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"IOT Based Robotic Car for Railway Track Crack Detection System"

Swati Jagtap[1], Balaji Yadav[2], Sandip Shelake[3], Rizwan Patel[4], Ashutosh Koli[5]

Faculty, Electrical Engineering, AITRC Vita, India[1]

Faculty, Electrical Engineering, AITRC Vita, India[2]

Student, Electrical Engineering, AITRC Vita, India[3]

Student, Electrical Engineering, AITRC Vita, India[4]

Student, Electrical Engineering, AITRC Vita, India[5]

Abstract: In the developing country people are facing many accidents. It would be undesirable for any nation to losing their life for unwanted cause. Railways are one of the important transports in India. There is a need for manual checking to detect the crack on railway track and always railway personnel take care of this issue, even though the inspection is made regularly. Sometimes the crack may un-notice. Because of this the train accident or derailment may occur. In order to avoid this situation and automate the railway crack detection has been proposed. Here ultrasonic sensor is used to detect the crack in the railway track by measuring distance from track to sensor, if the distance is greater than the assigned value the microcontroller identifies there is a crack. Here we are Using Arduino microcontroller. After crack detection or object detection the testing robotic vehicle stops and the longitudinal and latitudinal positions are sent via SMS to GSM and GPS to the control station. The IoT-based robotic car for railway track crack detection system presents a promising solution to enhance railway track inspection processes, ensuring safer and more reliable transportation infrastructure.

Keywords: Sensor Technology, GPS Module, GSM Module, DC Motor, Real time alert.

I. INTRODUCTION

Transport is a vital component of specialization, enabling the separation of product production and consumption sites Because increased trade results from improved transportation, transportation has historically encouraged growth. Transport capacity and rationale have always been key factors in economic growth. However, transportation infrastructure and operations are the biggest energy consumers and have a significant impact on the environment. Making transportation is safely it is the most important concern. In India, Railway transportation plays a significant role in supplying the essential transportation infrastructure needed to meet the constantly expanding demands of an economy that is expanding at a rapid space India has the fourth-largest railway network globally, but there are concerns about its dependability and meeting requirements. When GSM, GPS, and a microcontroller-based system work together, they create an effective way to detect broken railway tracks and avoid train derailments. Positioned between two stations, the gadget uses TSOP sensors to detect cracks in the track with sine waves. If a crack is found, the sensor alerts the Arduino UNO board, which is used to activate the GPS receiver. The GPS is used to determine the location and informs the control authority. Additionally, when the sensor signals, the webcam starts recording. India's railways are its lifeblood, and since they are the least expensive means of transportation, people prefer them above all others, Mode of transportation approach. There are several incidents involving railroad railing accidents when we read the daily headlines. In terms of severity and death toll, railway track related. incidents are more dangerous than those involving any other modes of transportation and all.

As a result, greater efforts are required to increase safety. Train collisions are sometimes fatal because the damaging forces of a train are usually too strong for any individual involved.an alternative type of vehicle. Because they cause enormous damage to people and property, such collisions are considered big disasters. impart Accidents happen often, despite the most advanced technologies. Worldwide rail operations depend heavily on railway protection. India has the world's fourth-largest railway network, but checking for cracks in railroad tracks is a slow and labour-intensive process for humans. An enormous percentage Numerous derailments and interruptions to services are brought on by the track linked problems. Axle load increases and primary vehicle yaw wheel-rail capacity, suspension stiffness, and iconicity have caused the track to sustain more damage. The goal is to create a railway track crack detection system that uses Ultrasonic sensors and a microcontroller that can identify cracks along its course. An ultrasonic sensor finds things and cracks. This provides the microcontroller with this data, stopping the Train right away. IoT-based robotic car for track crack detection system offers an efficient and automated solution for identifying and addressing railway track issues. By integrating sensors, connectivity, and robotics, it enhances the accuracy and speed of crack

