Railway Crack Detection using LED – LDR Technique

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Abstract— In India rail transport occupies a prominent position in providing the necessary transport infrastructure to sustain needs of a rapidly growing economy. Today, India possesses the fourth largest railway network in the world. However, in terms of the reliability and safety parameters, we have not yet reached truly global standards. The main problem about a railway analysis is detection of cracks in the structure. If these deficiencies are not controlled at early stages they might lead to a number of derailments resulting in a heavy loss of life and property. This paper proposes a cost effective solution to the problem of railway track crack detection utilizing LED-LDR assembly which tracks the exact location of faulty track which then mended immediately so that many lives will be saved.

Key words: Railway Crack Detection, LED – LDR Technique

I. INTRODUCTION

Transport is a key necessity for specialization that allows production and consumption of products to occur at different locations. In India, we find that rail transport occupies a prominent position in providing the necessary transport infrastructure to sustain and quench the ever-burgeoning needs of a rapidly growing economy. Today, India possesses the fourth largest railway network in the world. However, in terms of the reliability and safety parameters, we have not yet reached truly global standards. There are major dysfunctional parts in the present railway system, this can be improved using certain smart techniques. The principal problem has been the lack of cheap and efficient technology to detect problems in the rail tracks and of course, the lack of proper maintenance of rails which have resulted in the formation of cracks in the rails and other similar problems caused by anti-social elements. Hence, owing to the crucial repercussions of this problem, we have worked on implementing an efficient and cost effective solution suitable for large scale application. In our project we aim at detecting railway cracks accurately using LED-LDR technique.

II. EXISTING TECHNIQUES

Among the inspection methods used to ensure rail integrity, the common ones are visual inspection, ultrasonic inspection and eddy current inspection. Ultrasonic Inspections are common place in the rail industry in many foreign countries. It is a relatively well understood technique and was thought to be the best solution to crack detection. However, Ultrasonic can only inspect the core of materials; that is, the method cannot check for surface and near-surface cracking where many of the faults are located. Eddy currents are used to tide over this limitation associated with ultrasonic. They are effectively used to check for cracks located at the surface of metals such as rails. Further, (Magnetic Particle Inspection) MPI is also used in the rail industry but there are a number of problems inherent with this technique, some of which are mentioned below:

- Surface of the rail or component must first be cleaned of all coatings, rust and so on.
- To get a sensitive reading, contrast paint must first be applied to the rail, followed by the magnetic particle coating.
- The same inspection must then be carried out in two different directions at a very slow overall speed.

However, in India, we find that the visual form of inspection is widely used, though it produces the poorest results of all the methods. It is now becoming widely accepted that even surface cracking often cannot be seen by the naked eye.

III. PROPOSED TECHNIQUE

The core of our proposed crack detection scheme basically consists of a Light Emitting Diode (LED)-Light Dependent Resistor (LDR) assembly that functions as the rail crack detector.

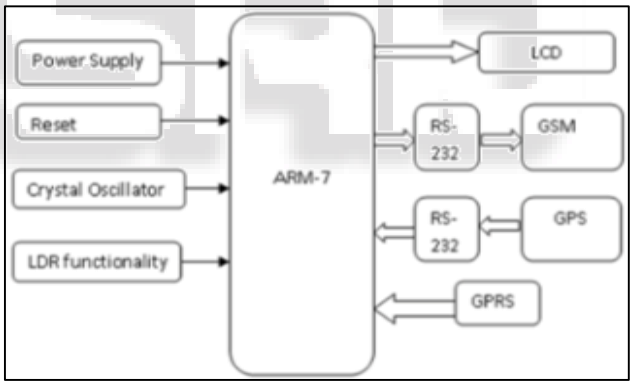

Fig. 1: Block Diagram of Proposed System

The principle involved in this crack detection is the concept of LDR. The LED will be attached to one side of the rails and the LDR to the opposite side. During normal operation, when there are no cracks, the LED light does not fall on the LDR and hence the LDR resistance is high. When the LED light falls on the LDR, the resistance of the LDR gets reduced and the amount of reduction will be approximately proportional to the intensity of the incident light. As a consequence, when light from the LED deviates from its path due to the presence of a crack or a break, a sudden decrease in the resistance value of the LDR can be observed. This change in resistance indicates the presence of a crack. In order to detect the current location of the device in case of detection of a crack, a GPS receiver whose function is to receive the current latitude and longitude data is used. To communicate the received information, a GSM modem has been utilized. The function of the GSM module being used is to send the current latitude and longitude data to the relevant authority as

an SMS. Using GPS and GSM we receive only the latitude and longitude location. So in order to get the exact location of the broken rail track we use GPRS module. We also consume low power and less cost by using ARM7controller. The aforementioned functionality has been achieved by interfacing the GSM module, GPS module and LED-LDR arrangement with a microcontroller. The robot is driven by four DC motors.

IV. OPERATION OF MODULES

1) Microcontroller: The microcontroller used in this system is LPC2148 microcontroller that is based on a32/16 bit ARM7TDMI-S CPU with real-time emulation and embedded trace support, that combines the microcontroller with embedded high speed flash memory ranging from 32 KB to 512 KB .Due to their tiny size and low power consumption, LPC21418 are ideal for applications where miniaturization is a key requirement.
2) GPS Module: SR-92 GPS receiver has been used as the GPS module. SR-92 is a low-power, ultra-high performance, easy to use GPS smart antenna module based on Si RF'S third generation single chip. The 5-pin I/O interface is then connected to the main board with either connector or wire soldering.
3) GSM Module: The SIM 300 GSM module has been chosen to achieve the SMS functionality. Featuring an industry-standard interface, the SIM300delivers GSM/GPRS900/1800/1900Mhz performance for voice, SMS, data and Fax in a small form factor and with low power consumption. The leading features of SIM300make it deal fir virtually unlimited application, such as Will applications, M2M application, handheld devices and much more
4) LED-LDR Assembly: The common 5V LED and cadmium sulphide LDR was found to be sufficient. The LED is powered using one of the digital pin of the ARM microcontroller. The LDR and a 45kΩ resistor form a potential divider arrangement. The output of the potential divider is given to one of the analog input channel of the ARM. The LDR is calibrated every time the robot is used. The light dependent resistor or cadmium sulfide (CDS) cell is a resistor whose resistance decreases with increasing incident light intensity
5) GPRS Module: In this system the GPRS module is used to know the exact location of the broken rail track. The GSM modem sends the coordinates of the faulty rail track to the GPRS which then sends the exact location to the mobile.
6) DC Motor: The proposed design uses 4 DC motors (Torque Rating: 10Kg and Speed Rating: 500 rpm) interfaced with the ARM With a wheel diameter of 5.2 cm and the total mass of around 5 Kg [6]. The approximate speed of the robot is around 0.5 meters/ sec.

V. CONCLUSION

In the proposed system of crack detection using led-ldr technique, railway crack are detected more accurately and precisely, which will in turn help to provide safety to users of railways. Hence it gives a better results then the existing traditional methods. Also there are many other advantages with the proposed system when compared with the traditional detection techniques. The advantages include less cost, low power consumption and less analysis time.

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