IJITCE

ISSN 2347- 3657

International Journal of Information Technology & Computer Engineering

Email : ijitce.editor@gmail.com or editor@ijitce.com

International Journal of Information Technology & Computer Engineering

ISSN 2347–3657

Volume 12, Issue 2, 2024

ADVANCED RAILWAY TRACK FAULT DETECTION AND REPORTING OVER IOT

[1]S. NAVYA JYOTHI,[2]SHAIK AISHA,[3]KACHHU ANUSHA,[4]JUPAKANAGA LAXMI,

[5]Dr.A.KRISHNA MURTHY

[1,2,3,4]Student, Department of ECE, PRINCETON INSTITUTE OF ENGINEERING AND TECHNOLOGY FOR WOMEN

[5]Assistant Professor, Department of ECE, PRINCETON INSTITUTE OF ENGINEERING AND TECHNOLOGY FOR WOMEN

ABSTRACT

In India, the majority of commercial transportation relies heavily on the railway network. Any disruption in this network can lead to significant economic loss and, more tragically, loss of life due to accidents. This paper presents a cost-effective and innovative solution for railway crack detection that is both simple and robust. With the increasing number of accidents at railroad crossings and on tracks, there is an urgent need for an efficient system to prevent such incidents. Despite various transport options available today, rail travel remains a preferred choice due to its cost efficiency and speed. However, accidents caused by track faults and obstacles on the tracks are a growing concern.

This paper proposes an advanced method to prevent train accidents by using a microcontroller to automate the detection of track faults with an Infrared (IR) sensor. Upon detecting a fault, the microcontroller alerts the train driver with a red LED, triggers a buzzer, and automatically stops the train. Additionally, the system sends information to a control room via IoT. The key components of this project include a microcontroller (Arduino), IR sensor, IoT module, buzzer, and DC motor. The IR sensor is crucial as it is a directional data transfer device, enabling precise detection of faults and allowing timely action to be taken. This system is

ISSN 2347–3657
Volume 12, Issue 2, 2024

particularly useful for ensuring trains run on time during adverse conditions, such as foggy weather or nighttime when visibility is poor. The proposed solution is highly beneficial for improving the safety of the Indian railway system.

Keywords

Railway Track Fault Detection, IoT Reporting, Microcontroller, Infrared Sensor, Train Safety

I.INTRODUCTION

In today's rapidly digitizing world, the importance of a reliable and safe transportation system cannot be overstated. Rail transport holds a critical position in India, meeting the demands of a growing economy. However, the country still lags behind global standards in terms of reliability and safety due to the absence of efficient and cost-effective technologies for rail track maintenance. The proper functioning of transport infrastructure has a profound impact on the economy, and the lack of maintenance can lead to severe consequences.

This paper discusses a proposed prototype for a railway track testing train designed to detect obstacles and cracks. The prototype is cost-effective and offers quick analysis, enabling the precise location of faulty tracks to be identified and potentially saving many lives. The primary objective is to locate gaps or hazards on the tracks, preventing accidents. The system utilizes an ultrasonic sensor and IR sensor to detect track faults, sending real-time alerts to the control room via SMS. This approach not only replaces human inspection but also enhances accuracy, saves time, and reduces costs.

ISSN 2347–3657
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The proposed system begins with motor initiation, which activates the ultrasonic sensor to detect track cracks. Upon detecting a crack, the vehicle stops, and the GPS module pinpoints the location. The GSM module then sends a message to the control room, reporting the obstacle's presence. The system resumes scanning after the message is sent, ensuring continuous monitoring. This automation significantly improves safety and reliability in the railway sector.

The Indian railway network is expanding rapidly, but its facilities still fall short of international standards. Surveys indicate that 60% of railway accidents result from derailments, with 90% of these due to track cracks. The current manual inspection system is slow, labor-intensive, and prone to errors. The proposed automated system, with its real-time monitoring and IoT connectivity, offers a significant improvement in detecting and reporting track faults, ultimately enhancing the safety and efficiency of the railway network.

