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Rail Crack Detection Robot Using IR

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Abstract *— In India, railway is an important aspect and is in very much demand for commercial transport. It is highly preferred for public transport. However Indian railway ranked 4th for having largest railway network and is ranked 1st for having highest number of employees, having the largest networks means more maintenance. Any problem or interference with this could lead to major consequences and even loss to life. In this paper we proposed an effective, user friendly and low cost rail crack detection method. The main objective of our paper include technical and design details of the crack detection method. The paper also gives the details of the simple components utilizing GPS module, GSM modem, IR based crack detection circuit for crack detection and object avoidance.*

Keywords *- GPS module, GSM modem, IR Sensor, Crack and Object avoidance.*

I. INTRODUCTION

In today's world transport is a key factor as in its absence, the availability of almost every product would be difficult in the areas which are far from the productive areas. In country like India where the facilities along with its cost is an important aspect, railway is a mode of transport which is not only economical but also has its network spread all over the country. Railway in India is one of the biggest networks in the world for transports. Such a huge mode of transport needs a large maintenance efforts, providing one of the major employment unit in the world. The maintenance unit of railway has a major problem to tackle i.e. the derailment of trains, which is uncertain and cannot be controlled unless a proper servicing and maintenance technique is installed.

According to the national survey conducted by the government of India, almost 65% of the accidents took place because of derailment of trains in last 5 years and the major reason behind the derailment is rail crack (either hidden or avoided crack). Our current Indian railway system uses techniques such as Ultrasonic Sound Method and Eddy Current Method, which are beneficial and effective as well. But in the proposed we have focused on a cost effective method i.e. railway crack detection robot by using IR and GPS, which could be used to detect the major crack automatically and on daily basis. One of the important advantage of this method is that it will require manual assistance only after the detection of the crack, so that the exact location of the crack can be traced and simultaneously crack can be repaired. Since we are using GPS and GPRS in our project, the location of the crack will be sent to the maintenance office on a registered mobile number, through SMS. The base of this project is the principle of reflection. Now the main issue in regard to this robot that would come to everybody's mind is, what if any obstacle or unwanted object (railway crossing) obstruct the movement of the robot?, then the solution for this would be an obstacle sensor on the front end of the robot to detect the unwanted objects. These obstacle could be temporary such as a migrating animal or a birds, so a small delay or halt and buzzer beep is programmed. But for stationary obstacles the scene is slightly different, it would require manual guidance to cross the obstacle in its path and carry on further detection of the cracks.

Another important thing to take into consideration is that, the timing and schedule of trains should not be affected during the detection period. The proposed project provides much relief in the field of timing, as the height of the robot is not more than that of the rail tracks and it will move between the two parallel rail lines, there is no need to block a railway route to detect the cracks. Though after detection, its servicing might require blockage of the same route which is necessary for safety purpose.

1.1 Motivation

In this era of new advancing technology people focus more on automation rather than human involvement, so our main aspect of this project is to provide an automated robot which is less costly and should involve minimum human efforts. This was our main motivation to come up with a user friendly, low cost and less bulky robot for crack detection.

1.2 Problem definition

According to the survey the major reasons behind the train accidents are fire collisions, derailment and railway crossing. Among this the derailment of trains being the highest reasons behind the rail accidents and derailment occurs due to rail cracks. There are many new technologies discovered for detection of cracks, but the disadvantage of these technologies is that they are not fully automated, they require large amount of human intervention.

1.3 Objective

As mentioned the objective of this project is to save life because of rail accidents and to detect the crack without disturbing the railway services.

1.4 Existing system

The existing system uses Ultrasound and Eddy current methods for crack detection which require more calculations, more time and greater number of human efforts. In our project we are using GPS and GPRS to get the exact location of the crack and also main advantage of our project is we can work on busy line, we do not need a separate window for inspection.

II. RELATED WORK

Basically there are three main categories of techniques which are used in present situations for crack or fault detection in rail lines and for monitoring the condition of the railway tracks. These include:

1. Visual inspection
2. Technologies such as sound emission or ultrasonic methods, magnetic field methods, eddy current methods, thermal field methods, fiber optics sensors of different types known as non-destructive testing(NDT)
3. Vibration-based global methods.

The primary technique used for defect identification in tracks, is Visual inspection. The region of suspected damage has to be known at the first and it should be readily accessible of physical inspection. Hence this method is time consuming, costly and ineffective for large rail networks. Non-destructive techniques gives us many options which can be used for inspection of rail lines, most widely used methods include ultrasonic sound testing and eddy current inspection method. Ultrasonic method is used in most frequently used in many countries. This technique is easy to understand and is the best method preferred for crack detection, advantage of this method is one can monitor rail lines continuously for broken cracks. The disadvantage of this method is that it can only detect the cracks present on core of the materials, it does not detect many of the faults which are present on the surface and near surface.

The next method is eddy current method which is used for minor crack detection, this method works on the principle of amplitude and phase change from the material. This method involve lot of analysis and calculations, the detected signals shows amplitude and phase change for the surface cracks.

III. PROPOSED SYSTEM

The proposed system works on the principle of reflection of light. The system uses GPS, GPRS module, and Infrared sensor which consist of infrared transmitter and receiver. Generally the IR transmitter i.e. the IR LED continuously emits IR rays at the emitting frequency of 38 KHz, which gets reflected back from the inner surface of the tracks to TSOP which acts as the IR receiver. When the crack is absent the light transmission and reception continuously takes place, but as soon as the crack is detected, the IR light falls on the cracks and it escapes through the gaps, which results in the loss of IR light, at this point the TSOP output becomes low and the system detects the crack in this way.

