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Railway Track Crack Detection using Autonomous Vehicle.

Abhishek Jain*, Parth Barhanpurkar, Animesh, and Kauser Ahmed P.

School of Computer Science and Engineering, VIT University, Vellore, Tamil Nadu, India.

ABSTRACT

Transportation is having a vital role to carry the passengers and goods from one place to another. An effective transportation setup leads to increase in trade. This leads to the implementation of an efficient and cost effective solution for railway application. India has one of the world's largest railway networks, manual inspection and detecting a crack on tracks is a very tedious and time consuming task. The objective of this paper is to design a Railway Track Crack Detection system using Microcontroller, IR obstacle Sensors, which helps to detect the cracks and to monitor the exact location of the crack by using the GPS module and alerts through GPRS based messages using GSM module. The vehicle moves along the path of railway track and IR Obstacle sensors mounted on the vehicle front end will inspect the track along the path. When any crack or deformation is detected on the track the vehicle stops and the location of the crack is identified and the location coordinates are procured using the GPS module and the GSM module is used to send these location coordinates in the form of an upload to a domain using the GPRS system in GSM module. This domain is present on a cloud based platform which can be accessed by android apps and web browser by the concerned authorities for reporting and repairing the cracks. . It helps in increasing safety of the vehicle.

Keywords: Ultrasonic sensor, Arduino, Global Positioning System (GPS), Global System for Mobile communication (GSM).

Corresponding author

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INTRODUCTION

Tracking systems were initially created for the shipping industry because they wanted to know where each vehicle was at any particular time. Passive systems were developed in the beginning to fulfill these requirements**.** India has fourth largest rail network in the world comprising 115,000 km of railway tracks. Approximately, 60% of rail accidents are due to derailments, of which, 90% are due to cracks problems [1]. The major reason for railway accidents is improper maintenance of railway tracks while first being human errors leading to the accidents. A method where the detection of cracks can be identified using infrared rays with the IR transmitter and receiver. IR receiver is connected to the signal lamp or electrified lamp with the IR sensor. Control Area Network controller is connected to the main node and it sends the information via global system for mobile communications and transmit the message to railway engine and to the nearest railway station [2]. The project relates to find the crack in the railway tracks. Ultrasonic Inspection [4, 5] is common place in rail industry in many foreign countries. It is a well understood technique and was thought to be the best solution to crack detection. However ultrasonic can only inspect the core of Material that is, the method cannot check for surface and near Surface cracking where many of the faults are located [3]. Another paper depicted that microwave horn antenna [4] technique for crack detection is found to be extremely useful in lab environment. A new method is proposed in[7] to overcome this limitation associated with ultrasonic and microwave horn Antenna techniques. They are effectively used to check for cracks located at the surface of the metals such as rails. Another paper proposes the idea of mounting IR sensors on the engine of a train and connecting it to a server that trains detect the flaw on the track while traversing it and hence help in detecting the state of the tracks. The front of the engine is mounted with the sensors and the data recorded from the train is stored in the database along with the coordinates where the crack is and the train number from which it has been recorded [8]. Cloud computing is utilized in present world for live tracking of a device and keeping record of it in the server, this method focuses on keeping track of the state of a device using various sensors like temperature, heat etc. all this is uploaded on a server from where all the users can access the data and evaluate the device being monitored [9].

Problems Identified from The Survey

- Usage of any other method for crack detection other that using IR sensors leads to higher cost or require very specific conditions to detect the crack properly.
- All devices that have been made thus far are using GSM module to only send SMS which is not very reliable.
- Some propose usage of Wi-Fi module to send data onto a Wi-Fi module placed on a platform which need memory to store data hence increases the energy consumption of the device
- The data accusation and upload on a server has not been used to along with an autonomous vehicle hence making it completely self-reliant.
- Most systems that are proposed require a battery assembly whereas more energy efficient methods can be used to run the device like solar energy.
- The GSM module is mostly used for messaging where as a website full of data is more efficient to use which can also be done using the same module using its GPRS connectivity.
- All proposed devices do not ensure any reliability of work being completed after the information has been sent.
- IOT is about reducing human effort and providing reliable solution all proposed system can only full fill one of the conditions for IOT system.

