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IR Pair with RF Transmitters For Detecting Crack in Railway Tracks

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***Abstract*—This paper present a simple solution for one of the causes of derailment by identifying the cracks present in railway tracks. The method used here not only identifies the visible crack also this indication and notify emergencies to control room. This is the main function of this railway track crack detection system. Several methods are available depending on the type of detection method employed and message transmission techniques used. A simple mechanism of IRLED-LDR or IR pair is propose as a detection circuits**

***Keywords*— Crack detector; IR pair**

I. INTRODUCTION

Rail transport posses a significant role in providing transport facility for an ever increasing need of a rapidly growing economy. But however, it hasn't reached the global standard in terms of reliability and safely parameters. The principle problem involves lack of cheap and efficient technology, to detect problems in the railway tracks and also its proper maintenances. From the past history, it has been identified that, one of the main cause of derailment is cracks. But still there is no cheap automated solution available for testing purpose. Current existing technical solution to detect railway cracks involves periodic maintenances along with an occasional monitoring.

The most common inspection methods that have been used are ultrasonic detection, visual inspection, eddy currents and laser methods. At the beginning visual forms of inspections where widely used and accepted. But only surface cracking is seen by naked eye. Ultrasonic method could only inspect the core of the material, either this method cannot check for surface cracks where many false located. The speed is restricted around 20 to 30 mph with and hence limits the viability of testing cracks regularly. In laser inspection method, laser tends to cut through reflecting surface instead of getting reflected back. Thus as a solution to all the problems involved in the discussed methods, a detection based method, which provides an inherent advantage of facilitating, monitoring of railway cracks on a daily bases during nights when the usual train traffic is suspended.

This simple idea ensures robustness of operation and is designed to permit the rugged operation. A commonly noticed disadvantage of the conventional commercial available testing equipment is that they are heavy and provides difficulties in practical implementation. However this has been rectified in the method as it poses an simple design which also enables the device portability. Overall the introduced method is designed to recognize the cracks in railway tracks and send information to the authorities. This idea can be implemented in the long run to facilitate letter safely standards and an effective testing methods.

This paper discusses about the crack detection using IR pair. The paper is organized as follows. Section II describes about different methods, section III discusses about design overview. Section IV describes about future scope, section V discusses about result and section VI describes the conclusion.

II. DIFFERENT METHODS

A. IR pair with Zigbee Transmitter

This method is the basic overview of the paper which consists of a crack detecting vehicle which will traverse the railway line looking for cracks. This mobile vehicle will be powered by a DC to motor goes along the railway line. This motor driven robotic vehicle is equipped with an IR LED (Light Emitting Diode) pair on either sides of the vehicle. When a crack is present in the railway line the IR couples detects the change in intensity. This is indicated to a microcontroller, which then stops the motor. The robotic vehicle is programmed by a PIC microcontroller. The onboard RF transmitter sends the information, whether a crack has been detected or not to the control room in form of a sequence of coded signals. This information is a binary coded signal. The vehicle moves further on pressing the reset button on it. The RF receiver at control station receives the coded signal transmitted by the RF transmitter and decodes it. These signals are then fed to a microcontroller where the further decoding occurs. This microcontroller is interfaced with liquid crystal display. A corresponding sequence of coded message is displayed on the screen of the LCD. To grab the attention of the person on duty, a buzzer circuit is also provided, which blows while the message is being displayed.

B. Ultrasonic Detection

The device does not hinder the movement of train while it is on its track. When the vehicle detects a crack, it sends a signal to the control room. This device involves a pneumatic system hence when the train comes, it shrinks. The detector present in the system helps to identify the cracks on the track and the GPS system allows to locate the vehicle. There are different ways of detecting cracks on rail tracks using infrared rays, ultrasonic waves, Rayleigh waves, eddy current techniques, image comparison technology and laser ultrasonic method.

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C. Visual Inspection Method

The Indian railway system involves the wide implementation of visual inspection method. This involves a person inspecting the railway tracks regularly at periodic intervals. It is not a satisfying method since it involves more and more manual labor and time. With the advancement of technology we could implement newer methods with more efficiency and outputs and involves minimum working hands. The main problem comes when the cracks involved are not visible to humans

III. DESIGN OVERVIEW

The following crack detection system can be simply explained with a help of a block diagram. The block diagram consists of two sections – vehicle section and railway control section. The figure 1 of block diagram explains the vehicle section of railway crack detector. This section consists of a power supply, a crack detector circuit, a motor circuit, a microcontroller, encoder and a transmitter. Here the motor will be powered by a supply. The supply is further equipped with a LED (Light Emitting Diode) and LDR (Light Dependent Resistor) arrangement. When a crack is present in the railway line the light falls on the LDR and its resistance decreases. This information is directed to a microcontroller which then stops the motor. The presence or absence of a crack in the railway line is indicated by a detector system.

