

# Railway Track Crack Detection

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**Abstract**—In India railways transportation service is the cheap and the majority convenient mode of passenger transport and also for long distance and suburban traffic. The main cause of the accidents happened in railways are railway track crossing and unrevealed crack in railway tracks. Therefore, there is a need to have new technology which will be robust, efficient and stable for both crack detection in railway track as well as object detection. This project discusses a Railway track crack detection using sensors and is a dynamic approach which combines the use of GPS tracking system to send alert messages and the geographical coordinate of location. Arduino Microcontrollers used to control and coordinate the activities of this device.

**Keywords**—GPS Module; Arduino Microcontroller; Railway Track

## I. INTRODUCTION

Railway is one of the most significant transportation modes of our country but it is a matter of great sorrow that, railway tracks of our country are very prone. That's why, a vast number of accidents are occurred every year due to this primitive type of railway tracks and as the consequences of those accidents we lose huge number of lives every year.

These types of incidents motivate us to think over the above mentioned issue and take necessary steps to protect those lives. Through our proposed system, we need to establish more modern and secure railway system. Besides this, there is no such type of technology or system in our country which can stop the collision between two trains coming from the opposite direction of each other on the same track. We actually think over this matter and motivated to do so. Moreover natural disaster can throw any object on the rail track which cannot be removed very quickly in the remote area. We thought if our system can detect those object or barrier and inform to the control room then they can take necessary steps to avoid accident. Figure 1 depicts the crack on track. The Rail transport is growing at a rapid pace in India. It is one of the major mode of transport but still our facilities are not that accurate, safer as compared to international standards. A survey on the internet states that about 60% of all the railway accidents is due to derailments, recent measurements shows that about 90% are due to cracks on the rails. Hence, it is not safer for Human Life. This needs to be at the utmost attention. These goes unnoticed and the properly maintenance of tracks is not done.

In previously existing system, the work is to be done manually, but the proposed system has a robot which will run automatically on the tracks. System having LED and LDR sensor assembly, but the main disadvantage is that the LED and LDR must be placed opposite to each other and also the environment needs to be perfect to detect the track. To overcome this

disadvantage, here sensors are used, which will detect the crack accurately. The existing system is slow, tedious and time consuming. This system has GSM and GPS module which will give the real time location or coordinates in the form of Short Message Service (SMS) to the nearest railway station.



Figure. 1. Railway crack on track

### A. Train accident statistics

TABLE I shows statistics of the number of injuries caused due to train accidents.

Table-I: statistics of the number of injuries caused due to train accidents

Year	Number of train accidents	Number of deaths/injuries	Number of deaths due to rail crack
2013-14	20	275	156
2014-15	15	196	124
2016-17	17	249	150
2017-18	29	57	58
2018-19	39	37	108

Figure 2 depicts the number of deaths due to rail accidents. As it can be observed from Figure 2, the number of deaths is increasing year to year. Hence there is a great need for

technical solution to the problem of rail cracks.

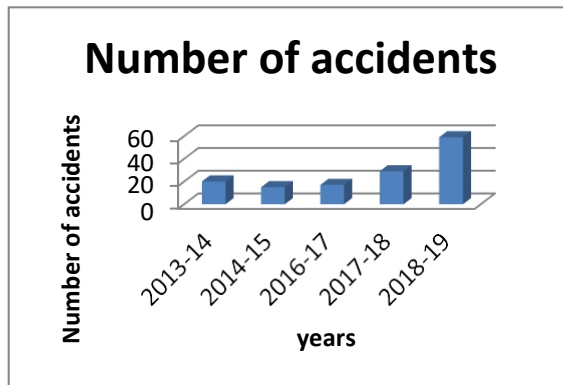


Fig. 2. Number Of deaths year wise

## II. METHODOLOGY

The main aim of project is to design the railway crack detection using Ultrasonic sensors. The project block diagram is shown in Figure 3, which contains microcontroller (Arduino), ultrasonic sensor, motor driver, motor, GPS module when the crack is detected, relevant geographical location coordinates will sent to the nearest station. This recording and sending of coordinates are done by GPS module. GPS network used by cell phones provides a low cost, long range wireless communication channel for applications that require connectivity rather than higher data rates. Infrared transmitter is one type of the LED which emits infrared rays generally called IR transmitter.

