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Railway Track Fault Detection System by Using IR Sensors and Bluetooth Technology

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ABSTRACT

The paper proposes designing of robust railway crack detection scheme (RRCDS) using IR sensor assembly for railway track geometry surveying system by detecting the cracks on railway tracks. Most of the accidents in the train are caused due to cracks in the railway tracks, which cannot be easily identified. The manual inspection of railway track took more time and human fatigue. The proposed system introduces Bluetooth based technology, to prevent the train accident. Two IR sensors are installed at front end of the inspection robot which monitors the track and gives the status to Arduino controller. If there is crack found it immediately sends the location of crack via Bluetooth to mobile phone. The proposed broken rail detection system automatically detects the faulty railway track without any human interference. There are many advantages with the proposed system when compared to the traditional detective techniques. The advantages include less cost, low power consumption, and less analysis time and also facilitate better safety standards for rail tracks and provide effective testing infrastructure.

Keywords: RRCDS, IR sensor, Bluetooth and Arduino.

1. INTRODUCTION

The Indian Railway network is the largest rail-passenger transport and it is now the backbone of the country's transport infrastructure. In India, most of the commercial transport is being carried out by the railway network because it is being cheapest mode of transportation preferred over all other means of transportation such as buses, flights etc. The rapidly improving economy of India has resulted in an exponentially increasing demand for transportation in recent years, and this has resulted into a very huge rise in the volume of traffic in the Indian Railway network. Transport is a key necessity for specialization that allows production and consumption of products to occur at different locations [1]. Economic prosperity has always been dependent on increasing the capacity and rationality of transport. But the infrastructure and operation of transport has a great impact on the land and is the largest resource of energy, making transport sustainability and safety a major issue Transport is very important to carry the passengers and goods from one place to another. The better transport leads to more trade. Economic level is mainly depends on increasing the capacity and level of transport. In this paper we use IR sensor to detect the crack in railroads. When the crack is detected its latitude and longitude values are send as a message to mobile phone. Then IR sensor is used for the surveying process [2]. This system is designed using Arduino Uno (ATmega328), IR sensors and Bluetooth to perform railway safety monitoring system.

2. EFFECTS THAT INFLUENCE RAIL DEFECTS AND RAIL FAILURE

There are two causes of cracks in rail tracks i.e. Natural and Artificial. Natural causes are like weather, floods, cyclone, landslides etc. Artificial causes are like terrorist attacks etc. Detection and maintenance of rail defects are major issues for the rail community all around the world. The defects mainly include weld problems, internal defects worn out rails, head checks, squats, palling and shelling, corrugations and rolling contact fatigue (RCF) initiated problems such as surface cracks.

2.1 Defects due to contact stresses or rolling contact fatigue (RCF)

One effect that can cause crack propagation is the presence of water and other liquids. When a fluid fills a small crack and a train passes over, the water becomes trapped in the void and can expand the crack tip. Also, the trapped fluid could freeze and expand or initiate the corrosion process.

3. TECHNIQUES USED FOR IDENTIFICATION OF DAMGES AND CONDITION MONITORING OF RAILWAY TRACKS

In general, there exist three main categories of techniques excitingly used for damage identification and condition monitoring of railway tracks. These include:

3.1 Non-destructive testing technologies

Such as acoustic emissions or ultrasonic methods, magnetic field methods, radio graphic, eddy existing techniques, thermal field methods, dye penetrate fiber optic sensors of various kinds.

3.2 Graphical inspections

Graphical inspection is the primary technique used for defect identification in tracks, and is effectively used in specialized disciplines. This method can be costly, time consuming and

ineffective for large and complex structural systems such as the rail track.

4. EXISTING SYSTEM

The existing system railway tracks are surveying manually. LED (Light Emitting Diode) LDR (Light Dependent Resister) sensors cannot use on the slab of the tracks [3]. Images processing input images are noisy system, high cost, and it's not getting accurate output. Automated Visual Inspection method is complex system because video color analysis is used to identify the crack in rail track under the bad whether condition is not getting perfect output. The existing system is delay in passing the information

5. PROBLEM STATEMENT

A broken rail represents one of the leading causes of the most expensive and dangerous rail derailments that occur around the world. Considering derailments in general, in the US alone, on average, more than one major derailment occurs for each three-day period, consistently over a decade. The statistics available on the frequency of broken rail derailments in other countries do not help properly understanding the economic, social and environmental impacts. In the proposed system, the system is made to run to and fro along the track at uneven intervals when the track is free. And if it detects any crack on the track it will send an error signal to the authority using a wireless module. Cracks are detected using IR sensors and the error signal is transmitted. The existing systems are inefficient in monitoring the surface and near surface cracks precisely and it is inappropriate in tunnels. The time delay in informing the railway authority about the crack is large. It has high cost and is less accurate.

