



IOT Based Flaw Detection System in Railway Tracks

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KEYWORDS

Embedded system, Internet of things, ultrasonic sensor, IR detector, Arduino Uno, GPS 2023

ABSTRACT

An IoT-based railway track crack and object detection system is an innovative solution for ensuring the safety and security of railway systems. The system uses a combination of sensors and cameras that are installed along the railway track to monitor it for any signs of damage or obstructions. The sensors can detect vibrations and changes in the track, which can indicate the presence of a crack or other type of damage. The cameras can capture images and video of the track, such as fallen branches, debris, or even people or animals. Once the system detects an issue, it can send an alert to the railway operators or maintenance personnel, allowing them to quickly address the problem before it causes any accidents or delays. An IoT-based railway track crack and object detection system can greatly improve the safety and efficiency of railway operations.

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. The system uses a combination of sensors, communication devices, and software applications to detect and report faults in real-time. This helps system to descry only crack and helps to remove unwanted objects. Transport pis truly important to carry the passengers and goods from one place to another. profitable position is mainly depending on adding the capacity and position of transport. When the crack is detected its latitude and longitude values are shoot as a communication to near station by using GPS and GSM service.



Fig. 1 Part of the track which was completely broken Ultrasonic is used for the surveying process also, other important element is This system used during road track examination. System is suitable to descry deeper cracks

with 80 success rate and minor. If our system can descry those objects or barricade and inform to the control room they can take necessary way 3 to avoid accident. Figure1 depicts the crack on track. The Rail transport is growing at a rapidfire- fire pace in India. It's one of the major modes of transport but still our installations are not that accurate, safer as compared to international morals. Hence, it is not safer for mortal Life. These goes unnoticed and the properly conservation of tracks is not done. To overcome this disadvantage, then detectors are used, which will descry the crack directly. The being system is slow, tedious and time consuming. This system has GSM and GPS module which will give the real time position or equals in Communication.



Fig. 2 Part of the track which has a Crack



Fig. 3 Accident due to crack in track.

2. Existing Model

In the existing system, techniques such as visual inspection, video transmission, and Magnetic field methods can identify the cracks on the railway tracks. Physical checking is one of the earliest methods in which all the necessary components will be scanned manually. This process is commonly used in India, despite generating the worst outcome. A camera is used

for continuous monitoring of the track while streaming content. In this procedure small cracks and a high-cost system cannot be seen. The current passes through the railway track for detection of flaws in the eddy current method and the results produced are not accurate. Many of these techniques require a lot of processing power and an extremely long period of time, making the robot's speed slow and therefore uncomfortable

3. Proposed Model

Our design is used to descry the crack in the tracks by means of detector and node mcu microcontroller, measuring distance for two rail road. In this design we use ultrasonic detector to descry the trains or objects in front and reverse of the train. It uses to measure the distance between the two objects. If any crack is passed in the track means a waking transferred to the nearest station or control room and ultrasonic detector measured the distance between the two objects if there's any small friction set up the communication which contains equals of that particular place will be transferred to the nearest station or control room. An IoT-based fault detection system for railway tracks can help improve the safety and reliability of train operations by detecting and alerting the maintenance team about potential issues in real-time.

- **Sensor Network:** The system would consist of sensors installed along the railway tracks. These sensors would collect data about the condition of the tracks, such as changes in temperature, excessive vibrations, or pressure variations.
- **Data Transmission:** The data collected by the sensors would be transmitted wirelessly to a central hub or gateway using cellular, satellite, or Wi-Fi connectivity
- **Alert System:** Once a fault or anomaly is detected, the system would trigger an alert to the maintenance team through SMS, email, or a mobile app. The alert could include the location of the fault, the severity of the issue, and recommendations for remedial action.
- **Maintenance Management:** The maintenance team would receive the alert and take the necessary steps to rectify the issue. They could also use the system's analytics and historical data to schedule preventive maintenance and reduce the likelihood of similar issues occurring in the future.

