



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 5, May 2024

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 8.423

 9940 572 462

 6381 907 438

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Railway Track Crack Detection System

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ABSTRACT: Railway infrastructure plays a crucial role in transportation and ensuring passenger safety is of utmost importance. One of the key safety concerns is the detection of cracks and defects in railway tracks. The main cause of the accidents happened in railways are railway track crossing and unidentified crack in rail tracks. About 60% accidents are happened at railway track crossing and due to crack in railway tracks resulting in loss of precious life of passengers and loss of economy. Therefore, there is a need to have new technology which will be robust, efficient and stable for both crack detection in railway track as well as object detection. which combines the use of tracking system and the geographical coordinate of location and IR sensor, PIR sensor for application of communication purpose. When a crack or anomaly is detected, the system triggers alerts to railway operators for immediate action. This proactive approach to track maintenance enhances safety and reduces the risk of derailments and accidents. The Railway Track Crack Detection System using Raspberry Pi offers a cost-effective and efficient solution for monitoring railway track integrity, contributing to the overall safety and reliability of the railway network. There for we are using the Esp32 microcontroller with an on-chip 32-bit microcontroller with integrated wi-fi + Bluetooth a wide range of applications.

I. INTRODUCTION

In India the railway network has a track length of 113,617 kilometres (70,598 mi) over a route of 63,974 kilometers (39,752 mi) and 7,083 stations. This is the fourth largest railway network in the world. The Rail transport is growing at a rapid pace in India. It is one of the major modes of transport but still our facilities are not that accurate, safer as compared to international standards. A survey on the internet states that about 60% of all the rail accidents is due to derailments, recent measurements shows that about 90% are due to cracks on the rails. Hence, it is not safer for Human Life. This needs to be at the utmost attention. These goes unnoticed and the properly maintenance of tracks is not done manually, but the proposed system has a robot which will run automatically on the tracks. System having LED and LDR sensor assembly, but the main disadvantage is that the LED and LDR must be placed opposite to each other and also the environment needs to be perfect to detect the track. To overcome this disadvantage, here proximity. sensor is used, which will detect the crack accurately. The existing system is slow, tedious and time consuming. This system has GSM and GPS module which will give the real time location or coordinates in the form of Short Message Service(SMS) to the nearest railway station. The better transport leads to more trade. Economic level is mainly depends on increasing the capacity and level of transport. This paper presents an implementation of an efficient and cost-effective solution suitable for railway application. Then other important component is PIR sensor it is used to detect the presence of humans in track. They then communicate their observations to the driver. Furthermore, a natural disaster might toss anything onto the train track that can't be removed in a distant location very soon. We reasoned that if our system could identify certain barriers or objects and alert the control room, they would be able to take the appropriate action to prevent accidents. An automated system that consists of a robot equipped with an IR sensor and a camera is proposed in this paper. The robot can detect cracks in railway tracks and take pictures of them. here are two distinguished technologies, HSR and maglev. Both provide higher operating speed. However, they have dramatically different technical specifications. Various organizations in the world are facing difficult decisions, when choosing or settling on a specific technology, in a particular corridor. it is not an easy task to select the most efficient technology in any given corridor. A new rapid transit system influences the society, the industry and the ecology in various manners. A HSR or maglev system must prove its advantages. Therefore, extensive, and detailed studies must be carried out. It must be examined in an intense The criteria for the decision must be evaluated in a multi-criteria procedure. This process delivers a master plan for new construction of the transportation network. The plan for the research and development of a rapid transit technology should be made at the national level. There are a few reports on the technical specifications of technologies and comparative studies. Most of the common drive assistant systems for detection of obstacles work unstructured environments. These environments generally include many non-planer surfaces which pose a big challenge for vision system.

II. RELATED WORK

The project block diagram is shown in figure 3.1, which contains esp32 microcontroller, ultrasonic sensor (hc-sr05), pir sensor, motor driver (l298n), gps & gsm modem, motor (dc motor, 12v), esp32 cam module and lcd display.

