Design and implementation for Managing Safety Accidents in Railway tracks using Internet of things (IOT)

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ABSTRACT- This study suggests a novel approach to track railway track abnormalities by updating track statuses in the cloud. To keep an eye on the condition of the railroad track, the Internet of Things-based Railway Track Monitoring System (IoT-RMS) is suggested. Any anomaly in the tracks is detected early on by the system. The purpose of this work is to present an automatic railway track fracture detection equipment. The developed device, which will be mounted on the train engine, has a sensor that can identify cracks up to a few meters away. The train driver will receive a signal as soon as a fracture is found, allowing him to apply emergency brakes, and the authorities will also be informed accurate location where the error is found. The suggested solution is safe because, being the largest railway network in Asia, the Indian Railways should have a reliable system in place to identify and address any accidents caused by railroad lines. Unlike earlier systems, the gadget in the proposed system is integrated into the train itself, potentially lowering labor costs and manual labor. It is suggested to use a new hybrid technique to locate anomalies on a track even when there is no GPS signal. Because IoT-RMS sensors may operate in a high-noise environment, pre-processing of the GPS signal is accomplished efficiently. The IoT-RMS shares and updates the location of the anomaly in the cloud with additional trains that are scheduled to travel by that spot. The goal of this initiative is to eliminate all casualties in Indian Railways; even a minor improvement in this system could have a significant impact on the country.

Keywords: Node MCU, Ultrasonic sensor, Tilt Sensor, GPS, Arduino Uno Board

1. INTRODUCTION

One of the largest users in the modern world is transportation, which is crucial to the sustainability and safety of the system. In India, rail transportation plays a pivotal role in mitigating the expanding demands of a rapidly expanding economy. However, when it comes to health and dependability, India is still falling short of the international norm. The primary causes of the issue are improper maintenance and a lack of dependable, reasonably priced equipment for identifying rail track problems. The correct functioning and maintenance of transport infrastructure, however, has a considerable impact on the economy. This model describes a test train design that is identical to the line that follows the test train in order to detect impediments and cracks. The proposed test train is convenient, and shorter analytical time. Along with Many lives can be spared by using this proposed technology, which makes it simple to locate the specific location of the problematic rail track.

This paper presents an Internet of Things (IoT)-based railway track condition monitoring system designed to provide ongoing railway track monitoring. The PCA approach was selected because of its easy-to-use software redundancy mechanism and techniques for lowering false alarms. 86 In the event that an anomaly is found in the track, the controller records the relevant GPS coordinates (87). When the acceleration signal is greater than the predetermined threshold value, the location of the anomaly (LOA) is recorded. The signal either weakens or happens as the train travels through any isolated or steep locations. From here on, it gets quite challenging to identify the place. To estimate the precise LoA, a hybrid sensing approach combining proximity sensors and GPS is employed. Other trains that pass through the problem location are informed of the updates to the LoA in the cloud server. In order to help the drivers of other trains slow down and prevent derailing, it also transmits information to them. To enable them to take the appropriate action, the communication is also forwarded to the maintenance department.

2.LITERATURE SURVEY

[1]. N.Karthick, R.Nagarajan, S.Suresh and R. Prabhu, - People employ a variety of transportation systems to get from one point to another in this planet. For safer travel, people prioritize public transportation the most. The transportation bureaus also inspect the safety precautions that have been put in place. In order to detect and avoid accidents, the suggested approach is appropriate for use in railroad transportation. The fracture detecting sensor used in this paper will be installed in the train engine. In this way, if a crack is found in the track, the train will automatically slow down and halt at that location, with the control room being notified of the precise location of the fracture. Second, preventing two trains that are opposite one another in order to prevent accidents the train stops at a

certain distance and automatically applies the brakes using the same sensors installed in the engine to detect the same signal from the opposing train. In railroad accidents, the derailment results in multiple fatalities. The suggested solution uses Bluetooth technology in an effort to stop rail accidents. Every locomotive front end has a Bluetooth device fitted. In the event that the train begins to derail, the engine driver receives a warning, the signal is automatically broken, and the emergency brake is automatically applied. Preventing train accidents without the use of manual power is the primary goal of the effort.

[2]. Akhil N., Dinu Mohan, Fayis P., SijaGopinath, We have established the application and functionality of the integration of ultrasonic crack detection in this study approach and full station for the surveying of railway track geometry that is eternal. The GPS module, GSM modem, IR sensor, and PIR sensor are the components of this system that enable crack detection, communication, and identification of any living thing that crosses the railroad tracks. In order to identify and communicate the railway geometric parameter of crack detection to the next railway station, the GPS module and GSM modem are useful. This research also describes the combination of wireless sensor networks (WSNs) with ultrasonic-based non-destructive testing (NDT) to continuously record the material without any interruptions during run-time. The PIR sensor is used to prevent manual patrolling and the discovery of live things on the other side of the tracks. This is capable of functioning both in the day and at night When WSN and NDT are combined, they can create a number of cutting-edge, popular applications that will increase the real-time cost-effectiveness of wireless material scanning.

