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Railway Track Crack Detection and Accident Robo

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Abstract:*The goal of this project is to create a robot that can detect accidents on railway tracks using a variety of sensors and an Arduino Uno microcontroller. The system's goal is to increase railway safety by spotting track irregularities and quickly responding to mishaps. An Arduino Uno board, an ultrasonic sensor, a GPS module, a buzzer, a DC motor, a motor driver, an accelerometer, and a Bluetooth terminal are among the major parts of the system the robot can anticipate potential threats ahead and take appropriate action by using the ultrasonic sensor to detect impediments or barriers on the railway rails. A built-in accelerometer can identify unusual vibrations or anomalies on the rails, which may point to track flaws or loose parts. In such situations, the system can quickly alert the maintenance team for immediate attention, ensuring the railway network runs without a hitch.The robot's precise location is tracked using the GPS module, allowing for network-wide monitoring and data logging. Planning for maintenance and additional analysis can be done using this data. The buzzer will sound to alert people in the area in case of an accident or emergency, and the accelerometer will give more details on the impact's severity. This information aids in assessing the possible harm inflicted and can be vital for emergency response teams. This research offers a complete approach to detecting railway tracks preventing accidents. The technology improves safety, reduces accidents, and aids in the smooth functioning of railway networks by combining several sensors and using Arduino Uno as the central processing unit.*

Keywords: Ultrasonic Sensor, Arduino UNO, Accelerometer, GPS, Crack, Bluetooth Terminal.

I. INTRODUCTION

A project called the Railway Track Detection and Accident Robot seeks to increase rail safety by seeing potential mishaps or dangers on tracks. This project intends to detect track anomalies and notify the relevant authorities in real-time, preventing potential accidents, by combining sensors with a robotic system. According to an internet study, derailments are to blame for 60% of all railway accidents, and recent data indicates that rail cracks are to blame for 90% of those incidents. Therefore, it is not safer for human life. The importance of this demands immediate attention. These are ignored, and the tracks are not properly maintained.

These outdated style of railway tracks causes a significant number of accidents every year, and as a result of such accidents, we lose a huge number of lives every year. These kinds of events urge us to consider the mentioned problem and take appropriate action to safeguard those lives. We need to develop a more advanced and secure railway system through the use of our proposed method. In addition, there is no technology or mechanism in our nation that can prevent a collision between two trains that are travelling along the same track in different directions. We are inspired to act after giving the issue some thought. Furthermore, a natural disaster could toss anything onto the train track that is difficult to remove swiftly in a remote location. We reasoned that the control room could prevent accidents if our technology could identify those objects or barriers and alert them.

The faulty rail track is automatically found by the proposed rail crack detection system without the need for human involvement. This system includes a GPS module, an accelerometer, and an ultrasonic sensor to enable object and crack detection. When compared to conventional detection methods, the suggested system has a number of advantages. The benefits include lower costs, decreased power usage, and shorter analysis times. This system's precise position on the problematic rail track can be quickly determined, and it will be repaired right away, potentially saving many lives. In order to promote greater safety standards and provide efficient testing infrastructure for getting better results in the near future, we believe that our notion can be put into practise over the long term.

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Fig. Cracks on Railway track

II.PROPOSED METHODOLOGY

The suggested system's block diagram is displayed in Figure. For the purpose of identifying railway track cracks, a prototype has been created. That is a prototype vehicle for the project that can manoeuvre between railway rails is being constructed. The driver circuit (L293D) and GSM module are interfaced with the Arduino microcontroller, which is used in the prototype car. For the movement of the car in this instance, we employed a Bluetooth device. When a crack in the railway track is noticed while moving, a message is delivered to the authorised person's Bluetooth terminal.

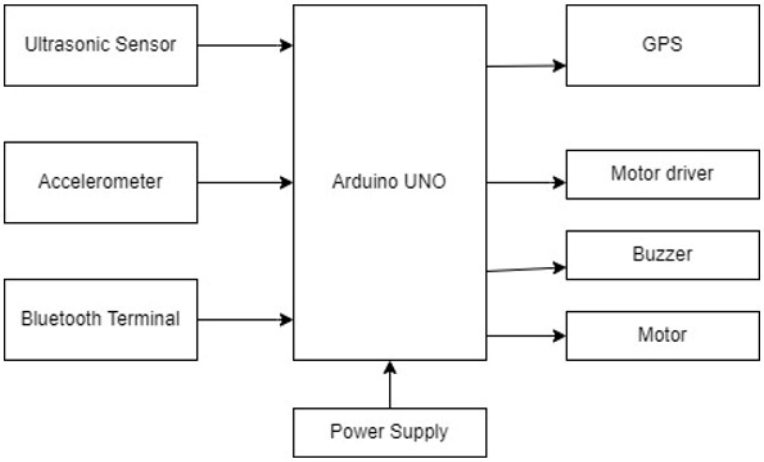

Fig. Proposed System Architecture

The brains of the system, which is based on the Microchip ATmega328P microcontroller architecture, are the Arduino Uno boards. With every other module, it will interact. The microcontroller gathers data from every module and processes it for use in additional processing. The authorised person will receive alerts whenever an issue arises.

1. The car moves along the model track when it is powered on with the on-board signalling system. The tracks' status is monitored using ultrasonic sensors.
2. Immediately when the sensor detects a fracture, the car stops, the alarm goes off, and the GPS receiver triangulates the vehicle's position to obtain the Latitude and Longitude coordinates from satellites.
3. A SMS message is created using the GPS's Latitude and Longitude coordinates
4. The track maintenance department is also informed about the text message.

