

# ADVANCED RAILWAY TRACK FAULT DETECTION AND REPORTING OVER INTERNET OF THINGS (IOT)

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**Abstract** - Indian Railways is the largest railway network in Asia and additionally world's second largest network operated underneath a single management. Due to its large size it is difficult to monitor the cracks in tracks manually. This paper deals with this problem and detects cracks in tracks with the help of ultrasonic sensor attached to moving robot. Ultrasonic sensor allows the device to move back and forth across the track and if there is any fault, it gives information to the cloud server through which railway department is informed on time about cracks and many lives can be saved. This is the application of IoT, due to this it is cost effective system. This effective methodology of continuous observation and assessment of rail tracks might facilitate to stop accidents. This methodology endlessly monitors the rail stress, evaluate the results and provide the rail break alerts such as potential buckling conditions, bending of rails and wheel impact load detection to the concerned authorities. Here we proposed an innovative approach to detect railway track crack as this system detects crack based on image processing. Many image preprocessing steps is used to detect railway track crack. As image is prone to noise. System converts image to grayscale image and uses filtering to remove noise from image. Noise removal helps to detect crack more accurately. Image luminous level is increased and image is converted to binary image. This helps system to detect only crack and helps to remove other unwanted objects. Image once converted to binary image, holes are filled by using image processing method this helps to reject all smaller objects which are not required for crack detection. Crack is detected based on the intensity value. Intensity value is for accuracy.

**Key Words:** IoT, NodeMCU ESP32, Ultrasonic sensor, IR Sensor,

## 1. INTRODUCTION

Railway is one of the most significant transportation modes of our country but it's a matter of great anguish that rail tracks of our country are veritably prone. That's why, a vast number of accidents are passed every time due to this primitive type of rail tracks and as the consequences of those accidents we lose huge number of lives every time. These types of incidents motivate us to suppose over the below mentioned issue and take necessary way to cover those lives.

Through our proposed system, we need to establish further ultramodern and secure rail system. Besides this, there's no similar 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. More over 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. 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.

In India the railway network has a track length of 113,617 kilometers (70,598 mi) over a route of 63,974 kilometers (39,752 mi) and 7,083 stations. This is the fourth largest railway network in the world. The Rail transport is growing at a rapid pace in India. It is one of the major modes 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 rail accidents is due to derailments, recent

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## 2. LITERATURE SURVEY

### 2.1 LITERATURE REVIEW:

Indian railways is one of busiest network in the world covering track network of 1,27,000 sq.km. Almost 2/3rd of the population use the railway network in India. Almost 60% of the accidents are occurring at railway track crossing and due to crack in railway tracks resulting in loss of precious life and loss of economy. So in current scenario this problem has immense potential in having an ideal solution to this problem. Now I want to put some light on existing systems that railways in order to counter this problem. So, basically we have the manual surveying and maintenance of tracks done by person and other is systems that they use like SPURT Car and USFD manual

machine that are used in detecting and monitoring of cracks. Basically in the both the methods, surveying and detection of cracks is been done but the limitation is basically maintenance people are required for both methods to monitor the crack in the track. Also this method is limited for certain routes and not all routes and divisions of railways can be covered. Also sometimes accuracy is faulted. Also eddy current method ultrasonic crack detector is also used in some instances. We have inferred the ideas in designing railway crack detection system using Arduino Microcontroller and sensors in order to detect the cracks and location of cracks been given by GPS module and alert through messages through GSM module. We are committed in building such system which will give an optimal solution to the crack detection problem and also reach in achieving higher accuracy and precision than existing systems. Also our project aims in giving safety assurance to railways, whereas the existing systems lag it completely.

India procures a major position in the list of quickly developing countries with notable and appreciable advancements in the field of railway network. Derailments contribute to several railway accidents that have been caused. This is mainly due to the cracks in the railway track. These cracks usually go unobserved due to irregular maintenance. Manual track monitoring also adds to this issue of railway accidents. In this work, an autonomous testing train has been proposed for examining and spotting the cracks that are formed in the railway track. It is capable enough to detect even the small cracks caused on the railway tracks. The proposed testing train moves along the alienated path, which is the railway track and detects the cracks and limits in the track the relevant officials are intimated with the exact location of the crack [1].