Also we have used a GPS and GPRS module which plays an important role in providing the exact location of the cracks, as soon as the crack is detected or any permanent object is present between the rail tracks the SMS will be sent to the registered mobile number. SMS will give the details of the crack as well as the object detection separately by providing the longitude and latitude of that area and will also give the sound alert by using buzzer

This system uses a 40 pin microcontroller IC i.e. AT 892C52, having its own clock and is being used for interfacing all the components with one another.

The proposed system not only detects the cracks and locates it but also detects the obstacles in the path of the moving robot. Two DC motors having torque is used to drive the robot. The DC motors are interfaced to the microcontroller IC using ICL293D which is a motor driver IC. Each IC is capable of driving two motors. The system gets power supply from a 12 volt chargeable battery which makes it a bit bulky but also improves its working period. Hence it works with a mobile power supply which is an advantage to the system. The robot has a LCD for displaying the location and also the reason that obstruct the working of the crack- detection robot.

Each time when crack is detected the location is sent through SMS, so it will require immediate servicing. Since the GPS will not change the location in the display within the range of 50 meters even if a new crack is detected in the range of 50 meters, the robot is made to take a halt at the location where crack is present. Hence when a crack is detected, the robot has to be reset again for further survey of the rail tracks.

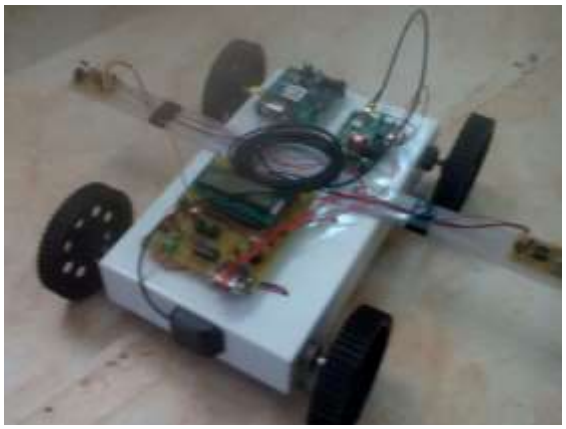

Figure 1:rail crack detecting robot.

IV. COMPONENTS USED

4.1 **Microcontroller:** Atmel 89s52 is four port microcontroller and is main component of this project. Its ports can be used for input as well as output purpose. Its help to interface easily of peripherals devices to interface with microcontroller.

4.2 **GSM Module:** The SIM300 is used here to send the messages to registered mobile number. Here it is interfaced with microcontroller using max232 at port 3 of microcontroller.

4.3 **GPS Module:** GPS here is interfaced with microcontroller at port 3 using max232. Here it is used to take the coordinate of the location. The obtained location is send to registered mobile number using GSM.

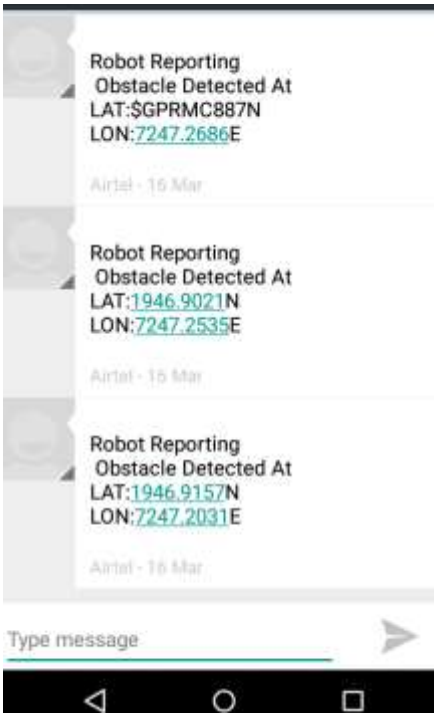

Figure 2: message for object

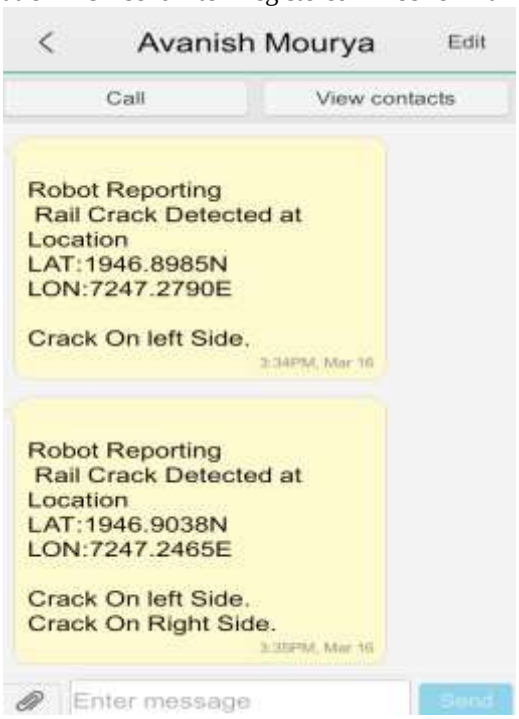

Figure 3:message for crack detected.

4.4 **DC Motor:** In this proposed system 2 DC motors are used. This motors are interfaced with microcontroller with help of motor driver L293D. The speed of 1.5 kmph is achieved with the help of wheel of diameter 6.8cm.

4.5 **IR Sensor:** It consist of transmitter and receiver section. It is the part of our project by which we actually detect the cracks and object in the path. It consist of a IR transmitter and receiver which works on the principle of light reflection.

V. CONCLUSION

The proposed rail system, detects the cracks and also provides the exact location of the cracks. In comparison with the traditional detection methods, the proposed system is more user-friendly, it has low power consumption as we are using two motors instead of four, less manufacturing cost and easy to get the location of the crack. By using this method we can easily trace the location and then operate it, which can save the human life. Also the inspection can be done on daily basis and with less human intervention.

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