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Automatic Railway Track Fault Detection System with Live Video Streaming

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Abstract—
Most of the Transportation of commercial goods in india is done by the railway network and any damage to these network leads to damage to economy. Indian railway has not yet reached the international standards in terms of the reliability and safety parameters. The main concern about railway network is early detection of any cracks in the structure. If these faults are not detected and repaired at early stages, they might lead to derailments which leads to heavy loss of life and property. Our model proposes a cost-effective solution to the problem of track crack detection using IR transmitter and receiver which detects the crack and feed location through GPS and video feed of the track immediately so that many lives can be saved. There are many advantages when compared with the traditional system i.e. cost effective, lower power consumption and lesser analysis time.

Keywords— *IR transmitter and receiver, Railway crack detection, GPS.*

I. 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 administered by the railway network because it's 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 really huge rise within the volume of traffic in the Indian Railway network. . Economic prosperity has always been hooked in to increasing the capacity and rationality of transport. But the infrastructure and operation of transport features a great impact on the land and is that the largest resource of energy, making transport sustainability and safety a serious issue Transport is extremely important to hold the passengers and goods from one place to a different . The better transport leads to more trade. Economic level is especially counting on increasing the capacity and level of transport. Here in this paper IR sensor is used to detect the crack in rails. 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.

Transport has throughout history been a spur to expansion as better transport results in more trade. Economic prosperity has always been hooked in to increasing the capacity and rationality of transport. But the infrastructure and operation of transport features a great impact on the land and is that the largest drainer of energy, making transport sustain ability and safety a serious issue. In India, we discover that rail transport occupies a prominent position in providing the required transport infrastructure to sustain and quench the ever-burgeoning needs of a rapidly growing economy. Today, India possesses the fourth largest railway network within the world. Today, India possesses the fourth largest railway network within the world. However, in terms of the reliability and safety parameters,

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we've not yet reached truly global standards. The principal problem has been the shortage of cheap and efficient technology to detect problems within the rail tracks and in fact , the shortage of proper maintenance of rails which have resulted within the formation of cracks within the rails and other similar problems caused by anti-social elements which jeopardize the safety of operation of rail transport.

In the past, this problem has led to variety of derailments leading to an important loss of life and property. Cracks in rails were mostly the cause for derailments in past, yet there are cost effective automated solutions available for crack detection purposes. The new method which utilizes simple components inclusive of a GPS module, GSM Modem, IR Transmitter and Receiver based crack detector assembly is extremely useful in railway crack detection.

II. LITERATURE SURVEY

In this paper Shubham Dhoke proposed a a simple, effective and portable robot for the identification of major railway track damages using Raspberry pie and Internet of things. It also uses a GPS system to urge the precise location of the damaged track. A robot will move across the railway track with IR sensors placed thereon to detect flaw on the track. Its location are going to be traced and can be transmitted to the most server. Author Connected a laptop to router and the raspberry pie is also connected to the router so the IP address of the raspberry is obtained through the router's configuration. After getting the IP address of the raspberry pie, put that IP address in TA software called "Putty". After putting the IP address login in the terminal using user id and password and doing this, we need a graphical user interface to work on raspberry pie scripts in a user-friendly way for doing so a software called VNC server is install on raspberry pie. After login open python script and run the script written for the sensors and GPS and as soon the crack is identified by the sensor the co-ordinates are transmitted over Internet via USB Wi-Fi dongle connected to the raspberry pie [1].

In this paper Disha Bhat proposed Arduino based rail crack detection system that has the potential for detecting the cracks within the rail track including minor cracks automatically with none human intervention. they're using suitable mechanism for on and off tracks using ATMega2560 microcontroller on board UNO board. The microcontroller is employed to regulate the IR sensor array output and ultrasonic sensor output and transmit the knowledge by using the GSM module and therefore the function of GSM module getting used is to send the signal whenever it detects the crack to the bottom station through an SMS [2]. IR sensor works on by employing a select- light sensors to detect a specific light wavelength within the infra-red (IR)spectrum. The transmitter section contains an IR sensor, which transmits IR rays to be received by an IR receiver module. The emitter is just an IRLED (light emitting diode) and therefore the detectors is just an IR photodiode which is sensitive to IR light of an equivalent wavelength as that emitted by the IR LED. When IR light falls on the photodiode, resistance and output voltages, change in proportion to the magnitude of the IR light received [3].