Input of ac supply 230v is given to transformer step down to its 12v and connected bridge rectifiers as a type of full-wave rectifier that uses four or more diodes in a bridge circuit configuration to efficiently convert alternating (ac) current to a direct (dc) current.

The 7805 and 7812 are part of the 78xx family of voltage regulators, which are positive regulators with a common ground. The main difference is their output voltage: 7805 produces 5 volts, while 7812 produces 12 volts.

Both are easy to use in various linear power supply circuits. Ultrasonic sensor and pir (passive infrared sensor) used as an input device which is used to detect the cracks in rail track, the crack is detected using ultrasonic sensor and principle of doppler effect.

Initially the robot will move on the track using motor, motor is given power through a motor driver and commanded through esp32 microcontroller. Whenever there is a crack detection the motor will stop and the robot will halt on the track after the crack detection the location data is to be sent to control room/through the telegram cloud.

III. METHODOLOGY

This section discusses about hardware and software used, development and working of the proposed system.

GPS Modem: The Global Positioning System (GPS) is a worldwide, satellite-based, radio navigation system that was developed by the U.S. Department of Defense for military purposes. It provides precise location information for vehicles regardless of their location, time, or weather conditions. The system comprises 24 satellites in orbit around the Earth, constantly monitored by earth stations. These satellites transmit signals that can be detected by GPS receivers installed in vehicles, allowing for highly accurate determination of their location.

ESP-32 Microcontroller which acts as the processing unit for the other peripherals interfaced with the IR sensor, GPS and video camera. controls the robot and the video camera. The complete model is placed on a four-wheeler robot which travels along the rails. Using commands, the robot moves along the track.

The robot is able to move forward and reverse and the video camera, which is placed in front of the robot, can move in all four directions of up, down, right and left. This model works on a simple principle i.e. the bot will move on the railway track continuously and immediately the IR sensors get the input signal low. It will stop the bot and send the exact location to the server via internet. Python code is returned in such a manner that it gives the data value in latitude and longitude form.