[3]. A. S. Muley, S B. Patil, A.H.Shelar, - With one of the biggest railway networks in the world, Indian Railways offers the most significant public transportation system in the nation, which is also the most widely used and reasonably priced long-distance transportation option. The primary issue with a railway analysis is finding track cracks. If these damages are not managed in a timely manner, they may cause several derailments with a significant loss of life and property. This paper presents a study that uses infrared (IR) sensors to build a robust railway crack detection technique (RRCDS). This prevents by looking for cracks in railroad rails, you can prevent train accidents. The robotic device has a built-in camera that can transmit live movies and images. Additionally equipped with the ability to use GPS and GSM modules to pinpoint its location and send SMS messages to the authorities informing them. The track deviation distance between the two tracks is displayed by the system's distance measuring sensor. This would prevent unintentional damage from the rail track from occurring to multiple trains in India.

[4]. Nikhar, R Pise, Avinash IJRASET- India, the country with the fourth-largest railway community in the world, uses trains more than any other country. Indian Railways is seeing an incredible boom, yet despite this, it is still beset by a number of significant problems, such as gate crossing troubles, fire incidents, and Derailment is caused by an issue with the track that is not being monitored. As a result, the track may develop cracks. This suggested system uses sensors to detect fractures and impediments on the track, and it uses a GSM and GPS module to send an SMS to the control room informing it of the situation.

[5]. Er.Kunduru Umamaheswari - People are involved in numerous incidents in our rapidly developing nation; it is not ideal for anyone to die for an unintentional reason. In India, one of the major modes of transportation is the railway. Even if the inspection is done on a regular basis, railway workers always handle this problem since physical testing is required to find cracks in the track. The crack may occasionally go unnoticed. Due to This could result in a train mishap or derailment. It has been suggested to automate railway fracture detection in order to prevent this scenario. In this case, an Arduino microcontroller is used to detect the presence of an obstacle in the track, and an IR sensor is used to detect the presence of a crack in the railway track by measuring the distance between the sensor and the track. If the distance is greater than the assigned value, the microcontroller detects the presence of a crack. The testing robotic vehicle stops when detecting a fracture or an object. The longitudinal and latitudinal positions are then sent by SMS to GSM and GPS, and the information is also sent to surrounding trains using RF communication. An RF transmitter is mounted on the robotic section, and an RF receiver is mounted there as well is placed on Train section.

3. EXISTING SYSTEM

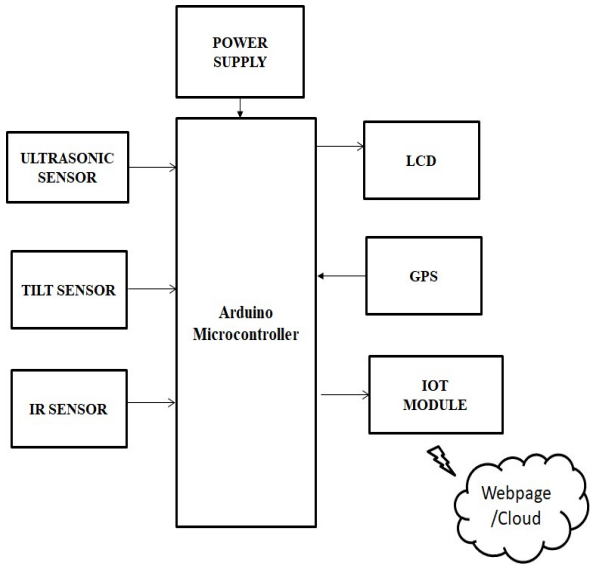
The railway track cracks can be identified in the current system using technologies including magnetic field procedures, visual examination, and video transmission. One of the earliest methods is physical checking, which involves carefully scanning all required components. In India, this method is frequently employed even if the results are the worst. When streaming content, a camera is utilized to continuously watch the track. Small fractures and an expensive system are hidden by this process. In order to find problems in the eddy current method, current is passed over the railway track, although the results are not precise. Many of these methods take a very long time and a lot of computing resources, which slows down the robot's pace and hence uncomfortable.

4. PROPOSED SYSTEM

To identifying faulty train lines, the proposed approach outperformed the limitations of the current system. the Arduino UNO board in the system that is being suggested. Coding is made much easier with Arduino, an integrated

open-source development environment. The suggested system consists of an infrared and ultrasonic sensor for obstacle detection, as well as an ultrasonic sensor for fracture detection. The IoT-RMS, which helps prevent train derailments, is covered in this section. Anomalies are located using a variety of sensors, including speed and acceleration sensors. The sensors are integrated with the IoT cloud for processing and storing after being mounted in the passenger or cargo railcars. In both the vertical and lateral directions of the axle-box, accelerometers have been placed. When an anomaly is found, the controller transmits information about the irregularity in the location data sent to Open GTS (an open-source GPS monitoring system). The Arduino controller's main function is to regulate the sensor outputs. It also transmits data via an IOT module, which is meant to notify the base station anytime an obstruction or crack is discovered using SMS. The precise longitudinal direction and latitude of the problematic track are determined by means of the GPS module. It is also possible to see minute flaws in this gadget that are invisible to the unaided eye. As a result, the suggested system is mineable and productive. The cloud server is linked to IoT-based railway track monitoring systems installed in the trains. The track monitoring system's controller carries out a number of tasks specifically, identifying unusual locations and updating the cloud server

4.1 BLOCK DIAGRAM



5. SYSTEM REQUIREMENTS

HARDWARE DESCRIPTION

5.1 NODE MCU

Fig 5.1 Node MCU

NodeMCU is an open-source, Lua-based firmware and enhancement board that is specifically designed for Internet of Things applications. It retains memory for devices that rely on the ESP-12 module and firmware for the Espressif Systems ESP8266 Wi-Fi SoC.