In this paper S. Bhagyalekshmi proposed a system which introduces an improvised, cost effective system with renewable based electric vehicle that detects major faults in the railway track with better accuracy. For an accurate detection, digital image processing is implemented. In region segmentation a particular region of the image is extracted using the boundary limits. The purpose of object segmentation is to separate a required region from the image based on the reference object [4]. In this paper Selvam Raju Somalraju proposed a system that uses LDR for railway crack detection. RRCDS utilizes simple components inclusive of a GPS module, GSM Modem and LED-LDR based crack

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detector assembly. In this proposed system they usedPIC16F877A microcontroller. The logic used in this crack detection is that light reaching the LDR is proportional to the intensity of crack. This change in value shows presence of a crack or some defect in the rails. The GSM module is getting used to send the present latitude and longitude data to the relevant authority as an SMS[5].

In this paper Parvathy A. proposed a system consists of a gauge which finds the amount of stress that is being applied over the rail lines during the train passes through it. Knowing the dynamic parameters of the rail (Young's modulus E, Poisson's ratio ν) and its geometrical characteristics (web thickness geometrical moment of inertia I, first moment of space H) the theoretical value of the strain can be calculated for a particular stress. If any changes in the width or length of the tracks, ultrasonic sensor detects it and alert the operator[6]. An automatic railway track crack detector system for Railway has been proposed by Haritha P, which aims in building a bot that can detect and analyze any kind of crack on the railway line and send the location of that defective line to the authorized person . The bot is equipped with two ultrasonic sensors, GPS, GSM modules and Arduino Mega based crack detection assembly which is cost efficient and robust to provide better safety standards in railways. LoRa technology offers compelling features for IOT applications including long range, low power consumption and secure data transmission[7].

In this paper Rohini Chavan have proposed a comprehensive GPS/GSM based train tracking system, which provides accurate, dependable and timely information to the controller. Here crack sensing circuit is used for sensing the crack present on the railway track. Here ultrasonic sensor and MEMS sensor are used for detecting obstacle present on the railway track. For the purpose of sending message to the authority person GSM (Global system for mobile communication) modem is used [8]. In this paper E. Dhivya proposed an automatic railway crack detection system using image processing. In this project we are using Raspberry pi 3B, reader module, webcam, cloud server. Raspberry pi is the major component which is used to get the information from the camera and compared those images with the reference images using image processing, and the raspberry pi receive the location of the crack by EM 18 reader module, and then it saves the location to the cloud server. The images taken by the webcam by image processing edge detection method which analyze the image by screening the edge of the track. If the crack is detected the RFID reader. In this paper module read the location information and store the information to the IOT and from the server the information about the crack is known to the supervisor in the railway department. If there is no crack detected then the RFID reader module does not read any RFID tag and the webcam continues to capture the images [10].

In this paper Rakesh V. Pise proposed a system which introduces an improvised, cost effective system that detects major faults in the railway track with better accuracy. The IR transmitter is attached to one side of the rails and the IR receiver to the opposite side. During normal operation, when there are not any cracks, the sunshine from transmitter doesn't fall on the receiver and hence the set value is low. When the sunshine from transmitter falls on the receiver, the worth gets increased and therefore the amount by which it's incremented are going to be proportional to the intensity of the incident light. As a consequence, when light from the transmitter deviates from its path thanks to the presence of a crack or an opportunity . The GSM module is getting used to send the present latitude and longitude data to the relevant authority as an SMS. The aforementioned functionality has been achieved by interfacing the GSM and GPS modules with the PIC16F877A microcontroller[11].