BLOCK DIAGRAM

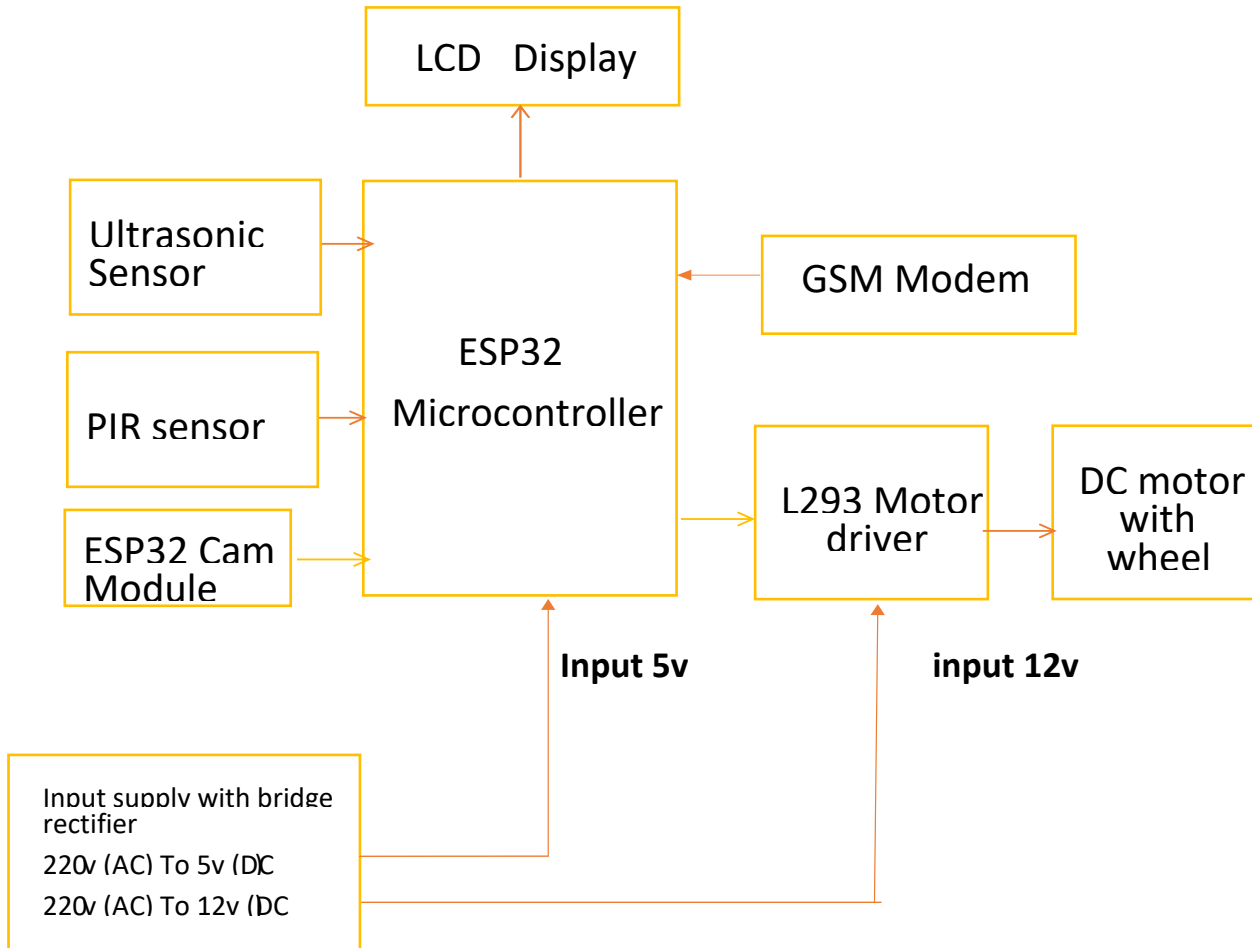


Fig 1 Block diagram

• CIRCUIT DIAGRAM

As per this project design, a 5V regulated power supply is required. All the modules are selected to work with 5V supply. LM317 adjustable regulator is used generate 5V regulated power supply. A 12V, 2A SMPS AC-DC adaptor is used as an external power supply. To operate the project the male socket to the adaptor is connected to the DC jack present on the microcontroller board. Our microcontroller power supply section is so generalized, we can use step-down transformer or DC adaptor to power ON the board.

The project Circuit diagram is shown in Figure3.1 , which contains ESP32 Microcontroller, ultrasonic sensor (HC-SR05),PIR sensor motor driver (L298N),Gps& Gsm modem motor (DC motor, 12V), ESP32 Cam Module and LCD Display.