detection, contributing to overall rail safety. This technology has the potential to reduce maintenance costs and improve the reliability of rail infrastructure, making it a promising advancement in railway monitoring systems. IoT-based robotic car for track crack detection system presents a cuttingedge solution to enhance railway safety. Through the integration of sensors and robotics, it offers an efficient and automated approach for detecting track cracks, contributing effectiveness of railway monitoring system. The project focuses on the development of an innovative solution using Internet of Things (IoT) technology to enhance railway track maintenance. The IoT-based Robotic Car for Track Crack Detection is designed to autonomously traverse railway tracks, equipped with sensors for realtime crack detection. This autonomous system aims to improve the efficiency and accuracy of track monitoring, ensuring timely maintenance and enhanced safety in railway operations. Arduino microcontroller in the IoT-based robotic car for track crack detection system provides a versatile and accessible platform for managing various components of the project. Arduino can serve as the central brain, orchestrating sensor data acquisition, processing, and decision-making. Its user-friendly environment facilitates rapid prototyping and integration of sensors, such as cameras and crack detection modules. Using Arduino allows for efficient interfacing with IoT modules, enabling real-time data transmission to a central server. Moreover, the flexibility of Arduino facilitates the incorporation of additional features, like GPS modules for precise location tracking and communication modules for remote monitoring. The open-source nature of Arduino also encourages community collaboration and potential future enhancements to the project. In essence, the Arduino microcontroller serves as a pivotal element in creating a robust and adaptable foundation for the IoT-based robotic car, ensuring seamless integration and effective control over the various functionalities required for track crack detection and monitoring to improved maintenance practices and overall reliability of rail infrastructure. This innovation holds promise for reducing costs and advancing the

II. LITERATURE REVIEW

1. P.V.V.N.D.P. Sunil1, Y.N.V.V.L. Prasanna2, M.L. Prasanna3, P. Sravani Gayathri4, P. Pavani Komali5 Assistant Professor, Department of ECE, D.M.S.S.V.H College of Engineering, Machilipatnam, India 1,March 2019.Microcontroller receives the information from all the modules and processes the data for further uses. Whenever any problem occurs it will give the alerts to the railway department control station. LCD use is to display the robot status. At the same time it will alerts to the nearby trains by using RF Communication, here RF transmitter is placed on Robotic section and RF receiver is placed on Train section. Train section is placed on all trains for receiving track Status information through RF Communication.[1]

2. Mr. Yogesh N1, Chinmaye H E2, K3, Madhusudhan L E4, and Deepak N5. July 2021, some resources has been introducing the vehicle id and the track id can be feeded for identification. Then the vehicle is sent for its further operation. The vehicle then runs on the track for inspection from source railway station to the destination railway station. It runs on power supply provided by the battery. It also contains various sensors to identify various faults. It can detect four types of track faults [2].

3. Sagar Kotkondawar1, Samyak Meshram2, Abhishek Rangari3, Dr. J.P. Sathe4, Dipali Nankate5, Eshakha Sarve6, March 2022, there are two sets of IR sensor units fitted to the two sides of the vehicle. This unit is used to activate/deactivate the Node MCU transmitter unit when there are any cracks in the track. The IR transmitter and IR receiver circuit is used to sense the cracks. It is fixed to the front sides of the vehicle with a suitable arrangement. When the vehicle is powered on, it moves along the model track.[3]

4. 1Nitin Padghan, 2Mayur Deshmukh, 3Ketan Sarode, 4Avinash Mahajan, 5Amar Chanore, September 2022 The whole device is incorporated on a fourwheeled IoT robot/vehicle that movements between educate tracks. The robot is programmed to transport ahead with an infrared sensor connected to the left, proper and ahead to hit upon barriers, which detects breaks inside the music. Arduino is programmed with Arduino IDE and it's far connected with some devices like motor motive force had to circulate our robotic ahead and backward, IOT module to ship message to the engine higher stage attitude, infrared sensor for detecting cracks, in our venture, there are infrared sensors installed on both facet of the version rails.[4]

5. A. Geethanjali1, T. Vijitha2, S. Naveen Kumar3, D. Gajendran4, U. Thulasi Ram5, N. Moulika6,Associate Professor, Department of Electronics and Communication Engineering1,2021,IoT Based Railway Track Faults Detection and Localization Using Acoustic Analysis:- Ultrasonic sensor assembly for the rail track detection system for detecting cracks in the train tracks. Most of the accidents of the train are caused by a train wreck, which can be easily detected. The hand-held inspection of the train track took more time and fatigue of the people. The proposed system introduces technology, to prevent railway accident.[5]

6. In the 2017 paper "Automatic Railway Barrier System, Railway Tracking and Collision Avoidance, International Journal of Computer Applications," Indian researchers Ishan Jain, Shubham Malik, and Soumya Agrawal presented a system that assists in track detection and train collision detection. Also, if there is a collision, the system sends the train driver an SMS warning.[6]

7. Prof. Navaraj of India published a paper in 2014 titled "Ultrasonic Sensor-Based Crack Detection System for Railway Track." The suggested system seeks to detect railway track defects and measure distance[7]