Fig (1) Crack on track

6. MAIN IDEA FOR PROBLEM SOLVING

Our paper deals with one of the cost and efficient method to avoid train accidents by formulate solutions to the problem of railway crack finding. This technique is used for outside of base station to avoid the drastic condition of Indian railway networks from stopping down still more; an automated system which does not rely upon the manual labor is fetched into bright. It proposes a cost effective solution to the problem of robust railway crack detection scheme (RRCDS) [4] by utilizing AT mega microcontroller, IR sensor, buzzer, GPS, Bluetooth assembly to ensure robustness, repeatability and easy implementation, the principle idea has been kept very simple. IR sensor is used to detect the crack. In order to locate current position of the crack detected, GPS service is used. It calculates latitude and longitude of place and converts them into analog signals. To communicate the received information, BLUETOOTH module is used. Using this message sent wirelessly to appropriate authority. Then an alarm rings with the help of buzzer indicating the detection of crack, thereby they track the exact location of track damage immediately so that many lives will be saved.

7. BLOCK DIAGRAM

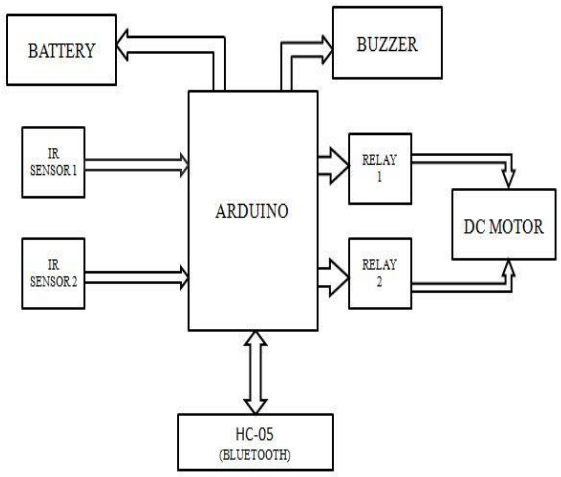

Fig (2) Block diagram of railway inspection robot

An Arduino board consists of an Atmel 8-bit microcontroller with complementary components to facilitate programming and incorporation into other circuits A lithium-ion battery or Li-ion battery (abbreviated as LIB) is a type of rechargeable battery in which lithium ions move from the negative electrode to the positive electrode during discharge and back when charging. A simple electromagnetic relay consists of a coil of wire wrapped around a soft iron core, an iron yoke which provides a low reluctance path for magnetic flux, a movable iron armature, and one or more sets of contacts. A brushed DC motor is an internally commutated electric motor designed to be run from a direct current power source.

8. RESULTS

When the inspection robot is placed on the track, If any fault is occurred on the track it will detect the fault on the track by using IR sensors and sends the message to the android mobile by using Bluetooth module. It also displays the message of a particular position of a track that is left side crack or right side crack on the track. It also tracks the GPS location of the track.

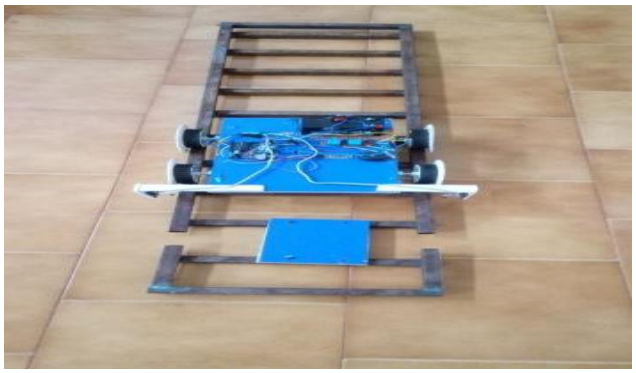

Fig (3) Track condition without fault

8.1 Case (i):

When there is no fault on the track it displays message that ―TRACK IS GOOD to the android mobile by using Bluetooth module.

Fig (4) Message displayed in the Bluetooth

8.2 Case (ii):

When the fault occurred on track as shown in it displays the message in android mobile as ―TRACK IS MISMATCH and it also shows GPS tracking.

For ex:

―Track is mismatch

GPS TRACKING: LONGITUDE: LN246890N

LATITUDE (N):3456N990065

Fig (5) Track condition with fault

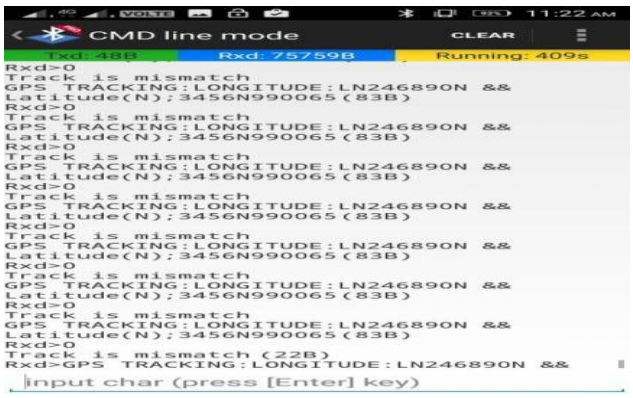

Fig (6) Message displayed in Bluetooth app

9. CONCLUSION

In this paper the system is presented to detect the cracks in the track effectively. We have implemented the IR sensor based railway crack detection system using Bluetooth technology and we also use IP based camera for monitoring the visual videos captured from the track. By this proposed model many lives can be saved by avoiding accidents. The idea can be implemented in large scale in the long run to facilitate better safety standards for rail tracks and provide effective testing infrastructure for achieving better results in the future.

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