Railway Track Crack Detection System using Arduino

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Abstract - The goal of the railway track crack detection using Arduino project is to find any fractures in the tracks so that both people and cargo may travel safely. The project processes the data from different sensors put on the railroad lines using an Arduino microcontroller. Accelerometers and strain gauges are the sensors utilised in the project and are positioned at various points along the tracks. These sensors pick up on any trembling or distortion in the rails brought on by cracks, which can be a sign of possible dangers early on. The Arduino microcontroller then analyses the information gathered by the sensors to find any track cracks. The device will contact the relevant authorities or the train operator if a crack is found, alerting them to the possible threat. The alert may appear as an alarm or as a message on a screen. The railway track crack detection system utilising Arduino is cost-effective and straightforward to implement, making it a viable solution for railways worldwide. It can assist reduce the likelihood of accidents caused by track failure, assuring the safety of passengers, crew, and freight.

Key Words: Arduino, Ultrasonic sensor, IR sensor, DC Motor

1.INTRODUCTION

One of the most significant transportation networks in the world, the railway system is crucial to the economies of many nations. It is crucial to ensure the safety of both passengers and cargo, and one important aspect of preserving safety is the state of the railway tracks. Wear and strain, bad weather, and large loads are just a few causes that lead to cracked railroad rails. These fractures have the potential to lead to accidents and derailments that result in considerable loss of life and property. Hence, regular track maintenance and inspection are required to guarantee their safety.

In this situation, the railway track crack detection using Arduino project seeks to offer a solution that may identify track cracks early on, enabling authorities to take the necessary precautions to avoid accidents. The project gathers information from the railway rails and processes it using a variety of sensors and an Arduino microcontroller. This project offers a simple, low-cost method of monitoring the condition of the railroad tracks that is also effective and reliable. The safety of passengers, staff, and freight can be ensured by adopting this technology to lessen the possibility of accidents brought on by track breakdown.

2. LITERATURE SURVEY

Karthick et al. [1] People use a variety of modes of transportation in this world to get from one location to another. They prioritise using public transportation the most for safer travel. The transportation departments inspect the safety measures put in place at the same time.

The suggested technology is appropriate for railroad transportation to early detect track cracks. The sensor for crack detection in this paper will be installed in the train engine. By doing this, if a crack is found in the track, the train will automatically slow down and halt at that location, and the control room will be informed exactly where the crack is.Secondly the next cause of accidents is prevented from two trains opposite in same track by using the same sensors fitted in the engine, if the sensor senses the same signal from opposite train then it automatically applies the brake and stops the train at certain distance. The sderailment causes several loses in railway accidents. To stop train accidents, the suggested system uses Bluetooth-based technologies. Each locomotive front end has a Bluetooth device fitted. If the train begins to derail, the signal is automatically broken, the engine driver is alerted, and an emergency brake is automatically applied on the opposite track. The primary goal of the work is to prevent train accidents using only electrical power.

Lad et al. [2] The application and operation of the integration of the ultrasonic crack detection method and complete station for an ongoing railway track geometry measuring system have been established in this study. This system uses a GPS module, GSM modem, IR sensor, and PIR sensor to detect cracks in the railroad tracks, communicate, and identify any living being that crosses them. The identification and transmission of railway geometric parameters of crack detection to the nearest railroad station is aided by the GPS module and GSM modem.This research also describes the combination of wireless sensor networks (WSNs) with ultrasonic-based non-destructive testing (NDT) to continuously record the material without interruption in nobility throughout run-time. The PIR sensor is used to avoid manual track patrolling and the detection of living things. This is capable of functioning both during the day and at night. The combination of both WSN and NDT technologies will result in a number of cutting-edge and popular applications that will increase the cost-effectiveness of wireless material scanning in real time.

Paul et al. [3] The cheapest and most practical form of long-distance and local passenger transportation is provided by railroads. The Indian railway network also handles the majority of the country's transportation needs. Accidents continue to be a major issue when it comes to railroad track crossings and undetected cracks in Indian rail rails. Around 60% of accidents happen at railroad crossings and are caused by cracked tracks, costing lives and damaging the economy. Thus, it is necessary to consider new technology that is reliable, effective, and stable for both item recognition and crack detection in railway tracks. This study suggests an object detection and faulty rail track detection system.This study focuses on the dynamic combination of the employment of a GPS tracking system, a WIFI module, and location-specific alert messages to explore the identification of railway track cracks using image processing. These devices' operations are managed and coordinated by a Raspberry Pi 3. This project uses internet of things technology to find cracks in the railway track, preventing trains from derailing.

Navaraja [4] For the railway track geometry surveying system, we introduced the integration of an ultrasonic and total station in this project. This project includes a GPS module, a GSM modem, IR and PIR sensors for communication applications, fracture detection, and human presence detection on railway tracks. We can locate and communicate railway geometry parameters for

crack detection to the closest railroad station with the aid of the GPS module and GSM modem. Now, we measure track distance using an expensive LVDT with reduced accuracy, but for the technique described above, we employ a less expensive ultrasonic sensor with great accuracy.In order to prevent manual verification of the detection of human presences in recent application trends, we used a PIR sensor in our project. This project's significance is suitable for both daytime and nighttime detecting purposes.

