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# RAILWAY TRACK CRACK DETECTION AND GPS TRACKING ALONG WITH ALERT SYSTEM USING ESP8266

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## ABSTRACT
With one of the biggest railway networks in the world, Indian Railways offers the most significant public transportation option in the nation, which is also the most widely used and reasonably priced long-distance transportation system. The primary issue with a railway analysis is finding track cracks. The seasons force the tracks to shorten and lengthen. If these damages are not managed in a timely manner, they may cause several derailments with a significant loss of life and property. The primary goal of the prototype framework built for this project is to establish a method for detecting cracks in railway tracks using infrared sensors. By identifying the flaws on railroad tracks, this prevents train accidents. This robotic model has an ultrasonic sensor built in to detect any rock objects that are placed in close proximity to the track.
**Keywords:** Arduino, IR Sensor, Ultrasonic Sensor, GPS location, Robotic model, Google Geo-location, DC motor, Motor Driver.

## I. Introduction
The railway network in India consists of 7,083 stations, 63,974 kilometers (39,752 meters) of track length, and 70,598 miles of track. however, more recent data indicates that rail cracks account for roughly 90% of these incidents. Everywhere in the world, train activity must include railroad security. Even in cases where the railroad is not at fault, disappointments that result in mishaps often garner extensive media attention and paint an inaccurate picture of the railroad in the public eye, which frequently encourages swift reforms. Across more than 1,15,000 kilometers, Indian Railroads operates one of the largest railroad networks globally. However, Indian Railroads falls short of international standards when it comes to consistent quality and passenger safety. Genuine concerns about the security of rail operations are raised, among other things, by the breaks in the tracks brought on by the necessity of timely discovery and associated maintenance. A recent investigation According to a recent research, cracks require replacing more than 25% of the track's length. The manual identification of these cracks takes a lot of time and requires expert technicians, making it a laborious and inefficient operation. The goal of this project is to create an automated track slotting system that is connected to a mobile application alert in order to solve this problem. With the use of this system, a significant amount of data may be gathered to identify and track rail issues. The ultimate objective of this design is to support road administrations in improving their safety procedures and creating the monitoring instruments required for contemporary safety operations. In this system, we detect railroad defects using an ultrasonic detector. This system is intended to run an ultrasonic detector, ESP 8266, road safety monitoring system.

## II. Objective
In order to keep a safe distance from train accidents and crashes, the rule's purpose is to identify breaks in the rail line track and snags in the track. This model uses ultrasonic sensor collection to track the exact region of defective track, which provides a reasonable solution to the problem of railroad track break acknowledgment. Through SMS, the GSM module will notify users to close the control room and indicate that the train route would be stopped as a result.

## III. Related literature

Railway track crack detection system identifies faults in tracks and identify the moving object or animal on the tracks, we learned an automated system based on a microcontroller and sensors. An autonomous robot with PIR and Ultrasonic sensors, coupled with GPS and GSM, is designed to provide real time alerts [1]. A crack detection system, which detects the crack without human intervention and transmits the location of the fault to the authorized personnel via GSM. Using this technique, cracks can be detected both during the day and at night, revealing the precise location of the fault [2]. Railway track crack detection system identifies tracks and identify the moving object or animal on the tracks, we learned an automated system based on a microcontroller and sensors. An autonomous robot with PIR and Ultrasonic sensors, coupled with GPS and GSM, is designed to provide real time alerts [3]. Some models employs an ultrasonic sensor, the global system for mobile communications, the GPS and an Arduino-based module, whose implementation will provide a cost-effective method for detecting cracks in the tracks and thereby avoiding train derailments [4]. Another model uses sensors and is a dynamic approach which combines the use of a GPS tracking system to send alert messages and the geographical coordinate of the location. Arduino microcontrollers were used to control and coordinate the activities of this device. Designing the railway crack detection system employing ultrasonic sensors is the main goal of the project [5].

## IV. Methodology

The block diagram of proposed system is designed to identify the crack and also any object present in front of the track. The alert notification is sent to nearby railway station centre, the communication is done by Blynk mobile application. The block diagram of the proposed system is shown in fig.1.

