



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY

INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 13, Issue 4, April 2024

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

9940 572 462

6381 907 438

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IOT Based Fault Detection in Railway Track System

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ABSTRACT: An IOT-based railway track crack and object detection system is the process for monitoring the condition of train tracks. The main objectives of this projects is provide IR based railway track fault detection. Railway track damage status is monitored by sensor transfer through wireless module. If the track position is normal both the sensor gives the constant sensed output. If any sensor misses their output condition to fail then there is defect on that side. The sensor will inform this by giving alarm and sends information to the smart phone android app in IOT based via wifi module. Ultrasonic sensor is used to detect the obstacle in the track if any obstacle detected means the Arduino automatically transmits the message to nearby station via IOT using wifi module. The location of this rail will automatically sends to each station via IOT using wifi module.

KEYWORDS: Arduino, LCD, Ultrasonic sensor, IR sensor, wifi module, DC gear motor, Motor Driver.

I. INTRODUCTION

Railway is one of the most significant transportation modes of our country. India is the 4th largest country in the railway network in the world and Indian railway carries over nearest to 13,169 million Passenger trains daily. In Indian railway scenario, most commercialized transport is being carried out by the railway network and therefore any problem in the same has the capacity to induce major damage to the economy-not with standing the social effect of loss of life. This project is based on the technical and design aspect in details and also provide the proposed robust crack detection algorithm. A work of detecting the crack in the railway track using IOT. Automation has affected every aspect of our daily lives. More improvements are being introduced are being introduced in almost all fields to reduce human effort and save time. The system uses a combination of sensors, communication devices, and software applications to detect railway crack in rail road when the crack is detected its latitude and longitude and report faults in real-time and send signal to nearby station. This helps system to descry only crack and helps to remove unwanted objects. 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 wifi module which will give the real time position.

II. EXISTING MODEL

In the existing system, techniques such as visual inspection, and video transmission 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. 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.

III. PROPOSED MODEL

Our design is used to detect the crack in the tracks by means of detector and Arduino microcontroller, measuring distance for two rail road. In this design we use ultrasonic sensors to detect 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 Wi-Fi connectivity
- **Alert System:** Once a fault or anomaly is detected, the system would trigger an alert to the maintenance team through SMS, or a web server. 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.

IV. BLOCK DIAGRAM

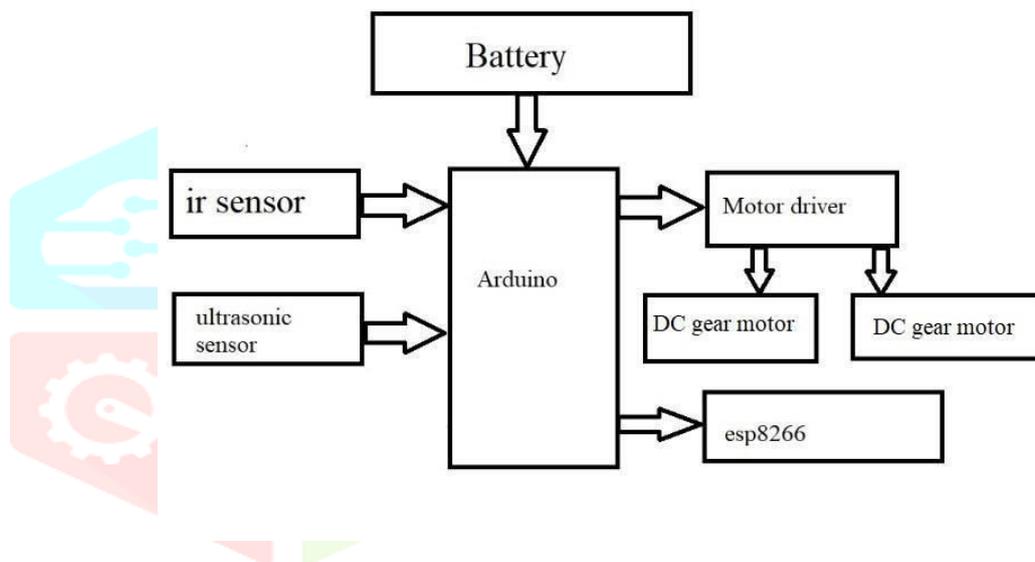


Fig 1:Block diagram

V. METHODOLOGY

1. Arduino UNO: Arduino UNO is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. Arduino interface boards more 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