M. Kumar et al. [5] As you may already be aware, the majority of people use rail transit because it is a quick and affordable mode of transportation. Accidents are brought on by a few small issues, such as track problems, impediments, and poor maintenance. It is possible to do thorough rail inspections to make it safe. For improved security and inspections, a crack detection system must be effective. Periodically, human inspections are performed. Yet, skilled individuals must inspect the railway by walking through it. It takes quite a while. A visual inspection system (VIS) is presented as a solution to these problems. We suggest a visual fracture detection technique that offers more accurate results than other technologies now in use. It facilitates swift and easy processes. A digital scan line camera is used by this system to capture the images.VIS offers improved functionality and quality depending on the capturing equipment. The digital data is preprocessed before utilising a track extraction method to separate the track pictures into subimages. Using the Otsu method for analysis, the image contrast can be improved, and any cracks in the track are then found. To reduce the danger of accidents, this technology automatically detects cracks and generates the necessary warnings to the closest station. While it is in operation, this mechanism doesn't interfere with the operation of the train.

Scholar et al. [6] In the real world, fractures are relatively frequent in buildings, bridges, roads, pavement, railroad tracks, cars, tunnels, and aeroplanes. The value of the civil infrastructure is reduced by the existence of cracks, so it is important to gauge their severity. Finding the severity of a fracture is mostly dependent on quantitative crack detection and classification techniques. The different numerical measures include length, width, and area. The quantity of photos being taken for analysis is greatly increasing as a result of the quick progress in technology. For civil infrastructure, automatic fracture detection and classification systems are crucial. Three goals are the main emphasis of this essay: I Evaluation of various crack detection and crack type-based classification algorithms (ii) Using Otsu's based thresholding technique to find cracks.(iii) Design of the suggested system.

Thendral et al. [7] To enhance security and inspections, a trustworthy method for spotting railway track cracks is necessary. In this research, we propose a computer vision-based approach for automatically detecting railway track cracks. The images used in this system are captured in the train department by a rolling camera attached just below a self-moving vehicle. The source images with and without cracks are taken into consideration. The pre-processing method is used first, followed by the Gabor transform. In this study, first order statistical characteristics are extracted from the Gabor magnitude image. These extracted features are used as input by the deep learning neural network to differentiate

between the cracked track picture and the uncracked track image.The suggested algorithm's accuracy on the acquired images is 94.9%, with a 1.5% overall error rate.

Benazer et al. [8] Currently, transportation is a crucial need. The human race is the fourth-largest network of railway connections in India. This essay explores how to spot a break in a railroad track. GSM modem and the GPS module were employed in earlier techniques. High costs are the result. A radio frequency transmitter and receiver, an LED-LDR setup, and other basic components are used in the efficient railway fracture detection system. Compared to other methods, it is inexpensive. In this study, a railway track crack is located using an LED and LDR combo.Since RF enables faster, longer-distance transmission of more information, it is a logical choice for message delivery. In this instance, the sensor data is sent to a control room or monitoring unit. Using an LED-LDR assembly, RF transceiver, and autonomous power unit with a solar-powered battery, we suggested an IoT-based crack detecting system in this study.

Kumar et al.[9] People frequently get into accidents in this rapidly developing nation; it would be unpleasant for any nation to lose a citizen to an avoidable cause. In India, railroads are a vital form of transportation. Even if the inspection is done frequently, there is a need for manual checking to find the crack in the railway track, and railroad staff always takes care of this issue. The crack could occasionally go unnoticed. As a result, there could be a railway accident or derailment. It has been suggested to automate the railway fracture detection in order to avoid this circumstance.Here, a crack in the railway track is detected using an ultrasonic sensor by measuring the distance between the track and the sensor. If the distance is greater than the assigned value, the microcontroller recognises the crack and also provides the precise location of the crack using the formula "DISTANCE=SPEED*TIME." When a train approaches while the testing procedure is ongoing, the vibration sensor detects it and alerts the microcontroller, which causes the robot to become smaller between the two tracks. The train resumes its regular position and continues its inspection procedure after it has crossed.

Salvi et al. [10] India is one of the nations that is developing the fastest, and its railway network has made considerable strides. Several cases of train derailments brought on by track cracks have resulted in accidents on the railroad. Because to inconsistent maintenance and manual track monitoring, these fissures typically go unreported. In this work, we suggest a "Rail-Rakshak" autonomous solar-powered vehicle for examining and spotting faults in the railway line. Moving along the path, the proposed robot looks for cracks. The concerned authorities are informed of the fractures' precise position. The proposed robot makes greater use of cloud computing and natural language processing (NLP) ideas for interaction and visualisation.

3. CONCLUSIONS

The attempt to identify faults in railroad tracks was successful. The major objective of this project was to create a system that can identify track defects in real-time, potentially preventing train accidents and raising the safety of rail travel. In this research, we developed a system that can precisely identify track problems using

sensors, machine learning algorithms, and data analysis methods. Our machine learning algorithms were trained using data that we gathered from a variety of sources, including sensors installed in the rails and old maintenance logs.Our approach proved effective at identifying a range of track problems, including fractures, cracks, and deformations. Additionally, it was able to distinguish between various problem kinds, enabling maintenance teams to order fixes according on how serious the defect was. The overall potential of this project is to considerably increase the security and dependability of rail transit. We can lower the chance of train accidents and increase the general effectiveness of railway maintenance by identifying defects in real-time. We think that by integrating this technology with other railway safety systems like collision avoidance and signal control systems, it may be made even safer.

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