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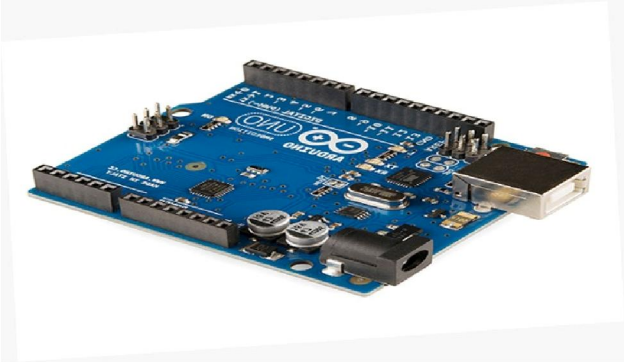
III.COMPONENTS USED

A.Arduino UNO

The ATmega328P is the basis for the Arduino Uno microcontroller board (datasheet). It has a USB port, a power jack, an ICSP header, six analogue inputs, a 16 MHz quartz crystal, and reset buttons. Additionally, it includes 14 digital input and output pins, six of which are PWM outputs.



B.GPS

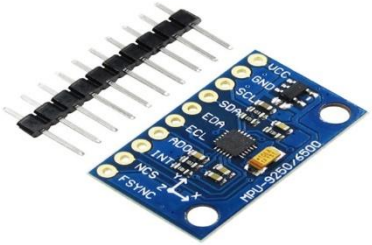
A microcontroller board called Arduino Uno is based on the ATmega328P (datasheet). It contains six analogue inputs, a 16 MHz quartz crystal, a USB port, a power jack, an ICSP header, and a reset button. It also has 14 digital input and output pins, of which 6 can be used as PWM outputs.

C.Ultrasonic Sensor

An ultrasonic sensor is a device that measures distance, detects objects, and calculates object speed using sound waves with frequencies above the range of human hearing. Numerous applications, including robotics, industrial automation, and automotive systems, make extensive use of ultrasonic sensors.

D.Accelerometer

An accelerometer sensor that detects acceleration along the X, Y, and Z axes is the ADXL335. It offers an output voltage proportional to acceleration that a microcontroller or other processing device can quickly read. The sensor is suitable for portable and battery-powered applications since it operates across a wide voltage range and uses little power. The ADXL335 is suitable for detecting motion and tilt in a variety of applications, including gaming, human-computer interface, and vibration monitoring, because it can detect acceleration in the range of +/- 3 g.



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IV.EXPERIMENTAL RESULTS

Currently, the microcontroller is interfaced with the GPS module, ultrasonic sensor, motor driver, and motor. When impediments and cracks are present on the track, the Bluetooth terminal receives the message "Crack Detected! Even though all the components are working as intended. Our device will be more useful since it can detect even minute changes in the distance between the sensor and an obstruction in front of it.

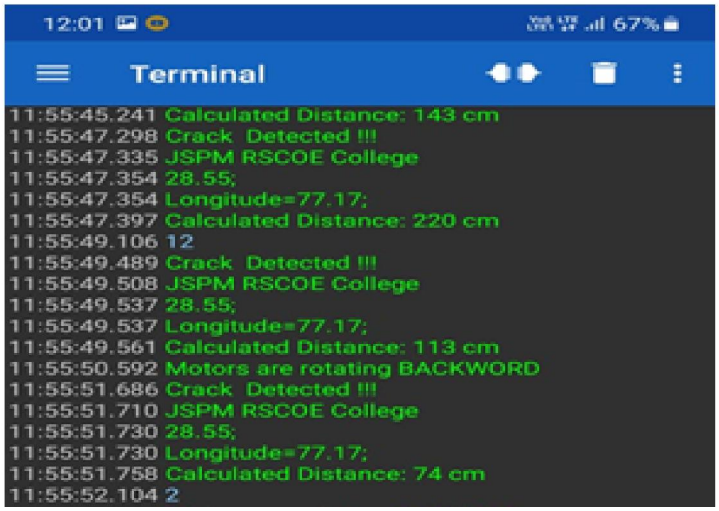

Figure: Output on Bluetooth Terminal

V.CONCLUSIONS

Throughout the course of the project, we were able to build a system that brings together a number of sensors and technologies to improve railway safety. The presence of items or obstructions on the rails is detected by the ultrasonic sensors. The GPS module assists in pinpointing the train's location and giving the system up-to-date information. The buzzer warns the train driver and any close staff members of any possible hazards when they are discovered, enabling them to take immediate action. The Railway Track Detection and Accident Robot project, in its entirety, offers a creative and effective technique to improve safety protocols in railway systems.

ACKNOWLEDGMENT

The preliminary project research paper on "Railway Track Crack Detection and Accident Robo" is presented with great joy. I would want to take this opportunity to thank Mr Shamkant Desale, my guide, for providing me with all the support and direction I required. I sincerely appreciate their thoughtful assistance. Their wise advice was quite beneficial. For his valuable guidance and suggestions, I am particularly grateful to Dr. S. N. Khan, Head of the Mechanical Engineering Department at the JSPM Rajarshi Shahu College of Engineering, Tathawade, Pune. I would like to extend a particular thank you to Mr. Shamkant Desale for offering several resources for our Project, including a laboratory with all necessary software platforms and ongoing guidance.

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