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# Effective Crack Detection In Railways At Diesel Loco Shed Using IR Sensor And ZIGBEE

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## Abstract

The project involves developing a railway crack detection scheme (RRCDS) that uses an IR receiver sensor assembly system to identify rail track cracks and alert authorities via a buzzer and LCD display, preventing a train accident. The device also has a distance-measuring sensor, which shows how far apart the railroad lines are from one another. This project uses an IR sensor, a zigbee transmitter, and a zigbee receiver and is implemented with a PIC 16F877A microcontroller. Here, IR sensors are utilized to locate the cracks, and anytime a crack is found, a zigbee receiver is informed of its location. The problem of railroad track crack detection is effectively solved by IR assembly, which records the precise location of broken track and then fixes it right away to save many lives.

**Keywords:** Zigbee, LCD, Relay, Buzzer, DC motor, PIC 16F877A, IR sensor.

## 1. Introduction

Everyone can travel around in a planet thanks to transportation. India's transportation system greatly benefits from rail travel, which also helps the economy of the nation. The rail network in India, which covers the entire nation, is known to carry over 30 million people and 2.8 million tonnes of freight per day. However, given how frequently trains are utilised in India, the biggest problem—and one that needs to be treated seriously—is track cracks. In order to enhance performance, particularly with regard to the false-positive rate, the DT makes use of the right picture preprocessing and post-processing TECH. Our system has a 98.5% accuracy positive rate and a 2.306 percent false positive rate. [3].

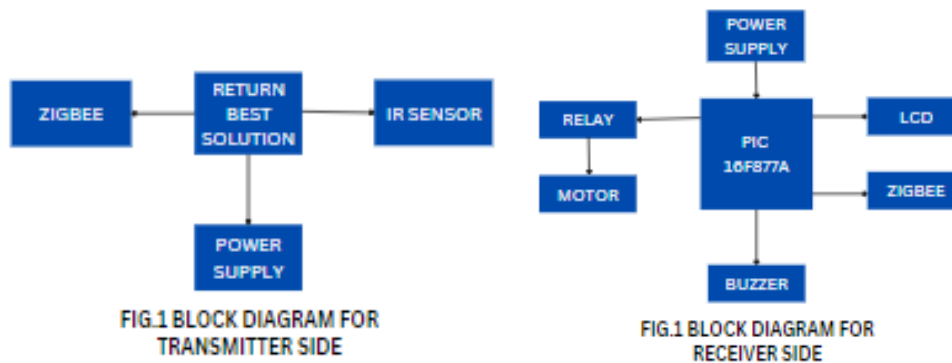
## Existing system

Railway tracks in the current system are being manually surveyed. Automated visual inspection is a difficult technology since it uses video colour analysis to find cracks in the rail track when the output isn't perfect or when the conditions aren't ideal. Every part of the track is examined on foot every day [2]. Gang patrol during unusual rain, night patrol during the monsoon, weather patrol for welded track, security patrol, watchmen at

sensitive areas, and weather condition patrol are the many types of patrolling. Gang patrolling is the practise of conducting foot patrols along railroad tracks in wet weather. To protect trains from track changes and traffic obstructions, security patrols has come to an end [1].

## 2. Proposed system

To get around the shortcomings of the current method, the proposed solution locates the problematic component. he device also has a distance-measuring sensor, which shows how far apart the railroad lines are from one another. This project uses an IR sensor, a zigbee transmitter, and a zigbee receiver and is implemented with a PIC 16F877A microcontroller [4]. By using the site's latitude and longitude, we may determine the precise location of the broken rail track. We've integrated an infrared sensor with a wireless module called zigbee into our system to transfer data [7]. Using the zigbee protocol increases the transmission speed.



There is one transmitter and one receiver setup used in our proposed system, which receives and transmits crack detection information. If any crack is occurs in the railway track, suddenly the IR sensor sense that unequal surface and send a output voltage to the controller. It can be operated in tunnel also without interruption. It totally reduced the manpower because it is fully automated. The IR receiver will be positioned on the opposite rail track from the IR transmitter, as shown in the illustration below [6]. The times taken for detecting the crack in the track are less and operate easily. It totally overcomes the manpower by fully automated.

### 3.1 System architecture

The PIC 16F877A controller, LCD, Zigbee, Buzzer, IR sensor, Relay, and DC Motor make up the suggested rail track detecting system architecture [11].

### 3.2 Operation

This section describes how the components in the architecture of the defective rail track detecting system work.

### **3.2.1 PIC 16F877A**

In a specific purpose system known as an embedded system, the computer is totally integrated into or dedicated to the system or device it controls. Personal computers are able to do predetermined jobs with highly particular criteria, much like regular computers [5]. PIC 16F877A are perfect for large applications because of its small size and low power consumption. It is utilised in remote sensing, home automation, and security and safety equipment.

### **3.2.2 IR sensor**

Although the dual version aids in increasing its width, the detecting area is very modest. Range can also be increased by increasing the IR LEDs' power or by employing more IR LEDs. The test set-up displayed below uses a number of IR LEDs (dark blue) as the source of light and twin phototransistors wired in series as the receiver. The IR obstacle sensor must have a large field of vision. With IR, this system functions similarly to a Frits LDR. In conjunction with a reflective surface or any object, it often covers a distance of between 10-15cm (4-6 inches).

