AUTOMATIC RAILWAY TRACK CRACK DETECTION SYSTEM USING MICROCONTROLLER & COMMUNICATION USING IoT

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Abstract: The Indian Railroads has one of the greatest railroad frameworks inside the world, Criss- crossing over 1,15,000 km in partitioned, all-over India. In any case, with respect to faithful quality and traveler security Indian Railroads isn't up to around the world rules. Among other components, parts made on the rails due to nonappearance of helpful area and the related upkeep pose honest to goodness questions on the security of operation of rail transport. An afterward consider revealed that over 25% of the track length is in require of substitution due to the headway of parts on it. Manual revelation of tracks is ungainly and not totally fruitful owing to much time utilization and prerequisite of skilled experts. This amplify looks at a Railroad track break area utilizing sensors and may be a lively approach which combines the utilize of GPS taking after system and to send alert messages and the geological organize of range. An ESP 32 Microcontroller is utilized to control and encourage the works out of this contraption with the development of IoT

Keywords: Railway Track, Crack Detection, Sensors & Controllers, GPS & IoT

Introduction

Railroad is a fundamental and cheapest mode of transport in India and is considered predominant to all other modes of transport. Perusing every day daily papers, we come over numerous railroad mishaps. Railroad mishaps are more unsafe than other activity mischances both in terms of seriousness and mortality, etc. In this manner, more endeavors are required to make strides security. Railroad security is an imperative portion of railroad activity all over the world. Disappointments that lead to mischances tend to get far reaching media consideration indeed when the railroad is not at blame, and make an ineffectual picture of the railroad among the open that regularly empowers prompt changes. Indian Railroads has one of the biggest railroad systems in the world, traversing over 1,15,000 km over India. But in terms of unwavering quality and traveler security, Indian Railroads is not up to worldwide benchmarks. Among other things, the breaks on the rails caused by the need of opportune discovery and related upkeep raise genuine questions around the security of rail activity.

A recent study revealed that further than 25 of the track length needs to be replaced due to cracks. Homemade identification of traces is clumsy and not completely effective because it takes a lot of time and requires professed technicians. This design work aims to break the problem by developing an automatic track slotting system with the proliferation of TV defenses. A huge quantum of data can be collected to detect and trace rail faults. The end of the design is to help the applicable road administrations to strengthen their safety culture and develop monitoring tools necessary for ultramodern safety operation. Railway crossings are veritably unique, special, and potentially dangerous and at the same time necessary in the world. Then, two different realities with fully different liabilities, fields of exertion and exertion meet and come together with the end of furnishing a service to the road stoner. In this design we use an ultrasonic detector to descry cracks in railroads. When a crack is detected, its status is transferred to the control room via the TV screen. An infrared detector is also used in the dimension process. This system is designed to operate a road safety monitoring system with an ESP 32, ultrasonic detectors and an TV display.

Literature Review

Designing of Improved Monitoring System for Crack Detection on Railway Tracks Author- Nilisha Patil1, Dipakkumar Shahare1, Shreya Hanwate1, Pranali Bagde1, Karuna Kamble1, Prof. Manoj Titre2. Published-April 2021. To overcome the issue of faults in tracks and identify the moving object or animal on the tracks, we learned an automated system based on a microcontroller and sensors. An autonomous robot with PIR and Ultrasonic sensors, coupled with GPS and GSM, is designed to provide real time alerts.

Detection of Crack in Railway Track using Ultrasonic Sensors Author- Anushree B.S, Priyasha Purkayastha, Anjali Girgire, Anjana K, Ruma Sinha. Published-May 2017. The paper proposes a crack detection system, which detects the crack without human intervention and transmits the location of the fault to the authorized personnel via GSM. Using this technique, cracks can be detected both during the day and at night, revealing the precise location of the fault.

Automatic Railway Track Crack Detection System Author- Rahul Singh, Leena Sharma, Vandana Singh, Vivek Kr. Singh. Published- May 2020. The goal is to develop a railway crack detection system (RCDS) employing an ultrasonic sensor, the global system for mobile communications, the GPS and an Arduino-based module, whose implementation will provide a cost-effective method for detecting cracks in the tracks and thereby avoiding train derailments.