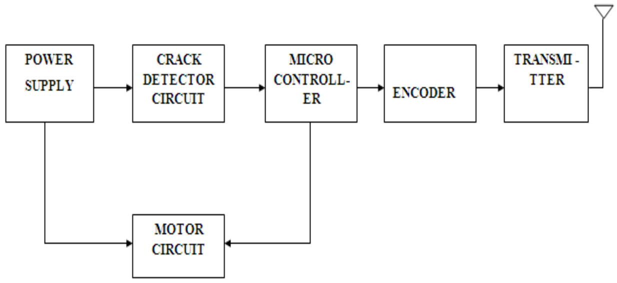

Fig. 1. Block Diagram of vehicle section.

This section consists of a RF receiver, decoder, microcontroller, an LCD display and a buzzer. Here the coded signals are received by the transmitter. The Rxd pin of microcontroller only selects the required coded sequence and other unwanted sequences are rejected. These coded sequence are then decoded by a decoder. The received sequences are displayed in the LCD screen. To grab the attention of the person on duty, a buzzer circuit is also provided, which blows while the message displayed is the one indicating the presence of crack. The presence of crack is indicated by logic high and which in turn activates the buzzer circuit.

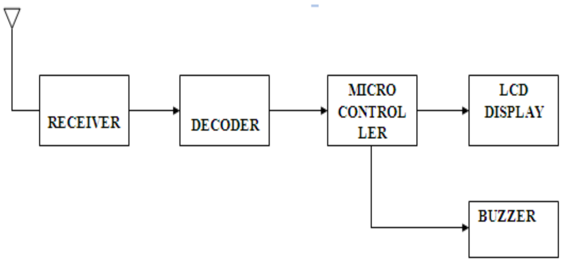

Fig. 2. Block Diagram of control section

A. Circuit Diagram

The circuit diagram of railway crack detection can be explained through two sections i.e. a Vehicle section and a Control section.

The first section is railway crack detector-vehicle section where the crack is detected, indicated and is transmitted in the form of a coded sequence to the control section. The second section is a railway control section where the transmitted signals are received decoded and the decoded sequence is displayed in the LCD screen. The presence of a crack is indicated through a buzzer.

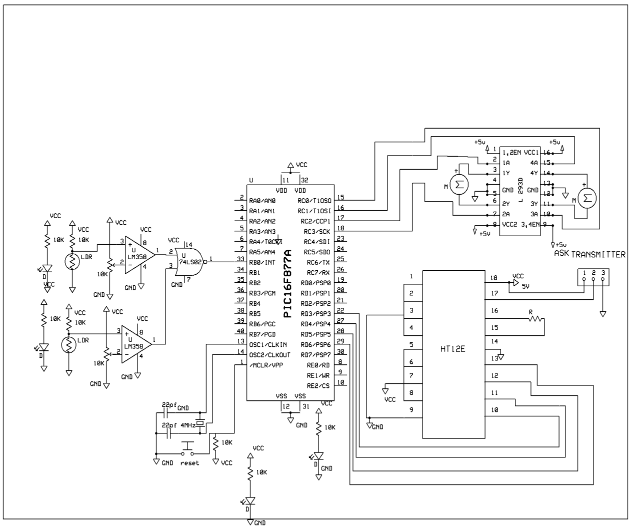

Fig.3. Circuit Diagram of Vehicle section

Consider the circuit diagram in the above figure. The circuit is powered by a supply. This activates the microcontroller and motor circuit. On switching the reset switch the capacitor gets charged and the RST pin of the microcontroller gets activated. The motor runs with a supply of 5V and 12 V clockwise and anticlockwise. The motor enables the vehicle section to move along the rails. The core of our proposed crack detection scheme basically consists of an IR LED-LDR pair that functions as the rail crack detector.

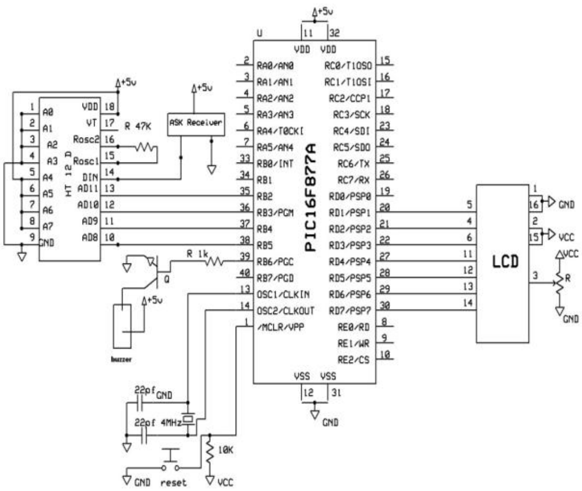

Fig.4. Circuit diagram of Control section

The IR pair output is given to the microcontroller 16F877A.The normal state of these ports are 0. The presence of a crack is indicated by a red LED and the absence of a crack by a green LED. The red and green LEDs are connected to ports. These ports are normally in 0 states. While the crack detection operation is being carried out, the microcontroller is programmed so as to stop the motor action whenever a crack is detected. It also sends a sequenced code of data for transmission to the control section through the transmitter. This coded sequence is encoded using a HT12E encoder. The data of crack detection is inputted to the transmitter as a coded sequence.