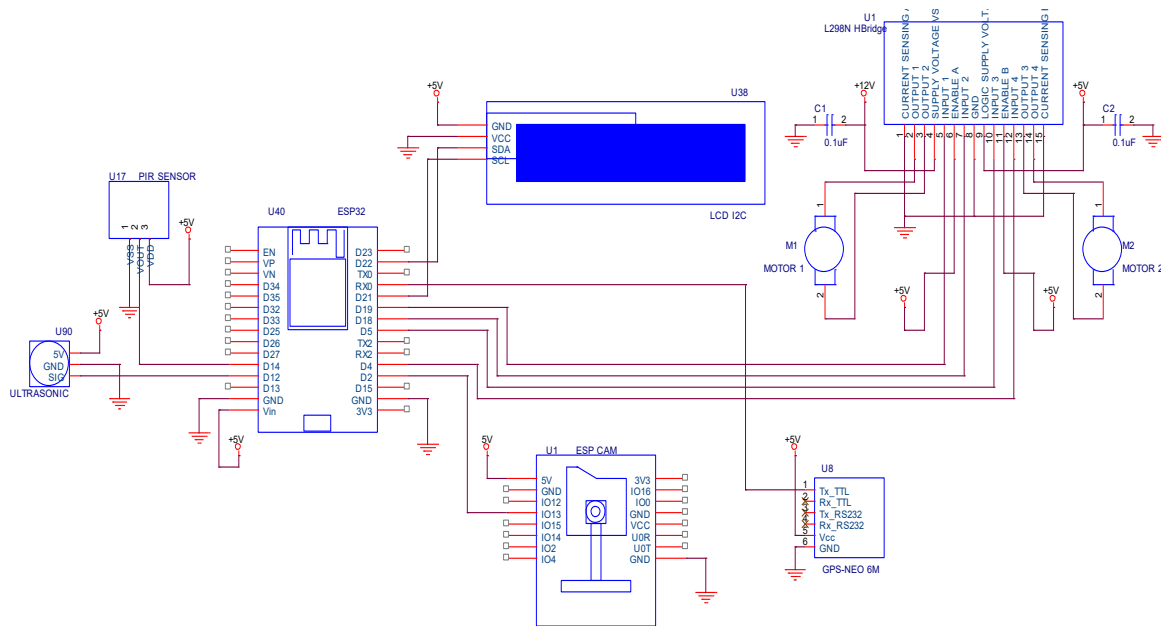


Fig.2 Circuit diagram

IV. EXPERIMENTAL RESULTS

The railway track geometry system in our project utilizes both ultrasonic sensors and PIR sensors to detect cracks on the track. The values obtained from these sensors are then passed to the controller board for further processing. Additionally, the is used to track the location of abnormal conditions on the track, and the coordinates are also passed to the controller board from the ESP32Microcontroller Finally, an SMS is sent to the user through the telegram cloud to notify them about the detected abnormal / crack condition.

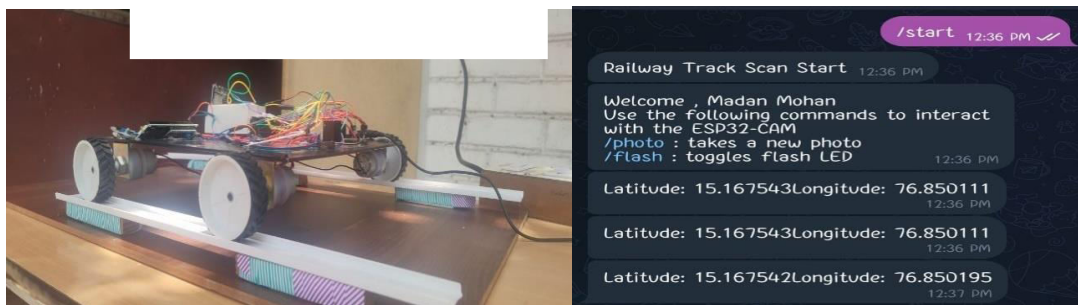


Fig.3 : Prototype of the railway track crack detection

V. CONCLUSION

In conclusion, the railway track crack detection system is a valuable tool that aids in ensuring the alignment and integrity of railway tracks. By employing advanced technology, such as sensors, this system enables accurate and efficient inspection of railway tracks, identifying potential issues such as misalignment and cracks. It providestimely feedbackto maintenance crews, allowing for prompt repairs and preventing potential accidents or delays. The implementation of a railway track crack detection system can significantly improve the safety, reliability, and efficiency of railway operations, reducing the risk of accidents and minimizing downtime. In summary, the railway track geometry system is a crucial asset for railway maintenance and operation, supporting the safe and reliable transportation of passengers and goods on rail networks. Also the easy availability of the components make an ideal project for industrial use with very little initial investment .so the device on rail rack can easily be measurement from station /control room .By this proposed model may lives can be saved by avoiding accidents.

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