Let us discuss each unit shown in fig.1. The Node MCU (Micro Controller unit) is an open-source software and hardware development environment built around an inexpensive System-on-a-Chip (SoC) called the ESP8266. It is highly integrated Wi-fi module that provides fast internet connectivity. L298N Motor driver provides high current to drive the DC motors as the microcontroller current alone is not sufficient to drive the DC motors. The DC motor converts electrical energy to produce mechanical energy and rotates the wheels. The Ultrasonic sensor is used to detect any object present in front of the track. Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver.

The GPS module gives the exact location of the crack and the object location. It gives the latitude and longitudinal direction of the fault location. An Infrared sensor (IR sensor) is used to detect the crack present in the railway track. It is done by the transmitter and receiver of IR sensor. The Blynk mobile application is connected to the wi-fi module and it retrieves the alert notifications from the Blynk server and sends to the destination.

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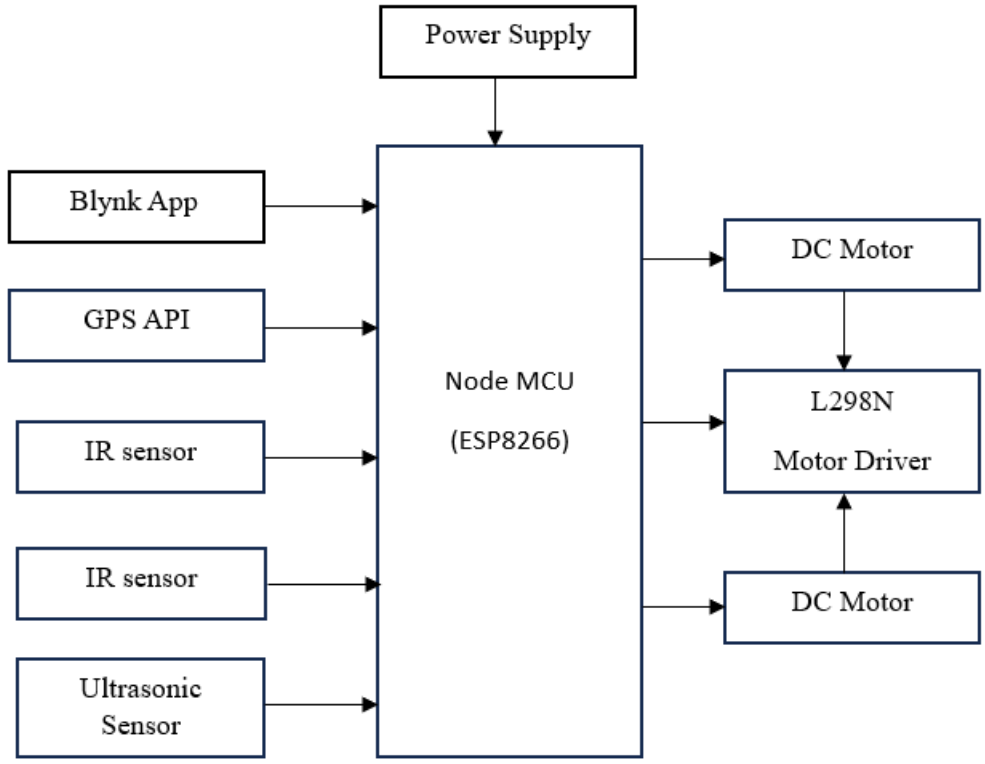

Fig.1 Block diagram

## V. Implementation

### 5.1 Hardware

Two IR sensors are employed to detect the cracks on the track, one on the left side and other one on the right side so as to detect where crack is present. These sensors are positioned on both sides of the robotic car connected to ESP8266 Microcontroller if any crack is damaged then the notification will be sent to the receiver within a fraction of seconds and this done by the ESP8266 as it is highly integrated chip with wi-fi connectivity. To move the robotic car two DC motors are employed and are connected to L298N motor driver as it provides high current and voltage to drive the motors. Ultrasonic sensor is positioned front of the robotic car to detect any obstacle. The circuit connections outlined above are illustrated in Fig.2.