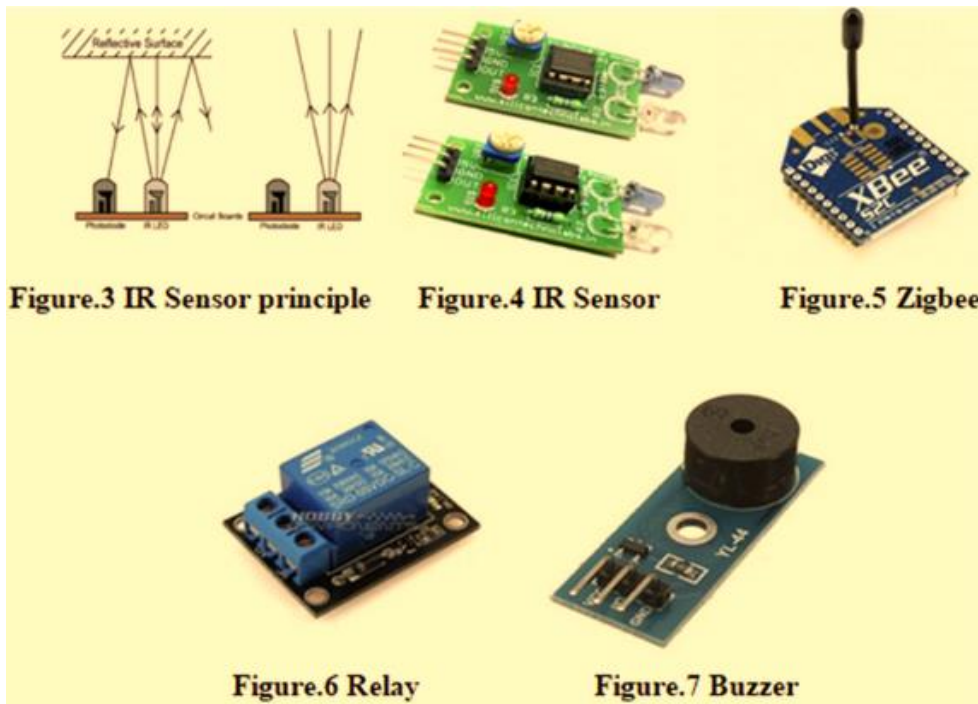
### **3.2.3 Zigbee**

Zigbee is a tool for pinpointing a specific location. These zigbees function at frequencies of 2.4GHz, 902-928 MHz, and 868 MHz. The intermediate two-way transfer of data between sensors and controllers is suitable for the data rate of 250 Kbps. It is a low-power mesh network that is used for track monitoring and control. It will travel a distance between 10 and 100 metres. With the aid of routers, Zigbee networks may be expanded and numerous nodes can link to one another to create a broader area network. It offers two different kinds of data services, including generic message and key-value pair services. Advanced eddy current techniques were introduced some time ago in two railway inspection trains (RIT) that previously had ultrasound technology installed. A system that was built from the ground up to combine these two non-destructive rail inspection techniques has recently been installed in a brand-new RIT. Rolling contact fatigue (RCF) faults can now be identified and assessed thanks to the development of the eddy current technology. The ultrasound method is intended for measurements in the rail bulk volume that are impractical to make with the eddy current method [7].

### **3.2.4 Relay**

Using low power circuits, a high voltage or current switch is made using an electromagnetic relay. An electromagnet is used in an electromagnetic relay to mechanically control a switching mechanism. The circuit's needs and how it is operating

will determine whether the driven relay acts as a switch in the circuit, opening or closing as necessary. Additionally, it offers separation between low- and high-power circuits [8].



### 3.2.5 Liquid Crystal Display (LCD)

A relatively basic component that is widely used in many distinct devices and circuits is a 16x2 LCD display. It is recommended to use these modules rather than multi-segment LEDs and seven-segment LEDs. Two lines, each of which may show 16 characters, make up a 16x2 LCD. Each character on this LCD is presented using a 6x8 pixel grid.

### 3.2.6 Buzzer

A buzzer is an aural signalling device that can be electromechanical, piezoelectric, or mechanical. Beepers and buzzers are commonly utilised as alarm clocks, timers, and to confirm human inputs like keyboard or mouse clicks.

#### 3.2.6.1 Electromechanical buzzer

The electromechanical system used by early devices was exactly like that of an electric bell, excluding the metal gong. Similar to this, a relay might be set up to cut off its own activating current, which would buzz the contacts. In order to use it as a sounding board, these units were frequently fastened to a wall or ceiling [9]. The rasping sound that electromechanical buzzers created is where the word "buzzer" originated.

### 3.2.7 DC Motor

A DC motor was an electrical motor that runs on direct current and mechanical commutation. The stator and stator current are by definition stationary in the area. The

commutator, which is stationary in space, switches the current in the rotor. WSNs are affordable networking systems that monitor the health of your machines. It saves a lot of money by avoiding cable usage and simplifying system implementation in the industrial setting [10]. In addition to a static field winding or permanent magnet, DC motors also feature a rotating armature winding that does not rotate. All electric motors or generators are powered by the speed can be altered by altering the voltage applied to the armature coil or the field current in the coil. [11]. The armature circuit or field circuit is given a variable resistance, allowing the motor's speed to be adjusted. DC drives, a type of power electronics system, are used to control modern DC motors.

#### **4. Results and discussions**

The proposed technology for detecting damaged train tracks does so automatically and without using a human interface. When compared to the previous detection methods, the proposed system has a wide range of additional benefits. Less expense and less power consumption are two benefits. With the use of an IR obstacle sensor, the suggested system can readily pinpoint the precise site of rail track cracks, which will then be repaired right away to save countless lives.

#### **5. Conclusions**

Cracks in the railway track are found using a manual inspection procedure. In this project, these issues are fixed. The robot can move automatically down a railway track and can see if there are any cracks on either side. Most people in this globe rely on the railroad system for transportation. The most accessible and affordable form of transportation is the railroad. Derailment is the main factor in rail accidents. Rail track cracks are the primary cause of derailments. The suggested system aids in fracture detection. The technology that was created is reliable and economical.

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