III. PROPOSED SYSTEM

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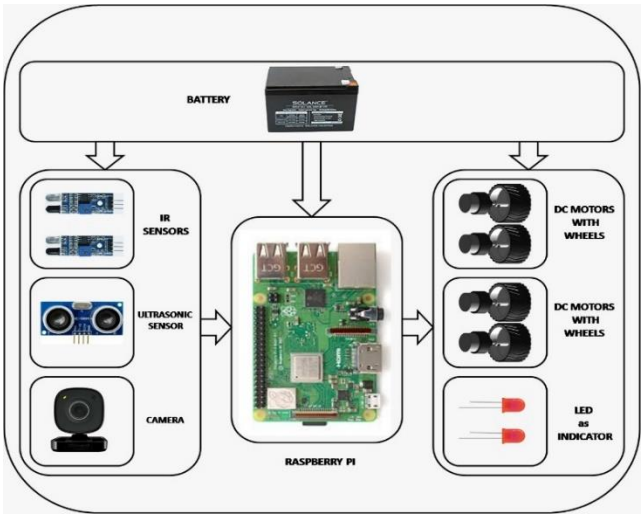

Figure 1: System block diagram

Above diagram shows the diagram of the proposed work “IoT based railway track crack detection system”. In this system we are using Raspberry pi, which acts as a brain of the system. This minicomputer controls the circuit function. Various components are interfaced with this to perform desired operation of the system. The hardware components utilized in this technique requires regulated power supply for the operation. This power is provided by the rechargeable battery connected within the system. The battery will be charged through mains supply.
In this system we've interfaced two TSOP IR sensors with the Raspberry Pi 3 module for the space and detection of the crack present within the track of the railway line. To communicate the received information, we make use of IoT technology and email service. The GPS receiver is used to collect the current latitude and longitude data from the satellite and to send it to the relevant authority as an email.

Two DC motors are used to move the bot in forward direction. These motors are interfaced and controlled through the controller unit. To operate these motors a driver circuit is used in this system. A pi camera is also used in this system. This camera is interfaced in the system for live streaming of the railway track. This is designed to monitor all the process remotely by the user.

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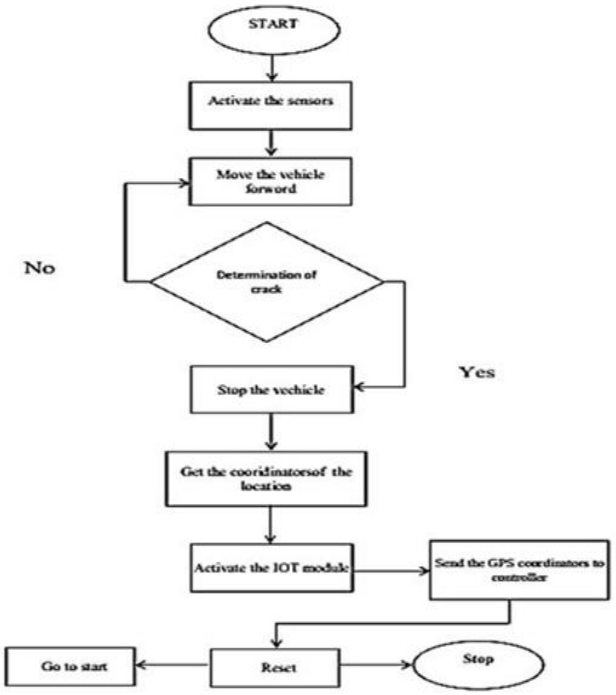

Figure 2: Flow Chart.

IV. PROPOSED METHODOLOGY

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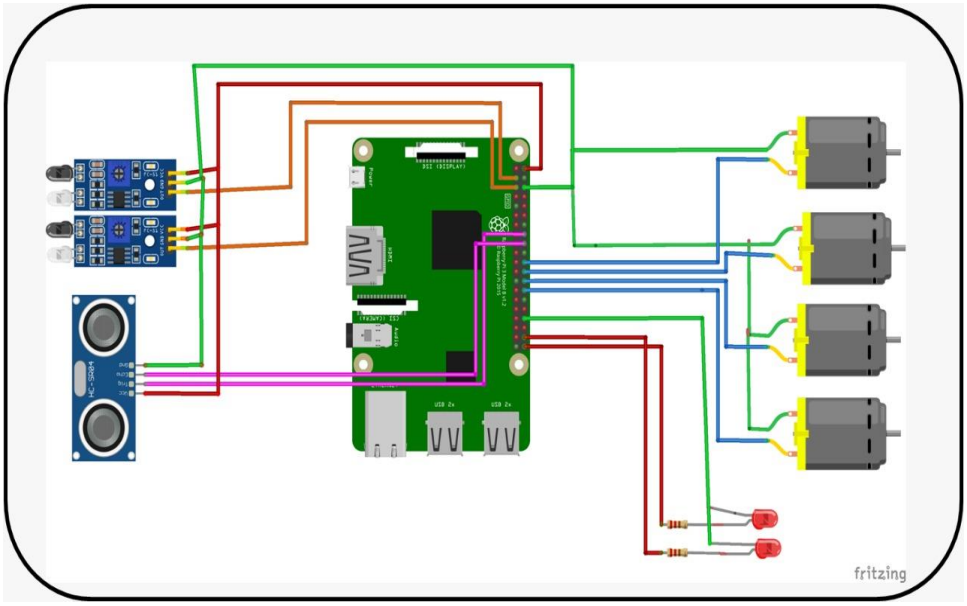