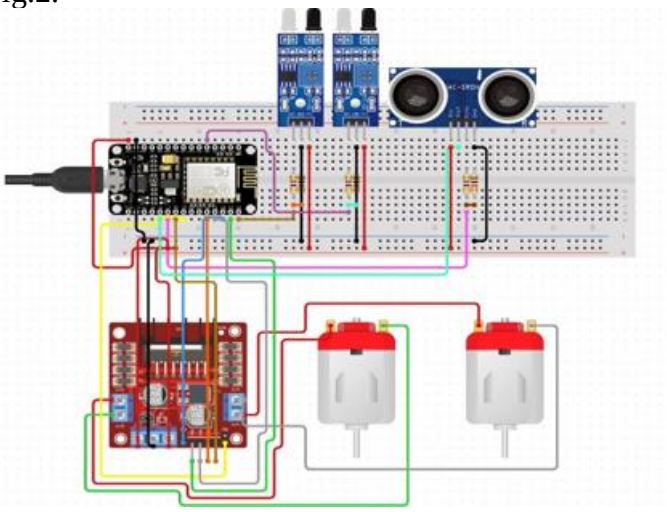
Fig.2 Circuit Connections

The proposed system is depicted in Fig.3 showing the circuit connections accurately. The proposed system is a prototype for detecting cracks on railway tracks. It has GPS module which will give the real time location or coordinates and transfers that location to near to the nearest railway station or the

provided number. With this proposed system the exact location of the faulty rail track can be easily located, so that many lives can be saved. Proposed system is small and is efficient to use.

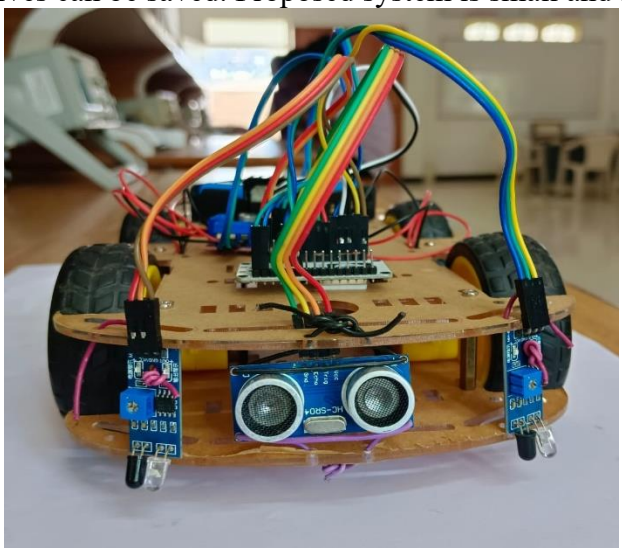

Fig.3 Proposed system

**5.2 Software**

The Blynk app interface seamlessly integrates with our hardware prototype offering intuitive alert notifications at the right time whenever there is a need. Within a few seconds the crack damaged or the object detected notification will be sent and just with a tap on the notification link on the mobile screen will give you the exact location.

## VI. Results

The proposed system gives result of sending notifications at the right time with high speed. While robotic car moves on the track, and finds some crack or object the through GPS it tracks location and with the internet connectivity the Blynk app server sends the notification to the nearby railway station centre.

**6.1 Left side or right side track damaged**

Whenever the robotic car detects that there is a crack on the left side of the track it sends notification like “Left side of the railway was damaged”. This type of notification will be received by the nearby station and whenever the robotic car detects that there is a crack on the right side of the track it sends notification like “Right side of the railway was damaged”. This type of notification will be received by the nearby station as shown in Fig.6.

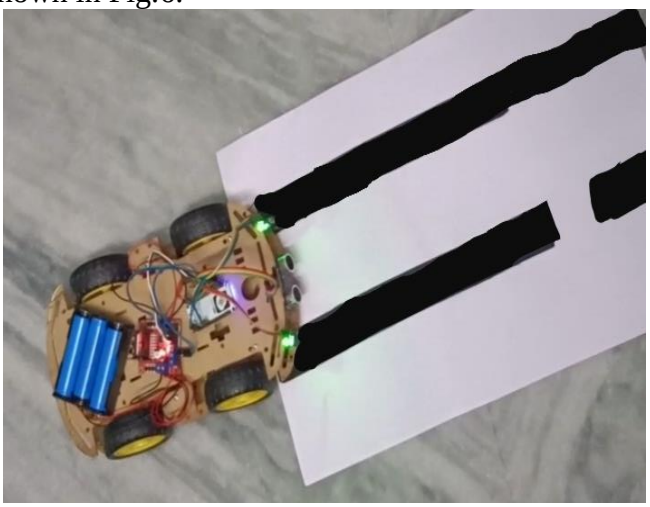

Fig.4 Right side track was damaged

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### 6.2 Object found

Whenever object is found in front of the railway, it sends notification like “Object found in front of railway track” as shown in Fig.6.