An RF transmitter receives serial data and transmits it wirelessly through RF through its antenna. The transmission occurs at the rate of 1Kbps - 10Kbps. On resetting the reset switch the microcontroller program can be restarted. The vehicle starts performing the operations as before on resetting.

Now consider the control section circuit, the transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter. The received data is send to the decoder. The decoder used here is HT12D decoder .The decoded data will be then displayed on the LCD screen .The receiver directs the received data to the RXD port of the microcontroller. This microcontroller port checks the received data and reads only the required subroutine codes and the unwanted codes are rejected by this port. If the port reads a code 1 .this represents the presence of a crack. The port which is normally in 0 state becomes logic high. A logic 1 to the base of the transistor activates it and hence the buzzer get activated and blows. To grab the attention of the person on duty, a buzzer circuit is provided, which blows while the message is being displayed. The presence of crack is indicated by logic high and in turn activates the buzzer circuit. A red and green LEDs are connected to ports. These ports are normally 0. The presence of crack is indicated by a red LED and absence by a green LED. When the crack is detected a red led is activated by microcontroller along with the buzzer. When the crack is not detected the microcontroller changes the port state to 1 and a green LED turns on.

IV. FUTURE SCOPE

This paper can be improved further by introducing adjustable piston, for adjusting the height of the vehicle section. This gives an additional advantage by making it possible to detect cracks even during peak traffic hours. The message to the control room can be sent by using GSM Module making it technically advanced. Rail tracking circuit can also be incorporated into it. By introducing this technology an alarming message can be sent to nearby train engine. This further reduces the chances of derailment due to delay in action or response by the person on duty at the control room. Thus, makes it more efficient and reliable technology in the present scenario. Many accidents are also caused due to anti-social activities like bombing the tracks, etc. There is no technology available at present to detect or control it. This robotic vehicle can also be used as a bomb detecting and disposing robot, if necessary circuits and programs are added to it. Thus makes Indian Railways the safest railway network in the entire world.

V. RESULT

The implementation of the project involves the robotic vehicle section, which can move along the railway track. The IR pair attached to each end moves along the track when the vehicle is moving. When a crack is detected a red light attached on the board indicates the crack detected, correspondingly a red light also will be generated by the message code along with a buzzer alarm. Once the intensity of the crack is studied and necessary steps are taken on that basis.

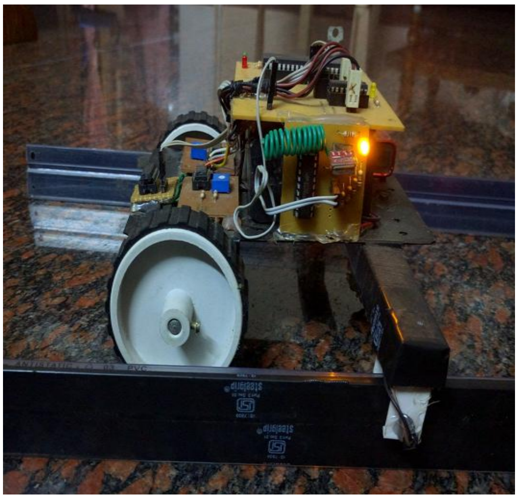

Fig.5. Model of the Robotic Vehicle section

VI. CONCLUSION

By using the proposed technique cracks in railway track can be detected effectively. The IR pair used in detection circuit can very well detect surface and core cracks, often invisible to naked eyes. This robotic vehicle runs through the length of the track in search of cracks, and is capable of reporting the presence of cracks if present, directly to the control room. This helps in reducing accidents in railways like derailments, thus making railways a safe and better mode of transportation. Since the components used in this technique are comparatively cheap, this technique can be employed on large scale, no or less maintenance is required thereby making its use more desirable. This vehicle possesses the inherent advantage of facilitating monitoring of rail tracks on a daily basis during nights when the usual train traffic is suspended. Further, that the simplicity of this idea and the easy-availability of the components make this project ideal for implementation on a large scale with very little initial investment.

The simplicity of this work ensures robustness of operation and also the design has been carefully modified to permit rugged operation. Another disadvantage that can be attributed to the conventional commercially available testing equipments is that they are heavy which poses a practical limitation. However, this important disadvantage has been rectified in this project as the design is simple and sensible enabling the device to be easily portable. While designing the mechanical parts of the robot, due consideration has been given to the variable nature of the tracks and the unique challenges posed by the deviations in the Indian scenario. For example, in areas near road-crossings the outer part of the track is usually covered with cement. Also, there is always

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the problem of rocks obstructing the path on the inside parts of the rails. The specialized wheels that have been provided in our robot have taken this into account and are specifically designed to overcome the aforementioned problem.

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