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In our project, there are two set of IR sensor units fitted to the 2 sides of the vehicle. The IR transmitter and IR receiver circuit is used to detect the crack. It is fixed to the front sides of the vehicle with an appropriate arrangement.When the vehicle is powered on, it moves along the track. The sensors continuosly monitors the condition of the track. When the battery supplies the power to the Raspberry Pi 3 module it starts the motor rotation to move in forward direction. When crack is detected then vehicle stops , after that the GPS receiver triangulates the position to receive the coordinates of the vehicle position from satellites. The coordinates received by GPS are converted into a text message which is processed by microcontroller. This message is then forwarded to the authorized person by means of email or sms. Also, the camera provides the live video streaming to the IoT application of the system through wi-fi over the internet.

The functionality of the model starts with the IR sensor

i. When the vehicle starts, it moves along its designated path model. The IR sensors sense the circumstances of the track.

ii. When a crack is detected by the Infrared sensor, nearest station gets the coordinates of vehicle location through the (GPS) from satellites.

iii. The Latitude and Longitude coordinates of vehicle is received by Global Positioning System (GPS) and are converted into a message which is done by the microcontroller.

iv. The IOT module sends the message to microcontroller which displays the message on webpage.

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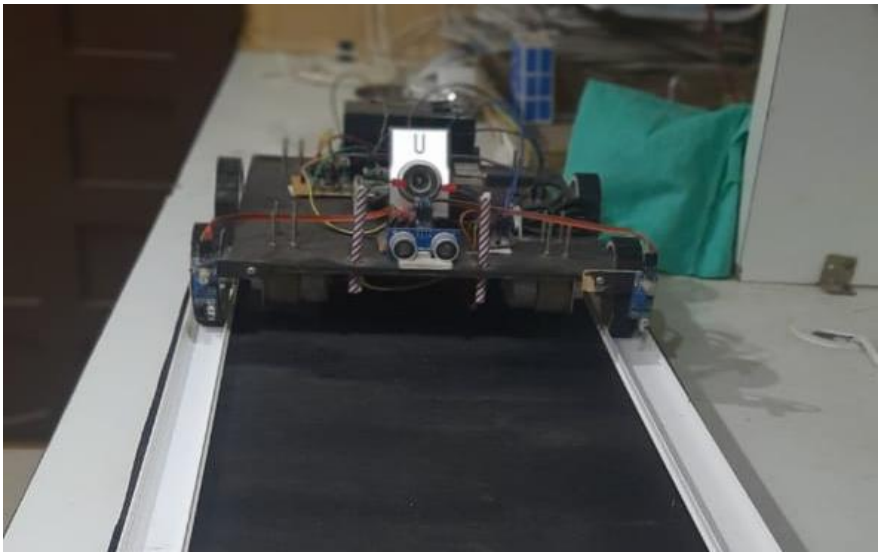
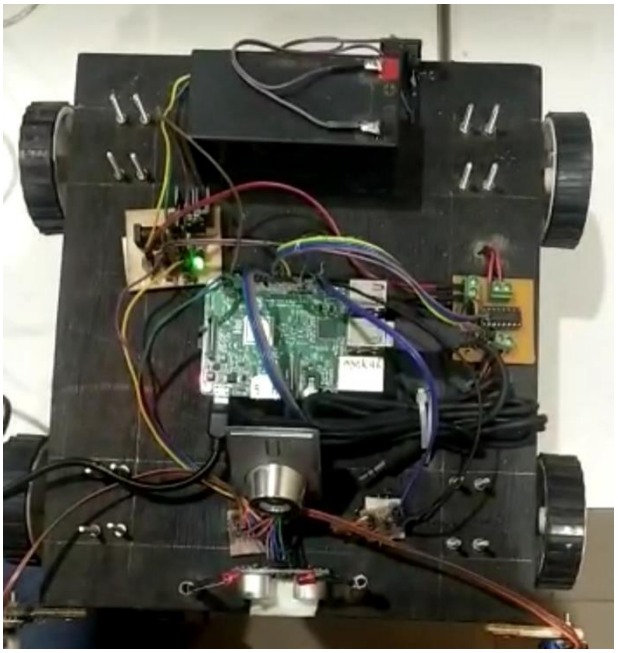
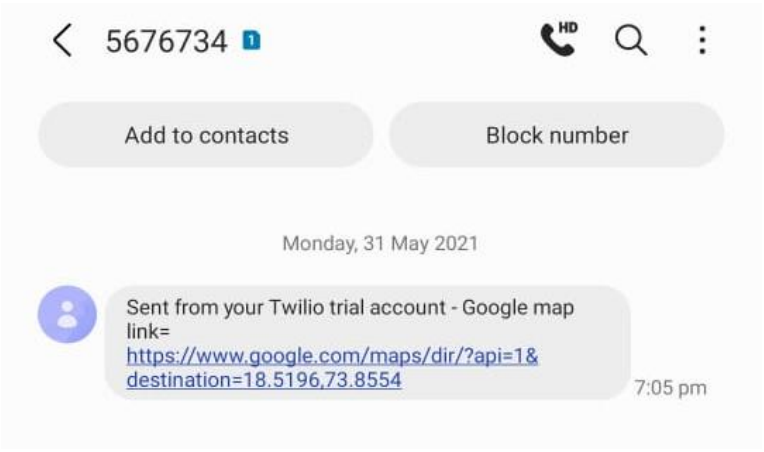