PROPOSED METHODOLOGY

The proposed system gathers data from the sensors attached to the vehicle and transmits the message and the location of the detected crack is transmitted to the nearest station using the GSM and GPS module. The transmitted data is stored in the database which can be displayed on the web portal and the android application. A user has to log in the portal using an authentic email id and a valid password. After logging onto the portal the user can check the status of a particular crack and if it is repaired then the authority who has fixed the repair. This may help the user to know the current status of the train following a particular track.

The GSM and GPS module are operated by an Arduino microcontroller which co-ordinates the operation of the entire system. Arduino consists of both a physical programmable circuit board and a piece of software, or IDE (Integrated Development Environment) that runs on your computer, used to write and upload computer code to the physical board. The GSM and GPS programmable code can be run in the Arduino IDE. The IR transmitter and Receiver have to place straight line to each other on the vehicle. In our project IR sensor used to locate the crack of railway track and send the details to the microcontroller.

A vehicle about the width of a railway track is used to traverse the railway tracks and detect the crack in track. The vehicle is run using the solar panels attached to the rear of the vehicle. Two motor engines also used to power the vehicle. The engine operations of two engines can be controlled by input at pins 2 and 7 and 10 and 15. Input logic 00 or 11 will stop the comparing engine. Empower pins 1 and 9 (comparing to the two engines) must be high for engines to begin working. Whenever an input is high, the related driver gets empowered.

The server is maintained in Cloud infrastructure. Cloud computing is Internet-based computing, whereby shared resources, software, and information are provided to computers and other devices on demand. The authorized user can access the cloud information via web portal. Each user have own username and password. So the manipulation of accessing others data is very less and the security is very high. The user can retrieve the information in real time as well as off line also.

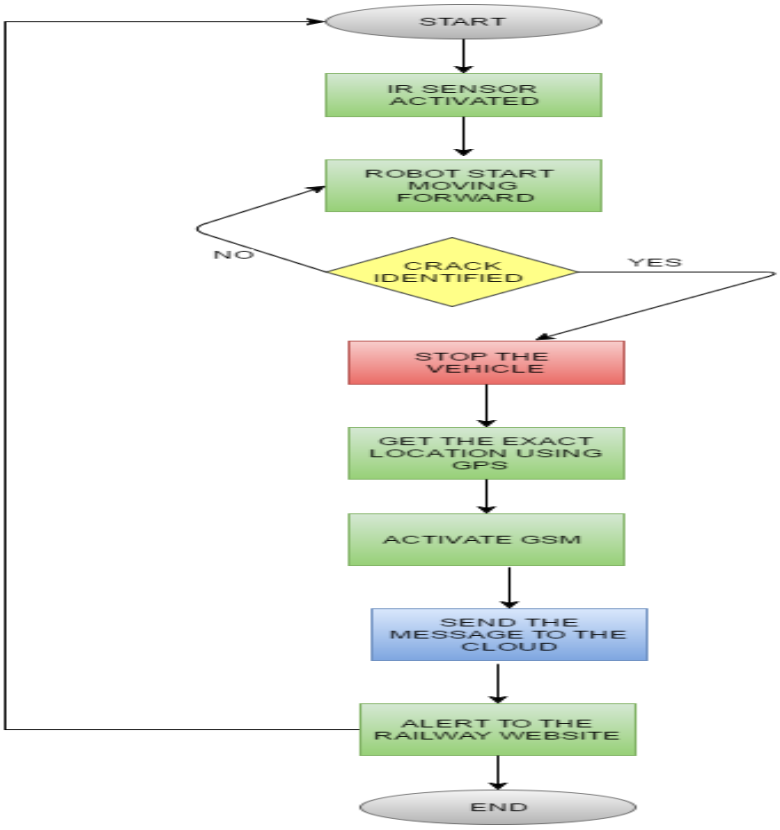

Fig. 1: Proposed Methodology

RESULTS AND DISCUSSION

This paper proposes an autonomous system which detects the cracks in railway tracks and uploads the data directly to a remote server where all authorities can see the data and can supervise the repairs done on the track. The device can navigate using the tracks and is powered by solar panels to ensure the eco-friendly working of the system. We also use an ultrasonic sensor to determine if there is an obstacle present in front of the device which ensures its smooth passing over a railway crossing.