In this paper, we present an automated system based on microcontroller and sensors to overcome the problem of faults in tracks and to identify the moving object or animal on the tracks. The system designed is an autonomous robot consist of PIR and Ultrasonic sensors, coupled with GPS and GSM for providing the real time alert. Global Mobile Communications System (GSM), GPS (Global Positioning) System) and broken rail track detection, based on the microcontroller, are an effective method of detecting cracks present on tracks, thus preventing train derailment. This device uses two stations to detect cracks on the path through TSOP sensors that transmit sinus waves to the ideal path. The crack detection on the railway line is used to locate the crack on tracks. The device proposed is used before 10 km to detect the railway crack [2].

The proposed system utilizes CNN to detect the faults in the railway tracks with the help of images. Their characteristics are obtained to extract the default railway track. This model helps to reduce the manual inspection work. The CNN algorithm, the ground truth databases on images of masks are utilized. The algorithm improves the accuracy of railway crack detection effectively under convoluted conditions. The convolutional neural network (CNN) is mainly designed for recognizing. CNN is performed outstandingly including both MNIST and SVHN datasets. Broken Rail Detection System using RF Technology is proposed. Mainly this system is used to detect the broken rail and provide the information exactly about the tracks. This model presents a synthesis of the art of computer vision this mainly explains the categories of the methods in computer vision methods, they are used to automate the damage and process detection [3].

The presented methodology is to monitor endlessly cracks in tracks, obstacles on rail tracks and any other train running on the same track oppositely by using sensors. When identified, the device will send an alert to the driver to prevent the accidents. The flame sensor detects it and sends a signal to the microcontroller and driver when the train compartment catches fire. With the help of this paper, we try to overcome few of the issues in railways as well as modernize the compartment. The crack detection track system has been designed to minimize rail traffic crack crashes. The paper describes the entire hardware framework and programmer architecture. The system accuracy and reliability are good for the identification of rail surface crack by experimentation [4].

System has many techniques, such as Ultrasonic Techniques, Electromagnetic Techniques and GSM Techniques. For the propose of this research, we study characteristics of railway track using acoustic emission, the device which is widely used for application such as crack Nowadays, railway track crack detection in aerospace space grade steel, detection of defects in rolling element bearing, fatigue crack growth detection. And use the MFCC ('Mel - Frequency Cepstral Coefficients') method which is generally used for low frequency to extract the feature of each railway track. According to that, we chose to adjust the MFCC method for an acoustic feature extraction in order for condition to be suitable used for this system, because the railway track crack detection system, we are interested in concentrates at 100-400 kHz [5].

Indian Railways is considered to be a microcosm of India and has an enormous importance in Indian economy. Accidents due to defects in tracks account for 40%-50% of the total accidents, which is a significant

figure. This data is published in RDSO (Railways Design & standards organization, India) Aim of our Discovering of cracks in railway track by using IoT Dept. of CSE, VKIT 2021-22 Page 11 research is to detect and record track level and gauge irregularities, by observing "Hunting Oscillations" causing the major train accidents that results into massive loss of lives and property. Hunting Oscillations are nothing but the unnecessary movement of a train coach in horizontal and vertical direction. This includes embedded C programming for ATMEGA32, GPS interface, SD card interface along with 16x4 LCD, power supply section using necessary regulators and a cloud-based web application for remote monitoring [6].

## 2.2 EXISTING SYSTEM:

The existing system railway tracks are surveyed manually. LED (Light Emitting Diode) LDR (Light Dependent Resistor) sensors cannot use on the slab of the tracks. Image processing input images are noisy system and it's not getting accurate output. This analysis is used to identify the crack in rail track under the bad whether condition which is not getting perfect output. The existing system is delay in passing the information.