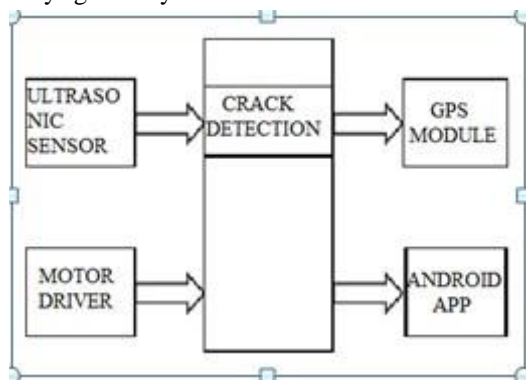


Figure. 3. Rail track detection

Ultrasonic sensor is used to detect the crack in the rail track with measuring the distance from track to sensor. Ultrasonic technique is the most effective method which detects cracks on a railway track. An android application will be developed to intimate about the rail cracks. As and when a rail crack is detected by the crack detection system, the corresponding loco pilot will be intimated through a pop-up message. This pop-up notification service will be implementing with the help of GPS module.

### A. Process of the rail track system

The project block diagram is shown in Figure 4, which contains following process

- Initially the tracks are being continuously monitored with the help of sensor, which is used to detect the crack in the track.
- This monitoring is done with the help of ultrasonic sensor

in order to sense the minor changes also which can be quite difficult with other sensors.

c) Whenever the crack gets detected with the help of ultrasonic sensor it passes the alert of crack found to the Arduino microcontroller.

d) The Arduino microcontroller will perform the process assigned to it accordingly.

e) The process mainly includes positioning, sending and alerting through the help of GPS module.

f) As the message gets delivered to the Railway Authority, the alert is to be taken into account and

important measures must be taken by them in order to avoid future incidents and miss happenings which can lead to loss of human life and also to major injuries.

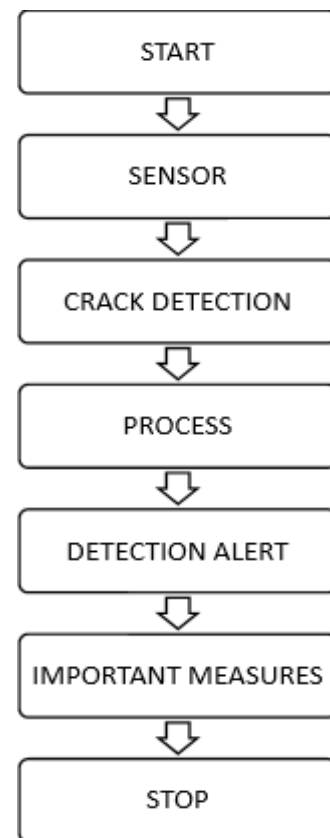


Figure.4. Process Flowchart

## III. ARCHITECTURE

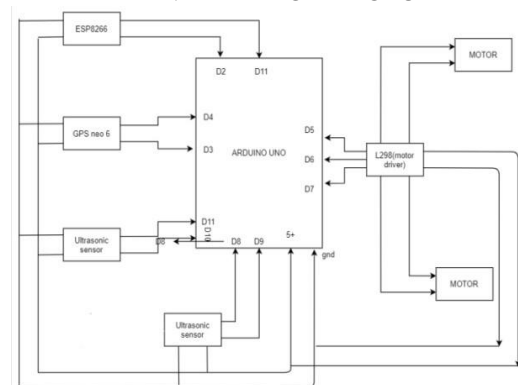


Figure. 5. Circuit diagram of system design

The project block diagram is shown in Figure 5, which contains microcontroller (Arduino), ultrasonic sensor, motor driver, motor, GPS module. Initially the system will move on the track using motor, motor is given power through a motor driver and commanded through Arduino controller. Whenever there is crack detection the motor will stop and the system will halt on the track. The crack is detected using ultrasonic sensor. After the crack detection the location data is to be sent to control room. GPS modules are used to get precise location of the car. This location is fed to controller. After successful delivery of message to control room, controller provides a signal to motor driver initiating the motor and hence car starts to move on the track. This process continues till the operator turns the system off.

