Advanced Railway Security System (ARSS) Based on Zigbee Communication for Track Fault Detection

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Abstract - **This paper presents an innovative electronic system designed to detect cracks and gaps between railway tracks accurately. Railways are a vital component of the transportation system in India, with increased railway traffic resulting in a rise in the number of accidents. To address this issue and reduce the loss of life associated with these accidents, this project proposes the use of a robot for crack and gap detection. The robot uses IR sensors to identify the precise location of cracks and gaps on tracks, while ultrasonic sensors detect any obstacles present. The system also utilizes ZIGBEE TECHNOLOGY to transmit fault detection messages via SMS to nearby stations, enabling quick repairs to be made. With this technology, faulty tracks can be identified and addressed in a timely manner, leading to fewer accidents and safer transportation for all.**

Index Terms - **Embedded system, ZIGBEE, IR sensors, Ultrasonic sensor, ATMega328 Microcontroller, DC Motor, LCD.**

I.INTRODUCTION

Railway transportation is a cost-effective and convenient mode of travel in India, with people often traveling long distances by train. Unfortunately, a significant percentage of railway accidents in the country are due to derailments, poor facilities, and most commonly, cracks in the tracks. Recent measurements indicate that up to 90% of railway accidents in India are caused by cracks in the rails. To reduce the number of accidents and increase safety for all, it is crucial to introduce new technologies to detect and rectify this problem.

Previously, cracks on the tracks were detected by human observation, which was a time-consuming process. Even when detected, the information had to be relayed to nearby stations, a process that could take too long, and if a train traveled on that route before the problem was rectified, it could lead to danger. In response to this issue, we propose the use of a robot based on embedded systems. The robot is capable of detecting cracks and gaps on the railway tracks and transmitting the longitudinal degrees and exact location of the problem via SMS and Zigbee communication to nearby stations. When the information is received, a buzzer will ring at the station where the Zigbee receiver is located, and railway authorities can rectify the issue quickly. This technology can decrease the number of accidents that occur and save lives and property.

Poor facilities and unattended cracks on the railway tracks are significant factors contributing to railway accidents in India, with derailments being a common outcome that leads to loss of life and property. By implementing advanced technologies like the embedded systems-based robot proposed here, we can detect and resolve track issues in a timely manner, minimizing the risk of accidents, and ensuring safer travel for all.

II. LITERATURE SURVEY

S. Mishra, A. Shrivastava and B. Shrivastav (2019) A Smart Fault Detection System For Indian Railways International Journal of Scientific & Technology Research The device built will be attached to a train engine and contains a sensor that can detect a few meters cracks and as soon as any cracks are found the train driver will receive a signal to install emergency brakes and the authorities will be notified of the correct location of the fault.

Parvathy A. et al. (2017) Automatic Railway track fault detection for Indian railways IEEE The Automatic Railway Route automatically detects the fares of the Indian IEEE Rail Automatically and detects cracks very quickly without human intervention.

Mansi R. Sarwan et al. (2018) Automated Railway Track Fault Detection System Using Robot International Conference on New Frontiers of Engineering, Management, Social Science & Humanities An IR (Slot sensor) assembly that tracks the exact location of a faulty track was quickly repaired so that many lives could be saved.

Kalpana Sharma, Jagdishkumawat, Saurabh Maheshwari and Neeti Jain Paper Intl. Journal of Computer Applications, Vol 96, June 2014, Pp.32-35 In this paper the following things have been studied. Like various techniques for detecting the cracks in the railway tracks. Method of inspection and maintenance with the help of a basic algorithm which uses the wireless sensors for detecting the cracks and breakages in railway tracks. Which is used for the examination of foot of rails especially in those area where corrosion is likely to be occur.

V. Saravana Moorthy and G.N. Murugananthan Paper "Identification of Obstacle and Crack Finding "Railway includes the techniques for the identification of obstacles and cracks finding techniques in ay system. According to their research, the train and the trolley would include a GPS receiver which sends the location tomicrocontroller placed in the train. "trolley" is the safety vehicle which will travel along a railway. If somehow, due to natural cause, trolley derail, stops or slows down due to any of the reason, then the CPU

III. PROPOSED SYSTEM

This system involves the design of cracks/ gap finding robots which sense the crack at some distance with the help of sensors attached to it. This system uses the microcontroller ATmega 328 to which the sensors, LCD, Zigbee, L293D are connected. DC motors are connected to the L293d module which helps the robot move in multi directions, which helps the robot to move front, back , right and left.