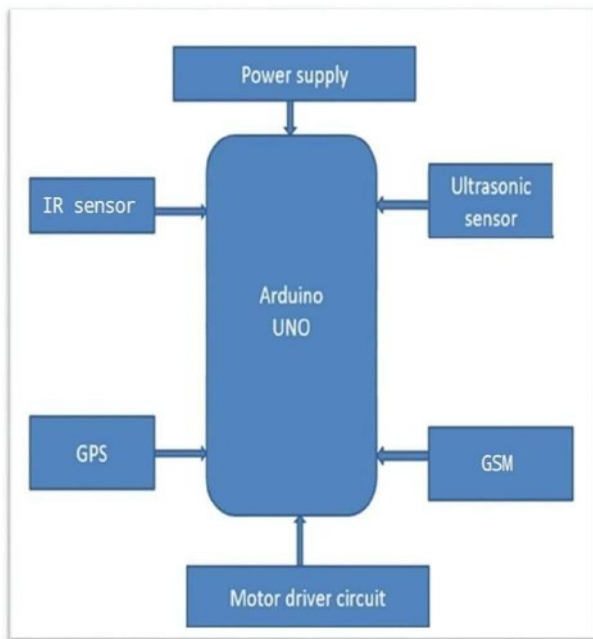


Fig.4 Block Diagram

4.Design and Implementation

A. Arduino UNO Arduino interface boards offer an affordable and user-friendly technology for engineers, artists, designers, hobbyists, and anyone who enjoys tinkering with technology to create interactive, creative, and practical projects. With this technology, a new generation of projects can be developed, which can be easily controlled from a computer. These boards enable the creation of interactive and innovative objects, useful projects, and a range of other applications that can be controlled from a computer. With Arduino boards, a whole new class of projects can now be built, opening a world of possibilities for creative expression and experimentation.

DESIGN GOALS

- Compatibility with Mac computers, as they were commonly used by design students
- USB connectivity, since most MacBooks did not have serial ports
- Appealing appearance
- Low cost, around 20 Euros, which was equivalent to the cost of a pizza in Europe
- Greater power than a BASIC Stamp microcontroller

III. METHODOLOGY

We developed an IoT-based railway track monitoring system to detect cracks and prevent accidents. The system integrates sensors, a microcontroller, and

wireless communication modules to identify track defects and immediately alert railway authorities with the precise fault location

A.WORKFLOW

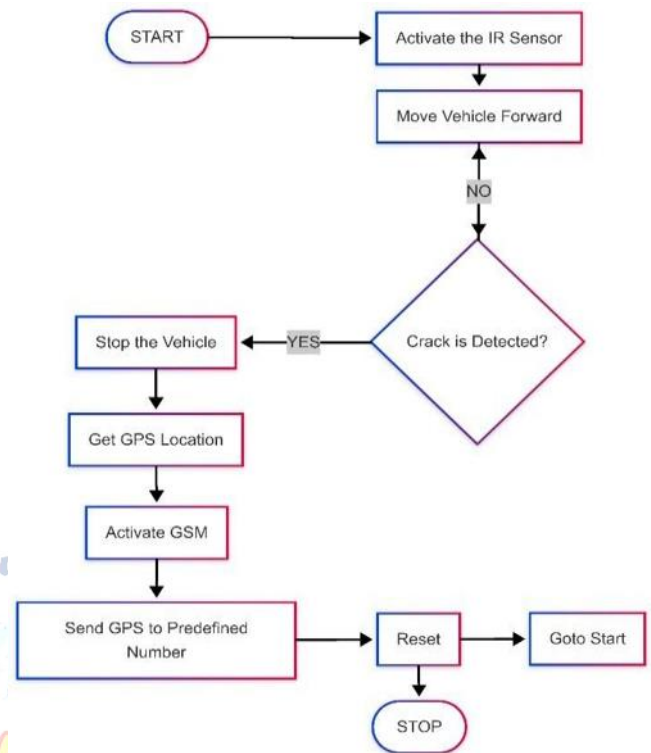


Fig.5 Workflow

B. Hardware Components:

a) Arduino Micro Controller

The Arduino micro controller as shown in Fig., is the main component in the model which controls and coordinates all the other components to work synchronously. All the components will be connected to micro controller with the help of jumping wire.