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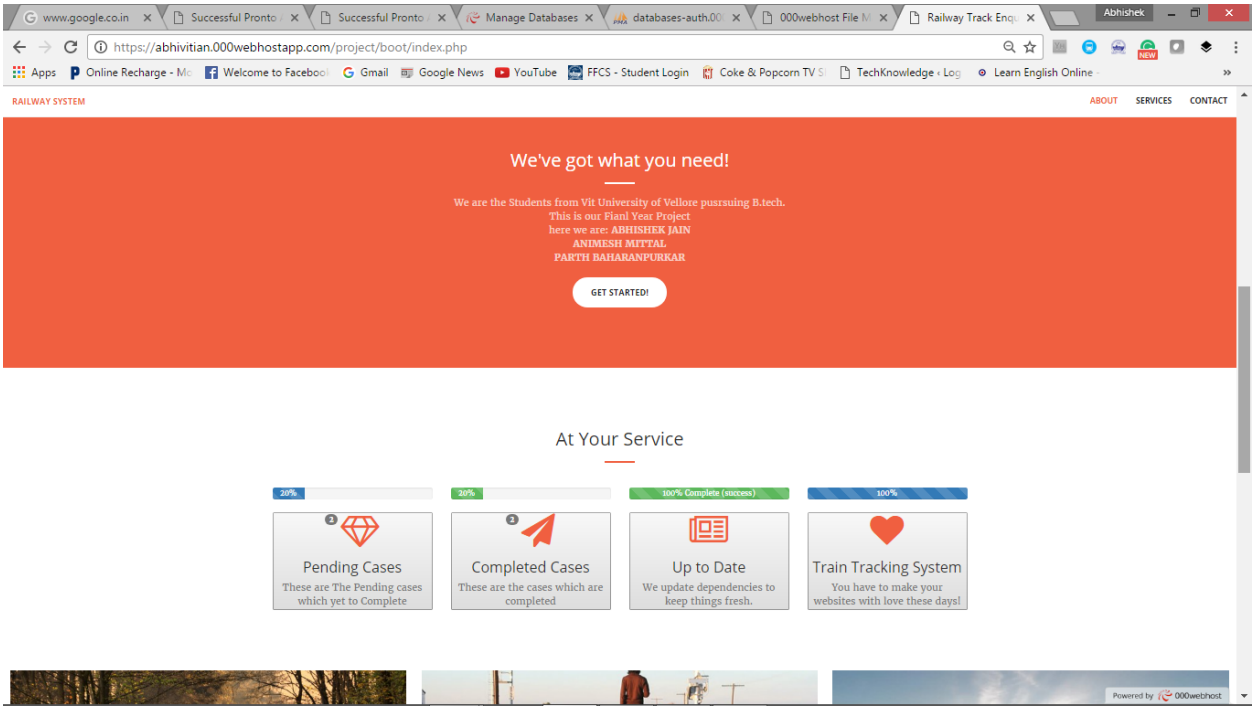

Fig. 2: Autonomous Tracking System

FUTURE WORK

Such a system can be used for other implementation and can also be upgrade to accommodate for the shortcomings of this system or for better analysis in following way:

- The system can be made more secure by changing the shape and features of the chassis so that theft of the device itself can be prevented.
- The chassis can be made by people who know how to make them and can be made more efficient.
- The device can be fitted with a rechargeable battery so that the solar power can be used to charge it and device can run for longer time.
- The device if configured with a train timing database that is updated in real time then using big data analytics the device can be diverted on other tracks if a train is using a specific track at a time.
- The device can be fitted with mechanism to get it off the track if a train is coming or even go to warehouse at night as it uses solar power to run.

The device can also be configured so as to send additional data about its components so if a component stops working it can be replaced.

CONCLUSION

This system has been aimed for solving the 2 major reasons for railway accidents namely human error and cracks in railway tracks. This system develops an autonomous system which detects the cracks in railway tracks and uploads the data directly to a remote server where all authorities can see the data and can supervise the repairs done on the track. This ensures that the repair man accounts for the work he has done. This system also removes the human effort that is involved in detecting the cracks. The device can navigate using the tracks and is powered by solar panels to ensure eco-friendly working of the system. We also use an ultrasonic sensor to determine if there is an obstacle present in front of the device which ensures its smooth passing over a railway crossing. This system can further be expanded by creating many such devices and deploying it over the complete length and breadth of Indian railway system.

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