LCD Display

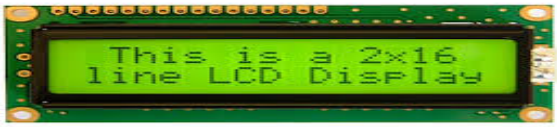


Fig 5.2 LCD

LCD displays characters, numbers, and designs. The microcontroller's (P0.0–P0.7) I/O port is interfaced with the showcase. Multiplexed mode is used for the presentation. The next showcase flashes on in 1/tenth of a second. Because of Vision's diligence, the show will result in a continuous display of tally.

5.3 GPS

Fig 5.3 GPS

The Global Positioning System GPS aids with navigation as well as following. Global positioning systems are used to track the car without the driver's assistance. Nevertheless, a route structure instructs the driver to reach the destination with minimal delays. Following and route both make use of the same design. As an accident occurs, the following stem identifies the awkward car, and an SMS message is sent to the salvage organization.

5.4 Power Supply

The 12V advanced step-down transformer is powered by an AC source. The 12V AC transformer is rectified by means of a diode connection. A capacitor separates the 12V DC diode bridge yield.

5.5 ARDUINO UNO R3 MICROCONTROLLER

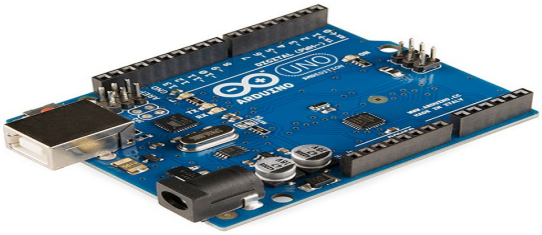


Fig 5.5Arduino Uno Board

A microcontroller board based on the ATmega328 IC is called the Arduino Uno R3. There were 6 analog inputs, a 16 MHz crystal oscillator, a USB port, 14 digital input/output pins (six of which may be utilized as PWM outputs), a power button for resetting, an ICSP header, and a jack. Everything required to support the microcontroller is included; all that's left to do is power it with a battery or an AC-to-DC adapter or connect it to a computer via a USB cable.

5.6 Ultrasonic Sensor

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Ultrasonic sensors, also called transceivers when they can send and receive, operate on a similar principle to sonar or radar, which measure a target's characteristics by deciphering the echoes of sound or radio waves, respectively. High frequency sound waves are produced by ultrasonic sensors, which then analyze the echo they get back. In order to compute the distance to an object, sensors measure the time elapsed between transmitting a signal and getting an echo.

5.7 Tilt sensor

Fig 5.7 Tilt Sensor

It should be feasible to determine tilt using a variety of sensor types. Despite the lack of direct vibration sensors, tilt can be approximated indirectly by estimating values derived from representative mechanical or optical quantities. Certain highlights are contrasted by these sensors. They can be isolated based on latent and dynamic conduct in addition to other factors. Some sensors operate in an outright manner, while others act relative to other objects. Recurrence range, signal components, and the type of estimation information are further noteworthy aspects. The auxiliary sensors that are on show here were initially arranged in two groups: one for reaching and the other for non-reaching objects. Within these groups, the sub-objects were speed and speed increment measurement.

6.CONCLUSION

If there are any, the method used can identify surface defects and obstructions. The suggested solution has many benefits over traditional detection techniques, such as lower costs, less energy usage, an effective detection system that doesn't require human intervention, and quicker analytical turnaround times. This prototype makes it simple to stop train crashes and derailments, perhaps saving many lives. Testing units for train operations also benefit greatly from it. Additionally, we can see that the system being utilized, the position failure, and the location data being sent to the default cellphone number. so that this also helps us maintain and control train lines. When we monitor using the detector model and we may say that it's a fusion energy vehicle. The outcome demonstrates that the effectiveness of the safety features for rail infrastructure will continue to rise thanks to this innovative new technology. The introduction of these features in real-time can reduce accidents by as much as 70%. It is simple to carry out manual testing in places where this vehicle is impractical, such as thick and deep forests, mountainous locations, and shallow coalmines. If the device sensors identify any cracks or irregularities, an automated SMS will be delivered to a pre-configured cellphone number when this vehicle is utilized for railway inspections and breakage detection. This will provide error-free management and control of the railway tracks' condition and, ultimately, their continued good condition.

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