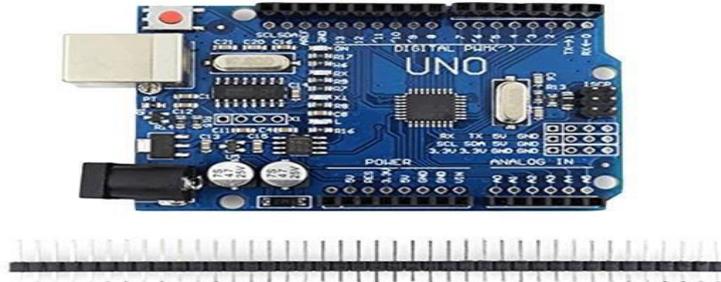


Fig 2: Arduino UNO

2. LCD Display: With the help of stepper motor, If fault is detected then it shows on LCD Display and information is shown on Cloud server. here we use 16*2 LCD Display.



Fig 3: LCD

3. Ultrasonic sensor: Main use of ultrasonic sensor which is a kind of active sensor. it has component for both receiver and transmitter. it is used to detect the fault and calculate distance by sending ultrasonic waves to receiver where fault is occurred. Ultrasonic sensors wide range of applications, including robotics, automotive, industrial automation, and security systems.

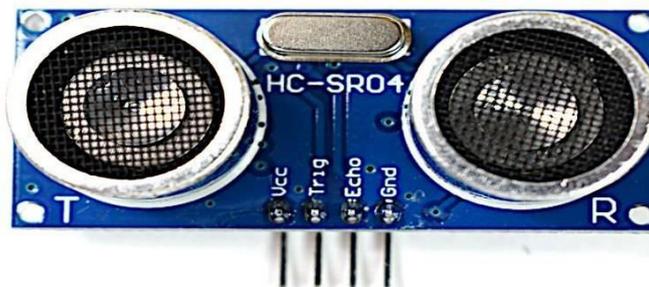


Fig 4: Ultrasonic Sensor

4. IR Sensor: IR Sensor can measure heat of object as well as detect an motion. An infrared sensor (IR Sensor) is an electronic device that measure infrared light radiating from objects in its area of view.

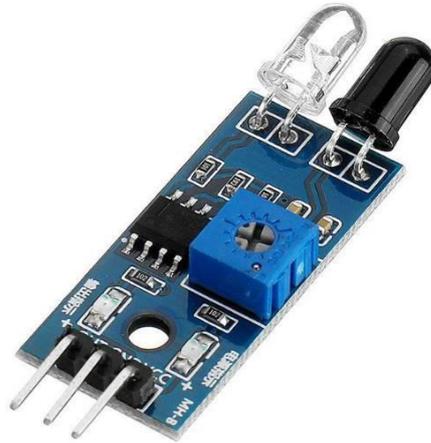


Fig 5: IR Sensor

5. WI-FI Module: Wi-Fi modules enable wireless communication between the railway track detection system and a central monitoring station or a cloud-based server. These modules allow for the transmission of real-time data, alerts, and status updates over Wi-Fi networks, enabling remote monitoring and management of the railway tracks.

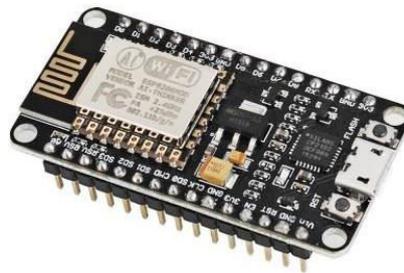


Fig 6: Wi-Fi module

6. DC Gear motor: We give power supply to DC Gear motor 12V and 5A from power adapter. DC gear Motors used to forward and reverse the robot inside railway track.



Fig 7: DC Gear motor

7. Motor Driver: Motor driver is used to control motion of a motor and its direction by feeding current accordingly. Output of a motor driver is in digital form so it uses PWM (Pulse Width Modulation) to control speed of a motor. Motor Driver are basically current amplifiers followed by input signals. It can also drive inductive loads such as relays, solenoids, transformer etc.