Fig. 6 Ardiuno uno

b) IR Sensor

IR Sensor as shown in Fig., will detect the crack. When there is a crack in the track there will change in the frequency of reflected ray from track to the IR receiver



Fig. 7 IR Sensor

c) Ultrasonic sensor (HC-SR04)

It detects obstacles by emitting sound waves and measuring their reflection time, providing 2-400cm range detection with $\pm 3\text{mm}$ accuracy.

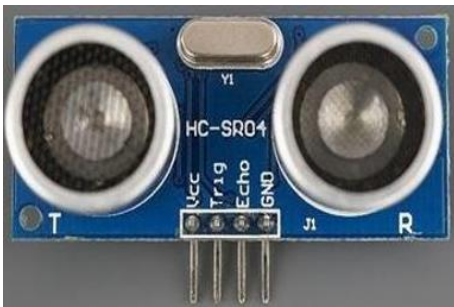


Fig. 8 Ultrasonic Sensor

d) Neo- 6M GPS Module

Whenever a crack is found GPS will capture the location of the crack, which will send to the railway authorities as shown in Fig.



Fig. 9 GPS Module

e) GSMA7670C 4G-LTE-CAT1 Module

GSM module will help in sending message to the registered mobile number (Railway Authorities) along with the location of the crack captured by GPS which is shown in Fig.



Fig. 10 GSM Module

f) L298N Motor Driver IC

It controls dual DC motors with 2A/channel capacity, featuring PWM speed control and built-in protection diodes. It connects to Arduino via IN1-IN4 pins for direction/speed control while handling 5-20V motor voltage.



Fig. 11 L298N IC

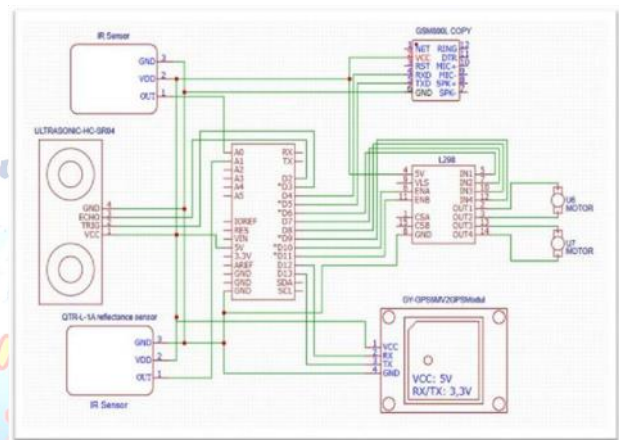


Fig 12: Schematic Diagram of Flaw Detection System

IV. RESULTS AND DISCUSSION

Here the proposed module is made up of hardware which was previously explained in the description of the system design hardware.

At Normal Condition:

IR sensor involves the transmission of infrared rays which are received by the IR receiver sensor. The transistor is used as an amplifier section and remains in an OFF state during normal conditions. Relay remains OFF and the vehicle continues to run uninterrupted



Fig. 13 Flaw Detection System

- At Crack Condition:

The LDR sensor has a high resistance when it is detecting a crack on the track. When a crack is detected, the sensor output becomes high. The robot automatically stops when the reflection becomes zero, indicating the presence of a crack. The GPS then calculates the robot's location and determines spot.



Fig. 14 Crack Detected

- At Object Detection:

The time it takes for the sound to return calculate an object. If an object is detected, the GPS location is obtained using the IOT module, and the robot comes to a stop while alerting the authorities.

V. Conclusion

The IoT based fault and crack detection system in railway tracks is a promising solution to the problem of detecting faults and cracks in railway tracks, which can lead to accidents and disruption of rail services. The system utilizes a combination of sensors, wireless communication, and data analysis techniques. The system has the potential to significantly reduce the risk of accidents and improve the safety of rail transportation, while also reducing maintenance costs

and improving the efficiency of railway operations. In conclusion, the IoT based fault and crack detection system in railway tracks is a promising technology that has the potential to improve the safety and efficiency of rail transportation.

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Conflict of interest statement

Authors declare that they do not have any conflict of interest.

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