II. LITERATURE SURVEY

India's railway network is one of the busiest in the world, covering over 127,000 square kilometers. A significant portion of the population relies on this network, with 60% of railway accidents occurring at track crossings or due to cracks in the tracks. The existing methods for addressing this problem include manual inspections and systems like the SPURT car and ultrasonic crack detectors. However, these methods are limited in scope, require extensive manual labor, and are not always accurate.

The current literature on rail crack detection systems highlights the use of ultrasonic and eddy current-based techniques, which, while effective, are costly and not

ISSN 2347–3657
Volume 12, Issue 2, 2024

suitable for widespread implementation in India. These methods also have limitations in detecting surface cracks, where many faults are located. The proposed system aims to address these challenges by using a combination of Arduino microcontrollers, sensors, GPS, and GSM modules to detect cracks more accurately and efficiently.

Several studies have explored the use of robotic systems for rail track monitoring, which offer the advantage of continuous, real-time monitoring, especially during off-peak hours. These systems are also lightweight and portable, making them more practical for large-scale deployment. The proposed system builds on these ideas, incorporating sensors and IoT technology to provide a comprehensive solution for rail track monitoring.

III. PROPOSED SYSTEM

The proposed system improves upon existing methods by integrating a Raspberry Pi board with an IR sensor for crack detection and an ultrasonic sensor for obstacle detection. A motor driver (L293D) is used to control the DC motors, enabling the system to navigate the tracks autonomously.

IV. SYSTEM OPERATION:

1. **Data Acquisition**: IR sensors continuously monitor the tracks for cracks, while the ultrasonic sensor detects obstacles.
2. **Data Processing**: The Raspberry Pi processes the sensor data in real-time, identifying any abnormalities.
3. **Fault Detection**: Algorithms running on the Raspberry Pi analyze the data to detect potential faults.

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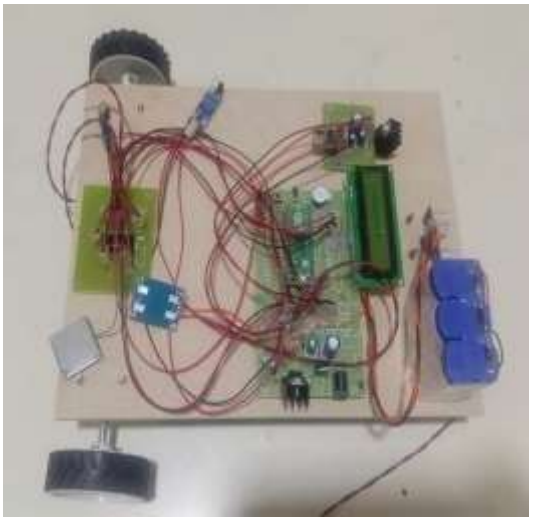
4. **Reporting**: Detected faults are reported to the control room via IoT, providing real-time alerts.
5. **Actionable Alerts**: Railway authorities receive these alerts, allowing for timely maintenance and repair.

This system ensures proactive maintenance, enhances railway safety, and optimizes operational efficiency by integrating sensor monitoring, data processing, fault detection, and reporting. The use of IoT technology enables real-time monitoring and minimizes potential accidents caused by track faults.The system was successfully implemented and tested, demonstrating its effectiveness in detecting track faults and reporting them in real-time. The use of IoT connectivity allows for prompt alerts, enabling railway authorities to respond quickly and ensure the safety of the network.



V.RESULT

Figure.1: advanced railway track fault detection and reporting over iot

ISSN 2347–3657
Volume 12, Issue 2, 2024

VI. CONCLUSION

The proposed system represents a significant advancement in railway safety. By leveraging embedded systems, IoT, and real-time monitoring, the system offers a robust solution for detecting track faults and preventing accidents.

The integration of live video streaming and automated crack detection further enhances its effectiveness, making it a valuable tool for railway authorities. This approach not only improves safety but also reduces the burden on human inspectors, ensuring more accurate and timely maintenance of railway infrastructure.

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