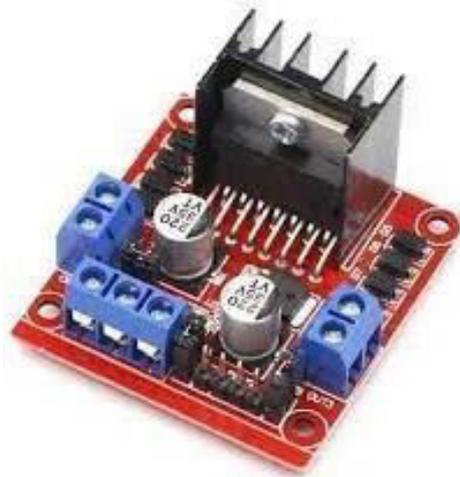


Fig 8: Motor driver

VI. FLOW CHART

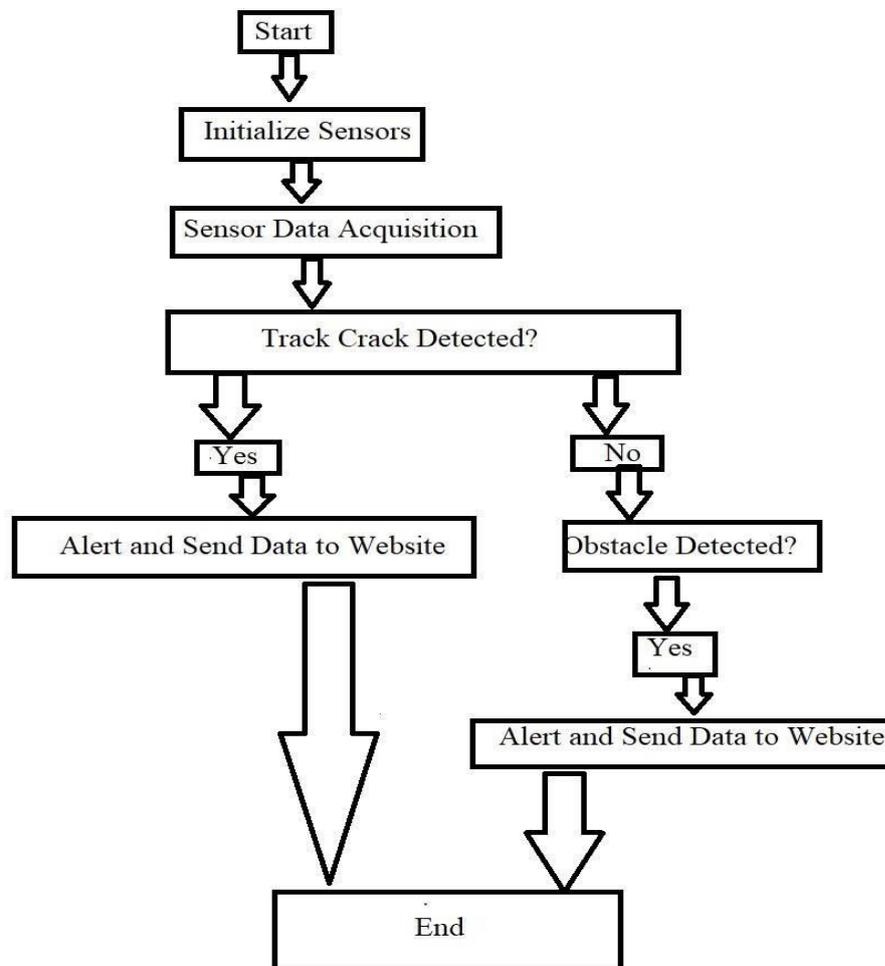


Fig 9: Flow chart

VII. ACCIDENT DETAILS

On June 2, 2023, three trains collided in Balasore district in Odisha state of eastern India. The Coromandel Express entered the passing loop instead of the main line near Bahanaga Bazar railway station at full speed and collided with a goods train.



Fig 10: Train accident

VIII. EXPERIMENTAL RESULTS

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

At track condition:

When a crack is detected, the sensor send signal to the control room and also location and which type of fault detected on display. We have used wifi module is used to provide location,



Fig 11: Track condition

Fault detection:

When fault is detected, it displays on LCD Display and latitude and longitude data shows on mobile phone.



Fig 12: Fault detection

IX. CONCLUSION

The IOT based fault and crack detection system in railway tracks is a solution which saves the human life as well as economy by 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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