Railway Track Crack Detection Author- Arun Kumar R, Vanishree K, Shweta K, Nandini C, Shweta G. Published-2020. This project discusses a railway track crack detection using sensors and is a dynamic approach which combines the use of a GPS tracking system to send alert messages and the geographical coordinate of the location. Arduino microcontrollers were used to control and coordinate the activities of this device. Designing the railway crack detection system employing ultrasonic sensors is the main goal of the project.

Problem Statement

The main issue was the absence of inexpensive and efficient tools for detecting issues with rail tracks, and of course the absence of regular upkeep of the tracks, which led to the formation of cracks in them, etc. similar issues were caused by antisocial elements that pose a threat to the security of rail travel. This issue has caused several derailments in the past, resulting in many casualties and property. Track cracks were identified as the primary cause of veering off course in the past, but there were no readily accessible, cost-effective automated methods for assessing them. Derailments are one of the leading causes of derailments worldwide. Taking into consideration derailments in general, the United States alone experiences an average of more than one major derailment every three days for more than a decade.

Fig. 1: Crack on track

Proposed Methodology

This approach involves the development of a robot capable of detecting cracks in railroad tracks. The robotic vehicle and crack detection sensor are interfacing with the controller. It gives a signal to the microcontroller after sensing the crack and detecting the obstacle. The microcontroller examines the indicated signals and then transmits the message to the LCD display to display the message. Our concept addresses one of the most cost-effective methods for avoiding train accidents by formulating solutions to the issue of railway crack identification. An automated system which does not rely upon manual labor is fetched into bright to avoid the drastic condition of Indian railway networks from stopping down. The concept is to propose a cost-effective solution by utilizing ESP 32 microcontroller, ultrasonic sensors, infrared sensors, buzzer, IOT assembly to ensure robustness, repeatability, and easy implementation. There are infrared sensors used to detect the crack. IoT service is used in order to locate the current position of the crack detected. The received information is communicated using the IOT module. Sending this message wirelessly to the appropriate authorities. Then an alarm sounds with the aid of a buzzer, signaling the presence of a crack. They then proceed to locate the exact spot of the track damage immediately, saving countless lives.
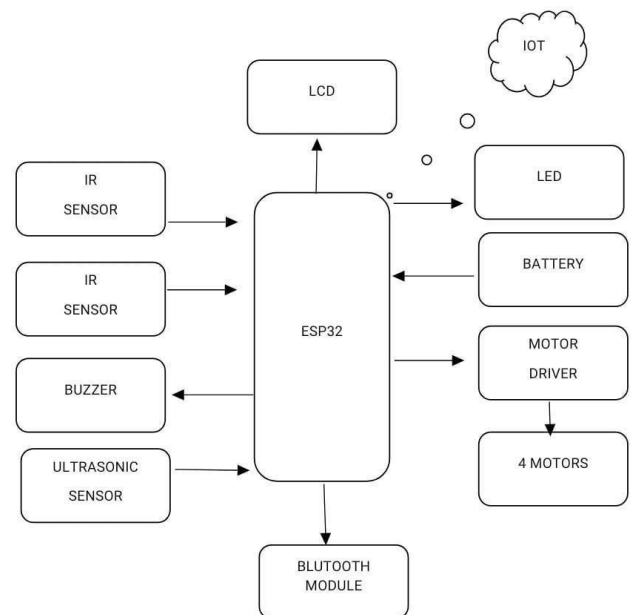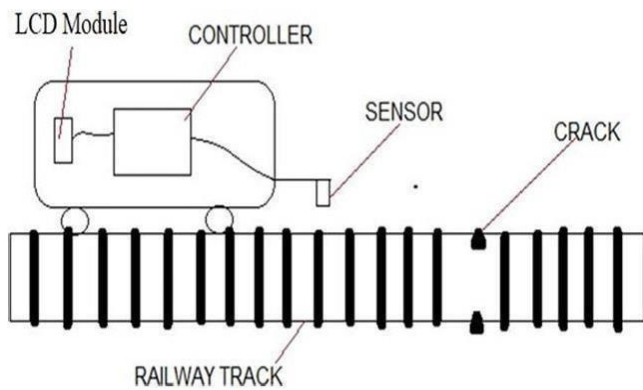
Block Diagram