## 2.3 PROPOSED SYSTEM:

In proposed system our project is used to detect the crack in the tracks by means of sensor and nodemcu microcontroller, measuring distance for two rail road. In this project we use ultrasonic sensor to detect the trains or objects in front and back of the train. It uses to measure the distance between the two objects. If any crack are occurred in the track means a alerting sent to the nearest station or control room and ultrasonic sensor measured the distance between the two objects if there is any small 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 IOT. This project is to be made in order to change the system of crack detection using IR sensor in railways which can be resulted out as not only cost-effective but also with good accuracy and time saving facility.

- a) Initially the tracks are being continuously monitored with the help of sensor, which is used to detect the crack in the tracks.
- b) This monitoring is done with the help of ultrasonic sensor in order to sense the minor changes also which can be quiet difficult with other sensors.
- c) Whenever the crack gets detected with the help of IR sensor it passes the alert of crack found to the nodemcu microcontroller.





### 3. BLOCK DIAGRAM

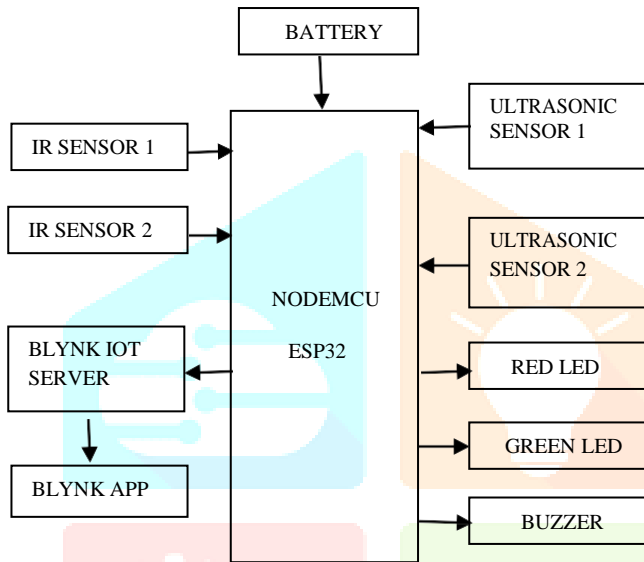


Fig: Block Diagram

### 4. WORKING

1. The device deals with the problem and detects cracks in tracks with the help of ultrasonic sensor attached to moving assembly with the help of Free wheels
2. Free wheels allows the device to moves back and forth across the track and if there is any fault, it gives information to the Blynk IOT cloud server through which railway department is informed on time about cracks and many lives can be saved.
3. This is the application of IoT, due to this it is cost effective system.
4. This effective methodology of continuous observation and assessment of rail tracks might facilitate to stop accidents.
5. This methodology endlessly monitors the rail stress, evaluate the results and provide the rail break alerts such as potential buckling conditions, cracks of tacks and alerts to the concerned authorities.

### 5. FUTURE SCOPE

- This system can be enhanced by implementing the GPS and welding system for prevention.
- This system can be enhanced by adding different sensor for more accurate readings.

### 6. ADVANTAGES

- 1) Transmitting signals are immediately transfer.
- 2) The auto crack detection method is more efficient in technical field.
- 3) Simple in construction, easy to maintain and repair.
- 4) The cost is very low compared to existing system. No fire hazard problem due to overloading and also the power consumption is low.
- 5) The signals can be send to the railway authorities via messages or through the alert systems.

### 7. APPLICATION

- 1) This system can be used for Construction Field for Crack Detection.
- 2) This system can be used for Industries for detecting the manufacturing defects.
- 3) This system can be used for automobile industries.

