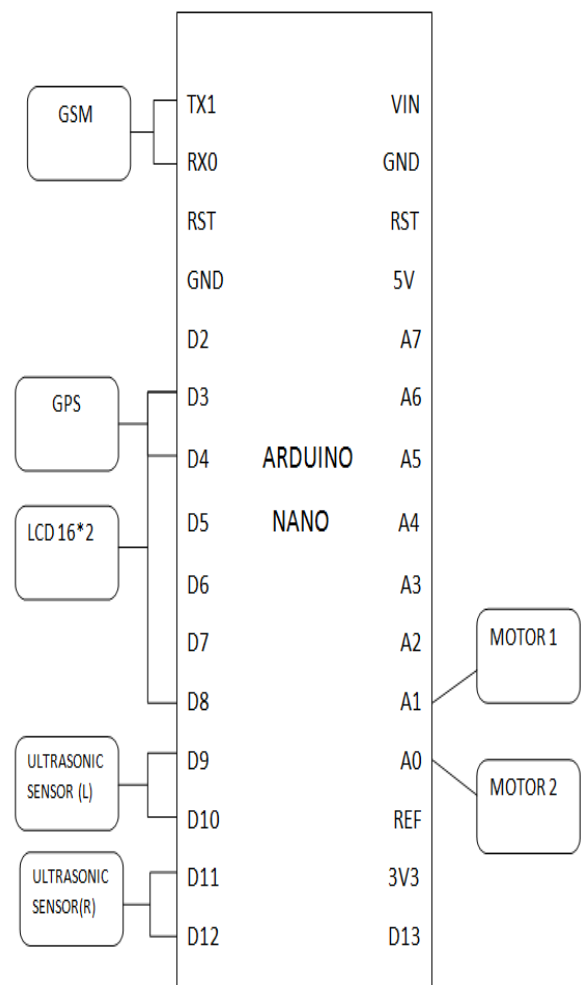


Figure 2- Circuit Diagram of the Project

**2.1 FLOW CHART** The flowchart drawn below describes the step by step procedure involved in the working of our Model

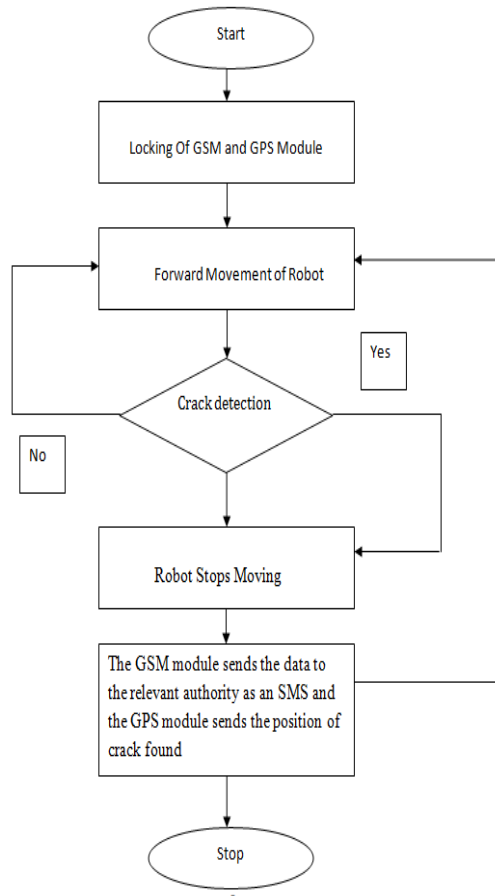


Figure 3- flowchart

### 3. REQUIRED COMPONENTS

#### 3.1 Arduino Nano

Arduino Nano is one of the microcontroller boards, it is structured by Arduino.cc. It's made to be worked with a microcontroller like Atmega328. This microcontroller is utilized in Arduino UNO. It is a little bigger in size and furthermore adaptable with a wide assortment of uses.

Arduino Nano Pin out consists 14 computerized pins, 8 simple Pins, 2 Reset Pins and 6 Power Pins. It accompanies a working voltage of 5V where it can held a voltage fluctuate from 7 to 12V. Each of these Digital and Analog Pins is relegated with various capacities yet their primary capacity is to be arranged as information Arduino Nano accompanies a precious stone oscillator of recurrence 16 MHz It is utilized to deliver a clock of exact recurrence utilizing consistent voltage.