Fig. 2: Block Diagram

Fig. 3: Experimental Diagram

Working

A sensor that detected a break in the track was used to continuously check the tracks at first. The track is monitored by two infrared sensors. An IR sensor detects a crack and sends its output to the Arduino microcontroller. The Arduino microcontroller will take care of the task that's been assigned to it. The location is communicated via a GPS device. As soon as the notification is provided to the Railway Authority, the Emergency Alert must be taken into consideration. Future accidents and near-misses that could result in human death or serious injury must be prevented by taking significant steps. The suggested method has not only overcome these difficulties, but also enhances precision and crack detection on rails. It's the most economical way to make sure our railways perform well and minimize the number of mishaps. There by possibly to save the precious lives of passengers and loss of economy. It saves time and money for the identification of crack by saving time and money.

Components Description

The block diagram of the desired system is shown in fig.3.

1) ESP-32

A low-cost System on Chip (SoC) that is perfect for Internet of Things (IoT) applications that need connection is the ESP32 microcontroller. It is a flexible option for developing Internet of Things applications because it has Bluetooth and Wi-Fi capabilities. The ESP32 has more functions than the ESP8266, which is solely meant for Wi-Fi networking. These include serial communication, high-resolution ADCs, and DACs. The ESPWROOM-32 module, two rows of IO pins (15 pins on each side), a micro-USB connection for programming and power, reset and boot buttons, power and user LEDs (attached to GPIO2, respectively), and an enable and boot button are all included in the ESP32 microcontroller. For IoT projects, the ESP32 microcontroller is a special and potent option because of these capabilities.
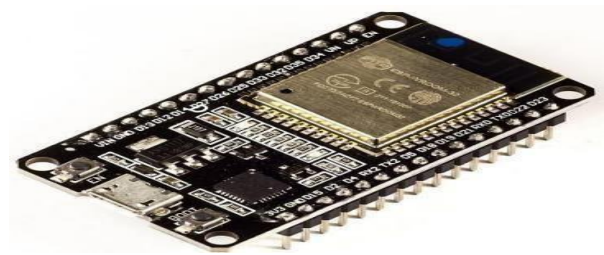

Fig. 4: ESP 32

2) Liquid Crystal Display

This gadget can be utilized to show any message, status or too can be utilized for investigating reason. In this extend it shows the status of breaks.

3) L298N Motor Driver Board

Two DC motors may be simultaneously controlled for both speed and direction thanks to the twin H-Bridge motor driver L298N. DC motors with a peak current of up to 2A and a voltage between 5 and 35V can be driven by this module. The voltage applied at the motor's VCC determines this. A jumper may be used to enable or disable the module's built-in 5V regulator. The 5V regulator may be turned on if the motor supply voltage is up to 12V. The 5V pin can then be utilised as an output, such as to power our Arduino board.
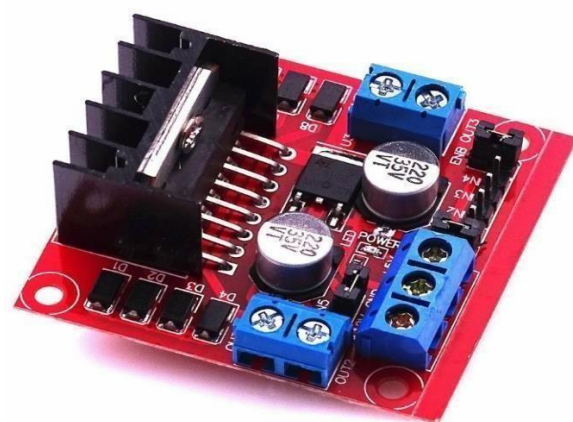

Fig. 5. L293D Motor Driver Board

4) Ultrasonic Sensor

An ultrasonic sensor is an instrument that measures the separate to a question utilizing ultrasonic sound waves. An ultrasonic sensor employment a transducer to send and get ultrasonic beats that hand-off back data approximately an object's vicinity.