### 8. RESULT

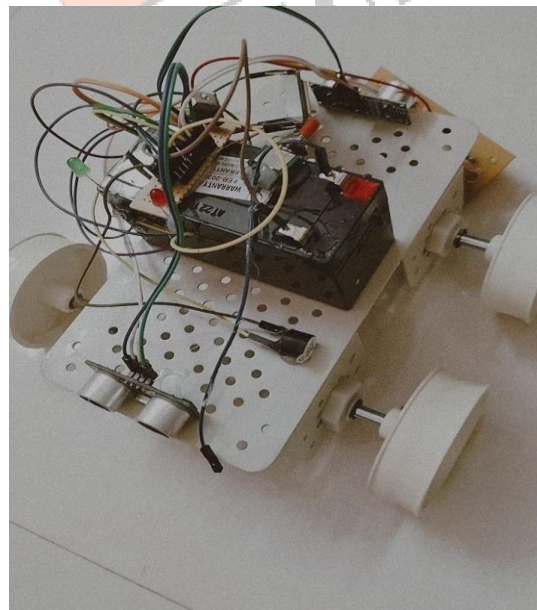


Fig: Proposed Model

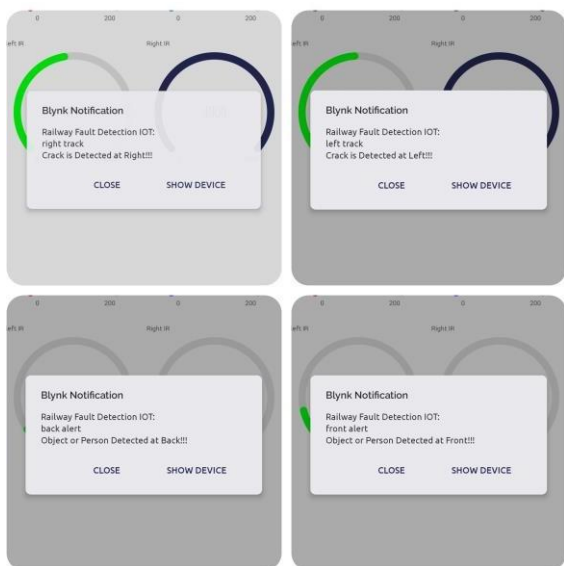


Fig: (a)Crack is detected on RIGHT& LEFT track

(b)Object is detected on BACK & FRONT

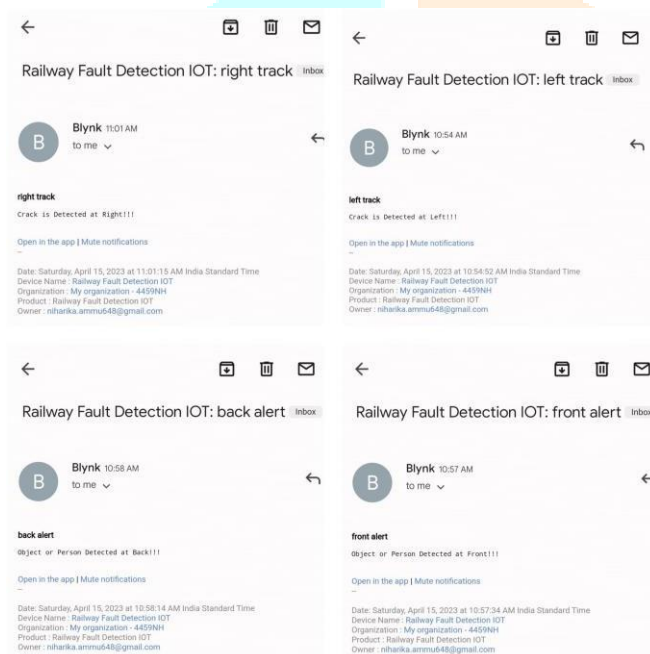


Fig: Mails sent to the Railway authorities.

### 9. CONCLUSIONS

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. The advanced railway track fault detection and reporting system over the Internet of Things (IoT) offers numerous benefits for railway infrastructure maintenance and

management. By leveraging IoT technologies such as sensors, wireless communication, and cloud computing, the system can accurately detect and report track faults in real-time, allowing for prompt maintenance and reducing the risk of accidents.

The system's ability to collect and analyze large amounts of data also allows for predictive maintenance, enabling railway authorities to proactively address potential issues before they escalate. The system's connectivity to the cloud also facilitates remote monitoring and management, which can improve the efficiency and cost-effectiveness of railway infrastructure maintenance. Overall, the advanced railway track fault detection and reporting system over IoT represents a significant advancement in railway infrastructure maintenance and management, offering increased safety, reliability, and cost savings. Its implementation could have a positive impact on the railway industry and its customers.

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