It uses the micro-controlled Arduino Uno to combine with the robotic vehicle and crack detection sensor. The cracks are detected by using the sensing devices due to their voltage variations, and then they give the signal to the Arduino Uno. The measured value and the threshold values are checked by the microcontroller and the robot controls according to it. If any crack occurs in the railway track, the robot will be stopped and the buzzer turns on.
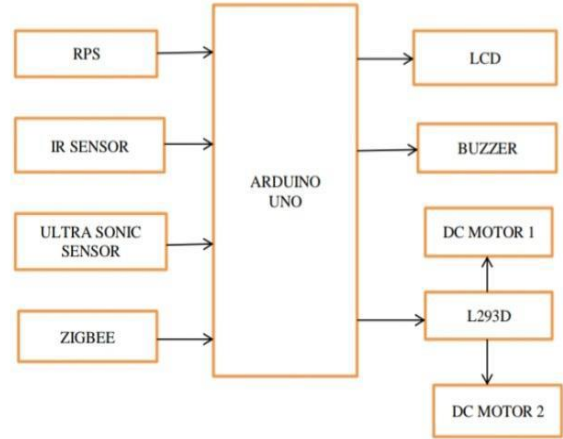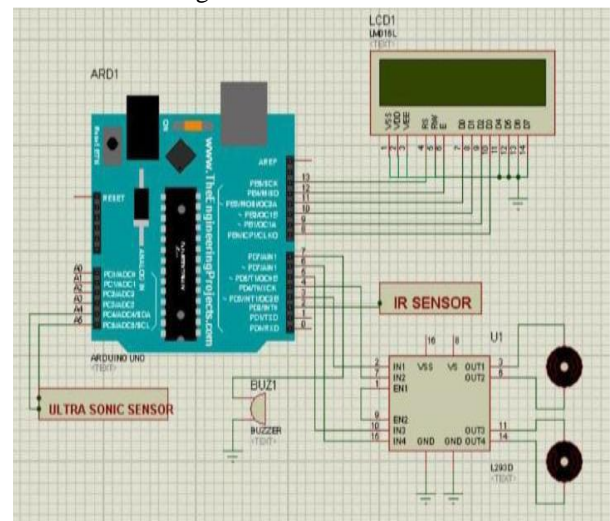

Fig 1.1 Block diagram

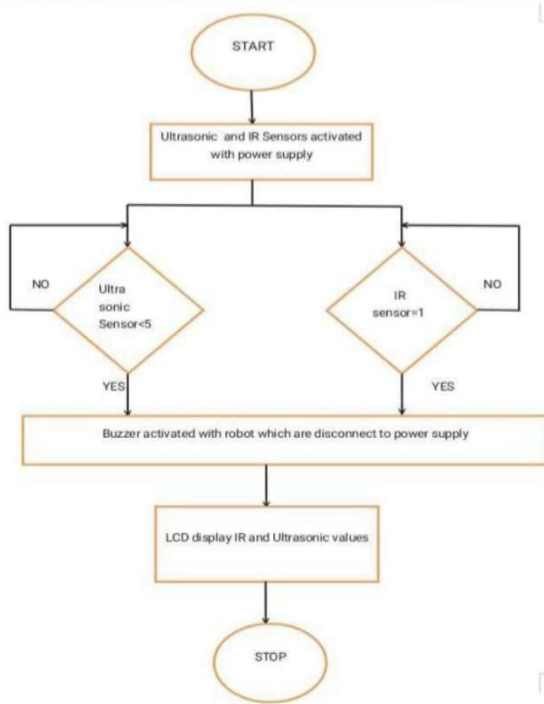IV. HARDWARE&SOFTWARE TOOLS

A. Hardware Tools
Arduino Uno
LCD Display
Motor driver IC L293D
DC motor
Buzzer
Ultrasonic Sensor
Power supply
B. Software Tools
EAGLE used to create schematic diagram.
PROTEUS software
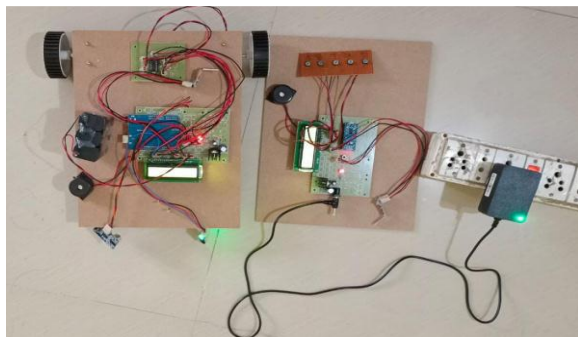
V.METHODOLOGY

A. Schematic diagram

B. Flowchart

VI. APPLICATIONS

- Can be used for railway departments.
- Can be used in industries.
- Used in detection appliances.
- Reduces a man power.
- Crack detecting efficiency is high.
- Accuracy is high.

VII. ADVANTAGES

- To easily detect the crack failures.
- Train accidents will be reduced.
- Authority get notification

VIII. RESULT

The proposed system represents an exemplary use of wireless networks for efficient railway track crack detection, with potential applications in both domestic and commercial settings. By replacing the labor-intensive and error-prone manual detection method with a sophisticated technological solution, this system can rapidly detect and alert railway authorities of any cracks detected along the tracks. This will enable quick repairs and prevent potential accidents or delays. Overall, this innovative approach to track maintenance will contribute to safer and more efficient transportation for all.

IX. CONCLUSION

In conclusion, the safety and security of railway transportation systems are critical to ensure the well-being of passengers and staff. Accidents can have severe consequences, including loss of life and traumatic experiences. Our advanced railway security system that utilizes Zigbee communication and embedded fault-detection technology is a significant step towards preventing accidents and ensuring the safety of all individuals who rely on railway transportation. By implementing this system, we can create a safer and more secure railway transportation system that prioritizes the well-being of its users.

X. FUTURE SCOPE

The future scope of our railway security system includes integrating additional sensors to detect internal cracks in the railway track and scaling up the

system to more railway stations and tracks. This will facilitate better safety standards for rail tracks and provide an effective testing infrastructure for further refinements in the future.

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