#### IV. MODEL IMPLEMENTATION

##### A. Construction of circuit

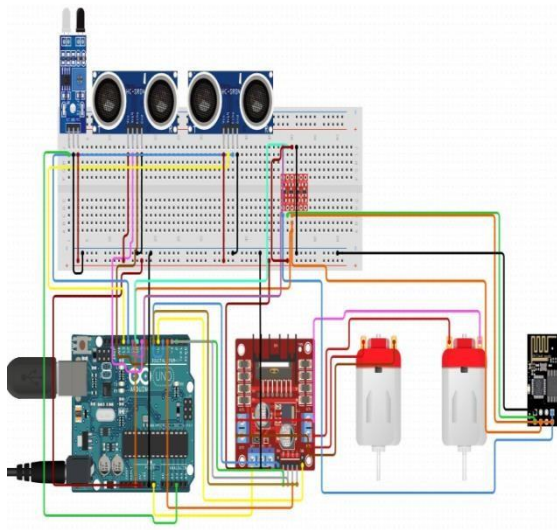


Figure. 6. Circuit Connection for System design

The main objective is to define any railway track fault using this system, which is implemented in effective and will also function efficiently. This method will be helpful in regular track checking as it is more convenient than the handheld checking system. The current system has a railway labourers walking on the railway tracks and detecting the fault manually. In Figure 6 here we are using arduino for control action to make system we are connecting Ultrasonic sensors and IR sensors to detect the obstacle and we are connecting dc motors, gps module is used. This requires a lot of time and labour. So we are using aUltrasonic sensors and IR sensors for railway track crack detection. The testing vehicle consists of motors driven by a motor driver. The IR, and Ultrasonic sensor which is connected to the Arduino. Message is generated using GSM and GPS and will be sent to the nearby station.

##### B. Arduino uno

Arduino is an open source programmable circuit board based on top of easy to use hardware and software. The above Figure 7 depicts aarduino uno. It is tough in nature and can support the peripherals efficiently. It is centered on ATmega328. It has 14

digital input/output pins 6 analog inputs, a USB connection, a power jack, an ICSP header, and a reset button. The power essential to run the board can supply through connecting it to the laptop using a USB cable or plugging an ACDC power supply.



Figure. 7. Arduino Uno

##### C. GPS module



Figure. 8. GPS Modem

A satellite navigation system used to position the ground place of an object. The above figure 8 shows a GPS modem. A GPS receiver calculates the position by timing the signals send by the GPS satellites high above the earth. The position is then displayed through moving map display or latitude and longitude. By the GPS module longitude and latitude value can exist as shown in figure 9.

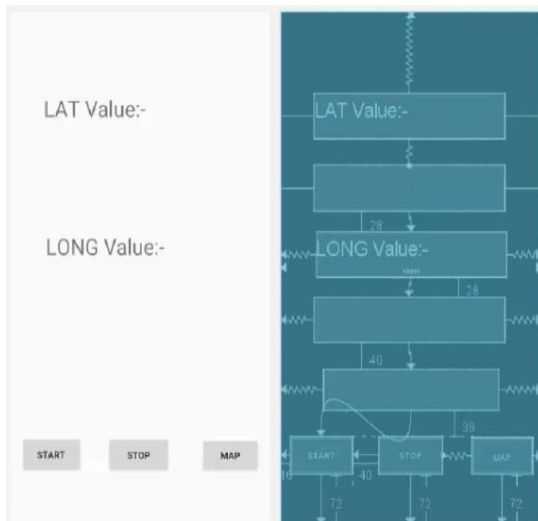


Figure. 9. Display of latitude and longitude value

#### A. Motor Driver: L298N

The L298N is a dual H-Bridge motor driver this allows speed and direction control of two DC motors at the same time. Motor L298N driver contains an IC as shown in the figure 10. The module can drive DC motors that have voltages among 5 and 35V, with a peak current capable of 2A.