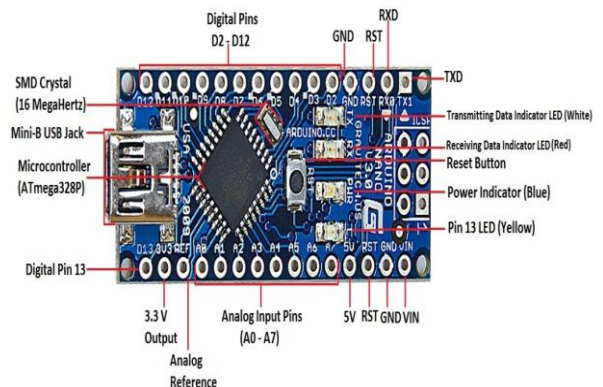


Figure 4-Diagram of Arduino

#### 3.2 LCD(Liquid Crystal Display)

LCD screen is an electronic showcase module which consist a 16x2 LCD display as it is an essential module which is utilized in different gadgets and circuits. An LED is often small in area (less than 1 mm<sup>2</sup>) and integrated optical components maybe used to shape its radiation pattern. The 16x2 LCD implies it can show 16 characters for every line and there are 2 such lines

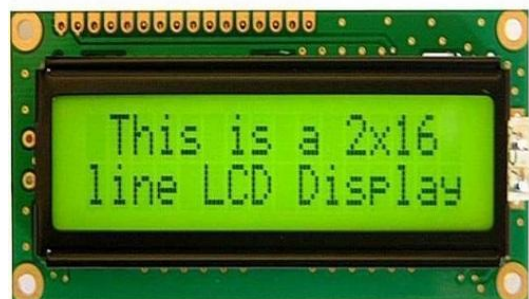


Figure 5-LCD display16X2

#### 3.3 GSMSIM900

This GSM can acknowledge any GSM arrangement administrator SIM card and act simply like a cell phone with its own one of a kind telephone number. The Favorable position of utilizing this modem will be that you can utilize its RS232 port to impart and create installed applications. Applications like SMS Control, information move, remote control and logging can be grown without any problem. Operations that can be performed using GSM modem:

- We can read, write and delete SMS.
- We can start Sending SMS.
- We can reply to a SMS.
- We can monitor the value of signal strength in particular locality.
- We can monitor the charging status and also the charge level of the battery.

f. We can read, write and search phone book entries.

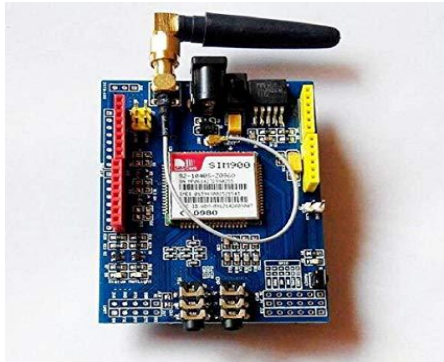


Figure 6- GSM Module



Figure 8- GPS Module

### 3.4 D.C MOTOR

A dc motor uses electrical energy to produce mechanical energy, very typically through the interaction of magnetic fields and current-carrying conductors. The input of a DC motor is current/voltage and its output is torque (speed).

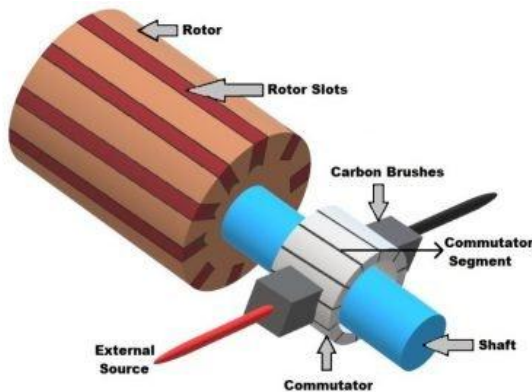


Figure 7- DC Motor

### 3.5 GPS MODEM

Global Positioning System (GPS) satellites broadcast signals from space that GPS receivers, use to provide three-dimensional location (latitude, longitude, and altitude) plus precise time. GPS receivers provides reliable positioning, navigation, and timing services to worldwide users on a continuous basis in all weather, day and night, anywhere on or near the Earth. Ultra-sensitive GPS receiver can acquire GPS signals from 65 channels of satellites and output position data with high accuracy in extremely challenging environments and under poor signal conditions due to its active antenna and high sensitivity.

The Global Positioning System (GPS) is global navigation satellite system which uses a constellation of between 24 and 32 Medium Earth Orbit satellites that transmit precise microwave signals that enable GPS receivers to determine their location, speed, direction, and time.

### 4. CONCLUSION

In this we have designed a cost effective, low-power embedded system, which facilitate better safety standards of railway tracks for preventing rail accidents due to cracks and obstacle on railway tracks. The Prototype of testing vehicle can efficiently detect cracks and obstacles on railway tracks and this prototype takes the power supply from a 12v battery that can be replaced by a solar panel which increases its amount of time it can work which was limited with the battery. The result shows that this new innovative technology will increase the reliability of safety systems in railway transport. By implementing these features in real time application, we can avoid accidents up to approximately 70%.

### 5. FUTURE SCOPE

More effective work can be done in order to provide a better speed to the automated vehicle robot. Also enhancement can be done to get better accuracy about the location of the place where the fault had occurred. Also the robot can be made large so that by using its weight track shiftiness i.e. stress and strain parameters of the track can be determined so as to make this system more effective. A better module can also be incorporated for low cost short distance scrutinizing mechanism in order to provide good connectivity at a low input cost.

The battery of 12v can be replaced by the solar panel in order to achieve most out of it.

A more efficient prototype can be build with image recognition which will eventually increase the efficiency and accuracy of the vehicle as the vehicle can differentiate between the minor and the major cracks.

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