A. Front View of Bot



B.Top View of Bot



C. GPS co-ordinates received via SMS on Mobile

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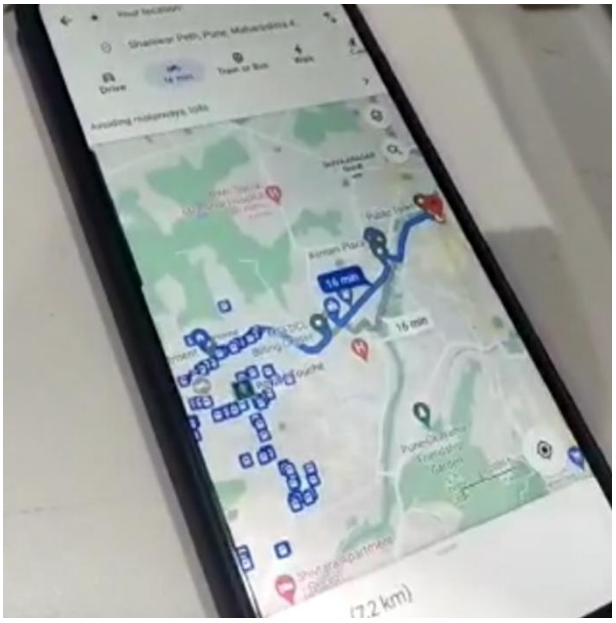
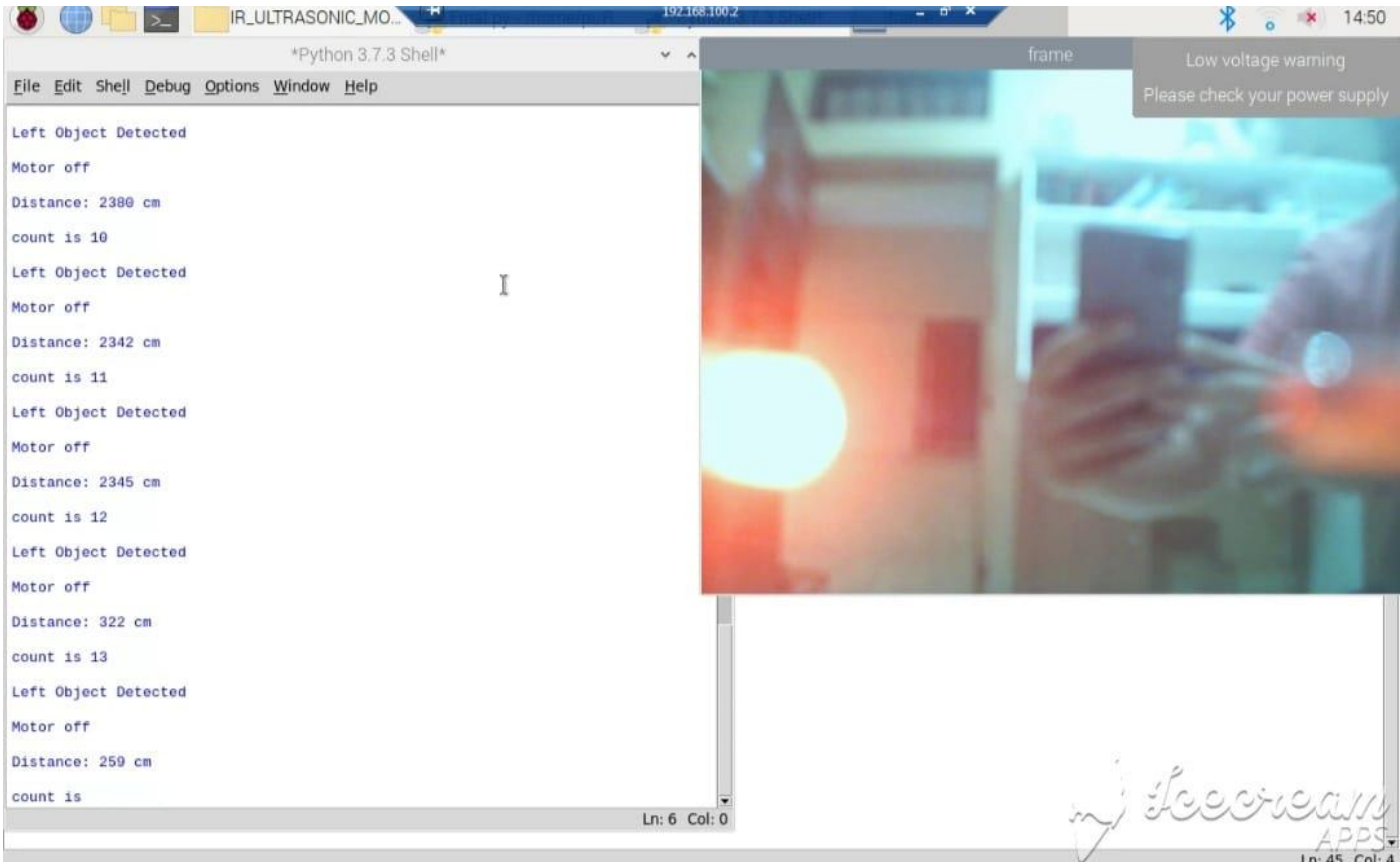


D. Geographic Location of bot on Google map



E. Live Streaming of Railway Track

V. CONCLUSION

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From above discussion we now surely come to know that it is highly effective, reliable and economical at dense traffic area, sub populated area and therefore the route where frequency of trains is more. As it saves some auxiliary structure also because the expenditure on attendant it's more economical at above mentioned places than traditional railway crossing gate system. We know that though it's very beneficial but it's also impossible to put in such system at each and each place, but it gives certainly a substantial benefit to us, thereby to our nation.The proposed scheme possesses many advantages like fast monitoring and reporting system, low cost, low power consumption and fewer analysis time. Also, the straightforward availability of the components makes a perfect project for industrial use with little or no initial investment. By this proposed model many lives are often saved by avoiding accidents. The idea are often implemented in large scale within the end of the day to facilitate better safety standards for rail tracks and supply effective testing infrastructure for achieving better results in the future.

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