Fig. 6. Ultrasonic Sensor

5) Proximity sensor

A proximity sensor is a sensor that detects nearby objects without touching them. Sensing without touching is done with the help of an electromagnetic field. As soon as the object comes within the field, it changes. As there are no mechanical parts or even any physical contact, proximity sensors have high reliability and very long life. Proximity sensors detect the changes in the physical attributes of an object.

Fig. 7. Proximity Sensor

5) GPS Module

The Global Positioning System (GPS) could be a satellite-based route framework made up of at slightest 24 satellites. GPS works in any climate conditions, anyplace within the world, 24 hours a day, with no membership expenses or setup charges
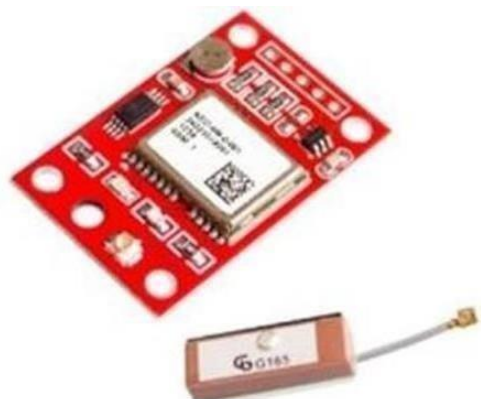

Fig. 8 GPS Module

Results

The "Railroad Track Split Discovery utilizing ESP 32" venture points to distinguish splits on railroad tracks utilizing an ESP 32 microcontroller. The ultrasonic sensor identifies the separate between the sensor and the rail, and any noteworthy variety in this separate demonstrates the nearness of a break on the track. The framework at that point alarms the railroad specialists through a GSM module, giving them with the precise area of the split, so they can take essential measures to repair it and avoid any potential mishaps. The extend has been effective in recognizing splits with tall exactness and has the potential to progress railroad security altogether. • Video show units show pertinent data agreeing to the controller's reaction to the provided circumstances. • The controller makes it easier for the driver to function and grants the motors to move. • The IoT module is at that point turned on, and it transmits the message to closest stations guideline them to perform the suitable activity. • The sensors are turned on and can dependably recognize breaks or other obstacles. • When a split is found, the word "broken" will show up on the Driven show. The consequent patterns suggests the "Crack Detected or impediments found" within the Arduino appear show screen

Fig.9.Crack Detected

The taking after figure appears that SMS gotten on cellular phones are interior the latitudinal and longitudinal areas where a crack or impediment is located.

Fig.10. Information Received in the mobile Phone

As message gets conveyed to the Railroad Specialist, the caution is to be taken into consideration and vital measures must be taken by them in arrange to maintain a strategic distance from future occurrences and miss happenings which can lead to loss of human life conjointly to major wounds.

Fig.11. Project Image

Applications

Railway track crack detection system has been applied for different application areas are listed below.

1) Automatic Crack Check

Rail Split discovery is the method of detecting a break within the structures utilizing any the proposed strategy employments progressively radiometric, geometric and relevant data. The vehicle draws control from the battery. The optical sensor is utilized to distinguish the split within the railroad track. Assume any racks are within the track the vehicle will naturally halt.

2) Wireless Application Protocol

Remote application convention (WAP) is the communications convention that's utilized for remote data access through the foremost portable remote arrange. WAP upgrades remote determination interoperability and encourages moment network between intuitively remote gadgets (such as portable phones) and the Web. Remote Application Convention may be a specialized standard for the getting to data over a versatile remote organize. A WAP browser is web browser for mobile gadgets such as portable phones that employments the protocols. Though WAP may be a modern innovation, but it reuses the concepts found within the Web.