Figure. 10. Motor Driver (L298N)

#### B. Generating a system

In the system crack in the tracks is detected by means of sensor and Arduino microcontroller, measuring distance for two railroads. In this project we have used ultrasonic sensors to detect the crack. The below figure 11 shows system for detecting the crack using ultrasonic sensors. It uses to measure the distance between the two tracks. If any crack occurred in the track means latitude and longitude coordinates of the place are to be sent to the nearest railway station or control room and ultrasonic sensor measured the

of the processing technique. The crack detection can be made of two ways. They are Destructive Testing and Non-Destructive testing. It is part of a vision system, generating a crack map to support condition monitoring for buildings.

distance between the two tracks if there is any variance found the message which contains coordinates of that particular place will be sent to the nearest station or control room with the help of GPS module. This project is to be made in order to change the system of crack detection in railways which can be resulted out as not only cost-effective but also with good accuracy and time saving facility.

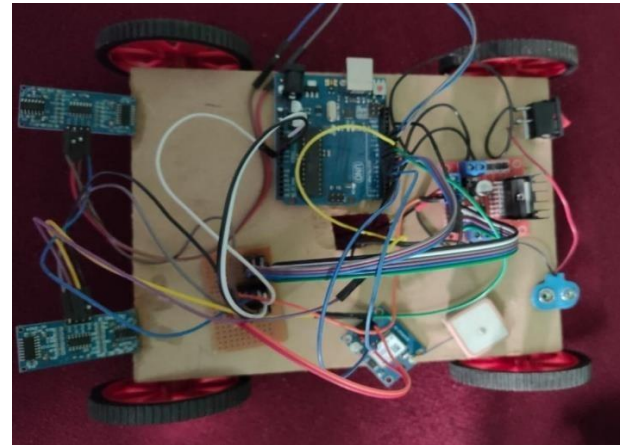


Figure. 11. system to detect rail track

- a) Initially the tracks are being continuously monitored with the help of sensor, which is used to detect the crack inside the track.
- b) This monitoring is done with the help of ultrasonic sensor in order to sense the minor changes also which can be quite difficult with other sensors.
- c) Whenever the crack gets detected with the help of ultrasonic sensor it passes the alert of crack found to the Arduino microcontroller.
- d) The Arduino microcontroller will perform the process assigned to it accordingly.
- e) The process mainly includes positioning, sending and alerting through the help of GPS module.
- f) As message gets delivered to the Railway Authority, the alert is to be taken into account and important measures must be taken by them in order to avoid future incidents and miss happenings which can lead to loss of human life and also to major injuries.

#### V. APPLICATIONS

Railway track crack detection system has been applied for different application areas are listed below.

- **AUTOMATIC CRACK CHECKING-**  
Rail Crack detection is the process of detecting a crack in the structures using any

The suggested method uses successively radiometric, geometric and contextual information. The vehicle draws power from the battery. The optical sensor is used to detect the crack in the railway track. Suppose any racks are in the



track the vehicle will automatically stop.

#### ○ WIRELESS APPLICATION

**Wireless application** protocol (WAP) is the communications protocol that is used for wireless data access through the most mobile **wireless** network.

WAP

enhances **wireless** specification interoperability and facilitates instant connectivity between interactive **wireless** devices (such as mobile phones) and the Internet. Wireless Application Protocol is a technical standard for the accessing information over a mobile wireless network. A **WAP** browser is web browser for mobile devices such as mobile phones that uses the protocols. Though WAP is a new technology, but it reuses the concepts found in the Internet.

#### ○ RAILWAY TRACK DAMAGE DETECTION APPLICATIONS

A railway damage detection and measurement system using neural networks. Railway- defects and damages often cause train accidents. Experimental result shows that this neural network based measurement system has high precision and is suitable for online railway damage detection and measurement applications. A list of methods used to detect flaws in railways: Ultrasound -is the most popular method. Eddy current inspections - great for surface flaw & near surface flaws. Magnetic Particle Inspection- used for detailed manual inspections. Ultrasonic sensor is used to detect the crack on the railway track by not receiving the echo from the track; if the echo sound is received then no crack is detected on the track. The output of ultrasonic sensors is given to the microcontroller, which is connected to the GPS, motor driver IC.

## VI. CONCLUSION

As per the study the existing systems are time consuming as well as uneconomical. The proposed system is not only overcome these problems but also improve accuracy and crack detection in rails. It is the most economical solution provided in order to achieve good results of railways of our country in order to minimize the stats of accidents caused. There by possible to save precious lives of passengers and loss of economy. It also saves the time and money for identification of crack.

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