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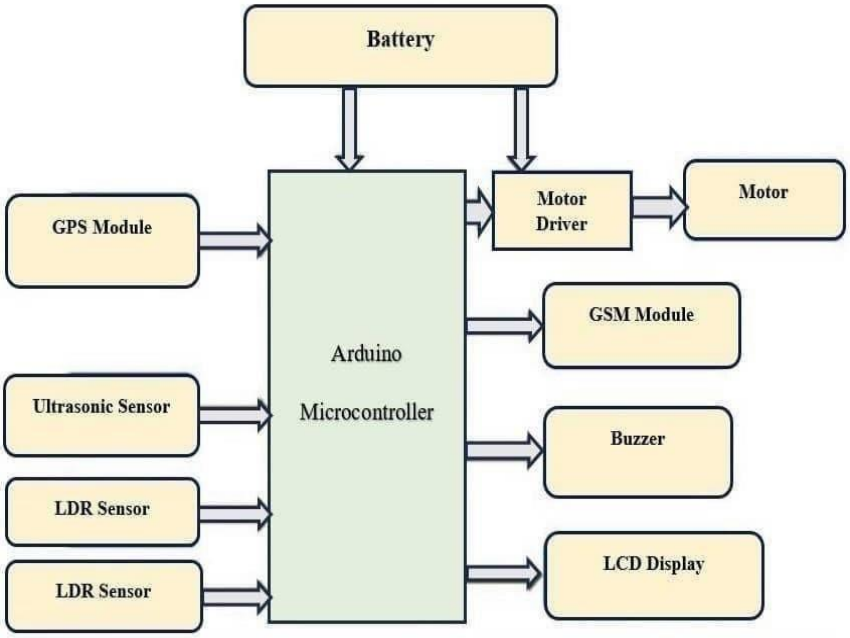
8. In a 2017 paper titled "IR Sensor Based Crack Detection of Railway Track Using GSM & GPS System,"P Nikhar, R Pise, & Avinash S. are used infrared sensor to find cracks in track, ultrasonic sensors to gauge the separation between the two tracks, and infrared sensors to find human presence on the track.[8]

9. With the title "Identification of type and degree of railway ballast fouling using ground coupled GPR antennas," Naresh PS and Bharatha from published a study in 2016. Three ground linked antennas and three fouling materials were taken into consideration when conducting GPR investigations on both model and real railroad rails.[9]

10. Vasupalli Manoj, Goteti Bharadwaj, and V Lokesh in 2018. HVDC “Programmed Railway Track Fault Tracer” covers Transmission and Protection, Applications of Power Electronics to Power systems, Power System Operation & Control, and Power System Stability & Analysis.[10].

III. METHODOLOGY

Block Diagram and its Explanation



Block Diagram of the proposed system as shown in Fig.It contain two sections for track surveying. In Robot section consists of ATMEGA328 microcontroller, GSM, GPS, Ultrasonic Sensor, LCD Display, Battery etc. Motor driver and 4 DC Motors, Here Ultrasonic sensor is used to detect the obstacles presents on track and LDR sensor is used to detect the crack occurred on track. GPS is a Global Positioning System which is used to get the location of Robotic car or crack occurred on track as well as obstacles present on track from the satellite in the form of latitude and longitude and send to the microcontroller. GSM is a Global System for Mobile communication which is used to receive the data from microcontroller and convert it into the SMS and send to the control authority. At ATMEGA 328 microcontroller, LCD display, Battery, Power supply and buzzer are all included in the train section. Here, GSM is used to receive track status information from the GPS. The information is the displayed on LCD display. The best technique for architecture detecting crack in railroad track is ultrasonic technique and LDR sensor technique. A Rail crack notification application for Android is in the process of development a pop-up message will alert the corresponding local pilot as soon as the crack detection system find a rail crack. The GPS module will be used to implement this pop up notification service. Above fig. shows the block diagram of our project it consists the input and output components such as GPS, Ultrasonic sensor, LDR sensor, Wi-Fi Module, Battery, LCD, GSM, Buzzer, Motor and Motor Driver. Arduino Uno (ATMEGA328): Acts as the central processing unit, coordinating interactions between all system components. In GSM Module It is a Global System of Mobile communication. It Utilizes the cellular networks to send alerts or notifications to the railway department when track issues as well as Obstacles detected. In GPS Module it is a Global Positioning System. It Provides real-time geographical coordinates like latitude and longitude, and facilitating precise location identification of track faults or any obstacles detected on track it get location from satellite. Ultrasonic Sensor Detects nearby obstacles or objects along the tracks to ensure safe traversal. It included transmitter and receiver sensor. Ultrasonic sensor transmits the ultra sound or wave and if any obstacles are present on track this waves get reflect on receiver of ultrasonic sensor and it measure the distance.