Conclusion

The proposed Arduino based rail split discovery framework has the potential for recognizing the breaks within the rail track counting minor splits naturally without any human mediation. There are numerous focal points with the proposed framework as compared with conventional discovery strategies. The points of interest incorporate quick distinguish and detailing framework, less fetched, moo control utilization and less investigation time. Moreover, the simple accessibility of the components and the straightforwardness of thought make the proposed framework perfect for usage on a huge scale with exceptionally small starting speculation.

In this manner, it can work effectively and successfully beneath working condition. By this proposed show, we'll effortlessly maintain a strategic distance from the mishaps occurs by the track side split which can offer assistance us for sparing numerous lives. In this venture we have outlined a taken a toll successful, moo- control inserted framework, which encourage superior security guidelines for rail tracks for avoiding railroad mishaps due to splits and deterrents on railroad tracks. The Model of testing railroad show can productively identify breaks and deterrents on railroad tracks. The result appears that this modern inventive innovation will increment the unwavering quality of safety systems in railroad transport. By executing these highlights in genuine time application, ready to maintain a strategic distance from mischances up to roughly 70%.

Acknowledgement

References

[1]. Selvamraju Somalraju, Vigneshwar Murali, Gourav Saha, Dr.V.Vaidehi, "Robust Railway Crack Detection Scheme (RRCDS) Using LEDLDR Assembly," IEEE Int. Conf. on Networking, Sensing and Control, vol. 6, iss. 3, pg. 453-460 , May2012.

[2]. Qiao Jian-hua; Li Lin-sheng; Zhang Jing-gang; "Design of Rail Surface Crack- detecting System Based on Linear CCD Sensor," IEEE Int. Conf. on Networking, Sensing and Control, vol. 14, no. 4, pp. 961- 970, April 2008.

[3]. K. Vijayakumar, S.R. Wylie, J. D. Cullen, C.C. Wright, A.I. Shammaa, " Non invasive rail track detection system using Microwave sensor," Journal of App. Phy., vol. 9, iss. 11, pg. 1743- 1749, June 2009.

[4]. Reenu George , Divya Jose, Gokul T G , Keerthana Sunil , Varun A G," Automatic Broken Track Detection Using IR Transmitter and Receiver", International Journal of Advanced Research in Instrumentation Electrical, Electronics Engineering and (IJAREEIE), Volume 4, Issue 4, April 2015.

[5]. Prof. P.Navaraja, "CRACK DETECTION SYSTEM FOR RAILWAY TRACK BY USING ULTRASONIC AND PIR SENSOR", International Journal of Advanced Information and Communication Technology (IJAICT),Volume 1, Issue-1, May 2014.

[6]. Akhil n, Dinumohan , Fayis p, Sijagopinath," Railway Crack Detection System", International Research Journal of Engineering and Technology (IRJET) ,Volume: 03 Issue: 05 | May-2016 .

[7]. Rajesh lv, Manjunathgasuti, Mukundaswamy," CRACK DETECTION AND COLLISION 308 International Journal of Scientific Research in Science and Technology (www.ijsrst.com) | Volume 10 | Issue 3 Prof. Najma Siddiqui et al Int J Sci Res Sci & Technol. May-June-2023, 10 (3) : 302-309 AVOIDANCE IN RAILWAY TRACKS" IRF International Conference,Volume 2,12th June, 2016.

[8]. Saurabh Srivastava , Ravi Prakash Chaurasia , Syed Imran Abbas , Prashant Sharma, Nitin Kumar Singh," Railway Track Crack Detection Vehicle" International Advanced Research Journal in Science, Engineering and Technology(IARJSET), Vol. 4, Issue 2, February 2017.

[9]. Ajeya G R, Ashwini N,KavithaS,Latha D C, ChaithraG, "Robust Railway Track Crack Detection Scheme", International Research Journal of Engineering and Technology (IRJET), Volume: 03 Issue: 05 | May-2016 .

[10]. S. Arivazhagan, R. NewlinShebiah, J. Salome Magdalene and G. Sushmitha, "Railway Track Derailment Inspection System Using Segmentation Based Fractal Texture Analysis "Ict Academy Of Tamilnadu (Ictact) Journal On Image And Video Processing, August 2015, Volume:06, Issue: 01.