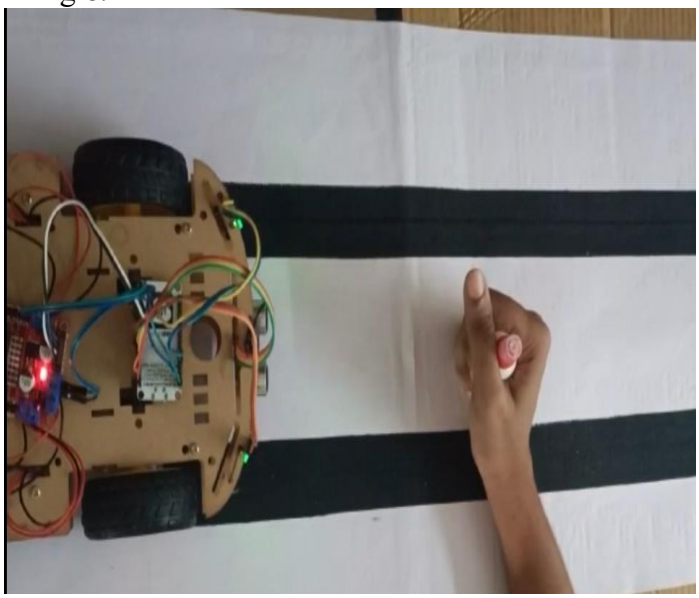

Fig.5 Object found


Fig.6 Notifications received on Blynk App

### 6.3 Tracking the location

The notification has a link that will be redirected to the location of the track crack or any object found.

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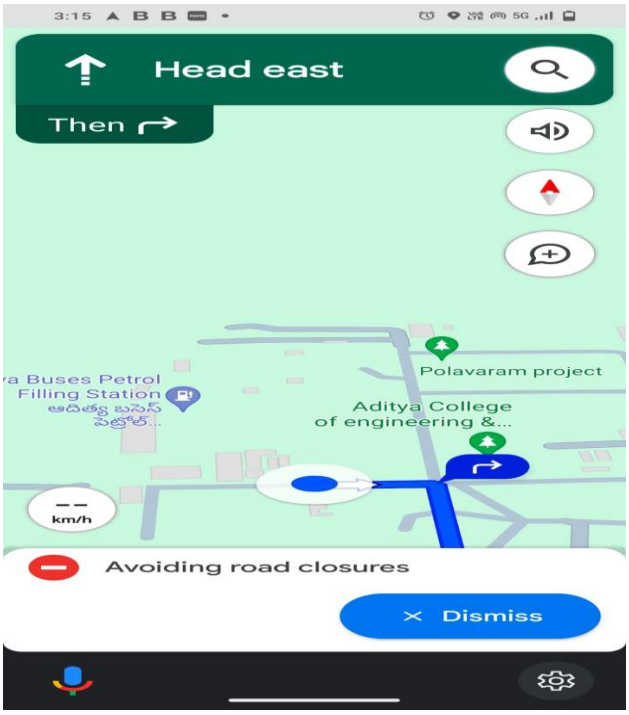


Fig.7 Location tracked

## VII. Conclusion and Future Scope

In conclusion, the railway track geometry system is a valuable tool that aids in ensuring the alignment and integrity of railway tracks. By employing advanced technology, such as sensors, laser measurement, and data analysis, this system enables accurate and efficient inspection of railway tracks, identifying potential issues such as misalignment and cracks. It provides timely feedback to maintenance crews, allowing for prompt repairs and preventing potential accidents or delays. Overall, the railway track geometry system is a valuable tool for maintaining track quality, ensuring safe and efficient railway operations, and enhancing the overall performance of railway networks.

In the future, this system could get even better. We might see the integration of Artificial Intelligence (AI) and Machine Learning (ML). Railway track geometry systems can leverage AI and ML algorithms to analyse large amounts of data collected from sensors and other sources. This can enable more accurate and automated detection of track alignment issues, cracks, and other anomalies, as well as predictive maintenance capabilities for proactive repairs and maintenance scheduling.

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