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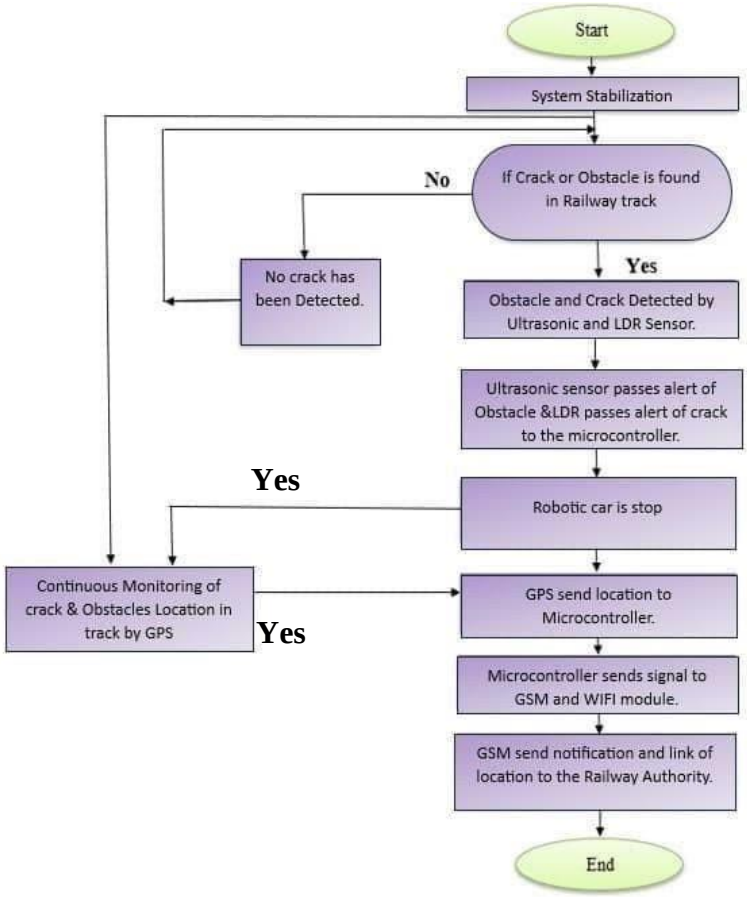
LDR Sensor: Identifies track discontinuities or cracks by detecting interruptions in the infrared signals across the tracks. The cracks in the rails are detected by the LDR system. LED emits the light continuously while moving over the track. If there is a crack in the railway track, the light of the LED will fall on the LDR through the gaps formed due to crack. inversely proportional to the intensity of light. Motor Driver and Motor: Control the movement of the inspection device along the tracks. LCD: Displays real-time system status, detected issues, or operational data for monitoring purposes. Battery and Solar Panel: The combination of the battery and solar panel ensures uninterrupted power supply, making the system self-sufficient and capable of operating even in remote locations without access to conventional power sources.

Flow Chart

1. Initially, the robotic car is sent on the railway track to monitor any obstacles or cracks that may have occurred on the track. The robotic car then moves onward.
2. Initially, the tracks are continuously monitored using a sensor to detect cracks or obstacles.
3. Ultrasonic and LDR sensors are used for monitoring, detecting slight changes that other sensors may miss.
4. If crack is detected Robotic car will stop and get the location from satellite with the help of GPS Module.
5. Ultrasonic and LDR sensors detect cracks and obstacles and inform the Arduino microcontroller.
6. The Arduino microcontroller will carry out the task provided to it properly.
7. The method mostly involves location, sending, and alerting using the GPS module.
8. When a message is delivered to the Railway Authority via GSM or WiFi, they must take appropriate action to prevent future incidents and injuries.



IV. RESULT

The following figure shows that the SMS obtained on the mobile phone with the latitudinal and longitudinal position at the point where a crack or obstacle is detected. STEP2 When the LDR sensor detect a crack on the track robot comes to a stop GPS locates the crack and display the crack detected message which is communicated to the control system via GSM, has shown in figure.

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V. CONCLUSION

The railway is the most commonly used mode of transportation by the people and for goods. The project aims to improve rail track management by reducing manpower. Our study makes it possible to detect cracks in railway tracks as well as obstacles on the tracks. In the proposed technique, an ultrasonic sensor is utilized to detect obstacles on the track, while an LDR sensor is used to detect cracks. The robotic part continuously monitors the crack and obstacle. GPS detects the location of cracks and obstacles, which are subsequently sent to authorities using GSM. The information is also sent from the robotic part to nearby train sections using the WiFi module. This will improve railway track maintenance and monitoring, reducing train accidents significantly.

This robot will assist in improving railway transportation safety by facilitating greater safety standard of railway track and reducing rail accident caused by unrelieved crack and obstacles on railway tracks. This robot is designed not just to detect crack and object, but also to work efficiently and correctly, resulting in less time and better outcomes. This robot will assist in the detection of fractures and object and the detection information will be rapidly provided to the authority mobile number using GPS it determines the precise location track or object and send message via GSM.

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