Railway Track Crack Detection Robot

Mohammed Rafi. H. Kerur[1], M N Dinesh[2]
Mahamad Nawazpeer[3], Manjunath Elavi[4],
Manoj H V[5]
Department of Mechanical Engineering
P.E.S. College of EngineeringMandya, Karnataka, India

Mohammad Ayaan M K[6]
Department of Electronics and Communication
UBDT College of Engineering Davangere,
Karnataka, India

***Abstract*— In terms of network size, Indian Railways is the fourth largest in the world. Most of Indians depends on railway to travel and transportation of goods to one place to another. Indian Railways contributes significantly to the country's GDP. But railway department is facing many train accidents by crack, discontinuity, and train crash. The accidents of trains harm the lives of people and property of train hence it is necessity to maintain the good track without any defaults. So Indian railway department appoints many labors to find and repair the cracks and discontinuity through manually. Here the labors cost is more, it may take more time and also it's not accurate. To overcome this problem the automatic crack detection robot model is made by using NodeMCU development board alongwith Wi-Fi module. The distance sensors will collect the signals whether the condition of track is good or not and send to the NodeMCU and robot will stop immediately. Simultaneously the information is send to operator through IoT by showing the red alert in the blynk application. So it is possible to take immediate action to repair the track. So it helps the railway department to maintain the good condition of track with low cost.**

Keywords— Railway, IoT, Sensors, NodeMCU, GPS module,DC motors

I. INTRODUCTION

Rail transport plays an important role in India in terms of providing the essential transportation infrastructure to support the needs of a fast rising economy. In India, rail transport plays an important role in meeting the ever-increasing needs of a fast rising economy. However, taking into account the India has not met the dependability and safetyrequirements. Not yet a global standard. The main issue is thatthere is none. Efficient and low-cost technology for detecting faults in rail tracks, as well as a lack of basic maintenance. In previously the crack and discontinuous in the rails is detected manually. But it is not accurate and it takes lot of time so it needs to develop the automatic track detection robot using ultrasonic sensor, NodeMCU, DC motor, GPS module [1]. According to an internet study, around 60% of all railway accidents are caused by derailments; however, current assessments reveal that approximately 90% are caused by rail cracks. The Indian railway network now spans 113,617 kilometers (70,598 miles). Spanning a distance of 63,974 kilometers (39,752 miles) and 7,083 stations. An ultrasonic sensor is utilized to detect the break as well as the distance. This project is about a method for monitoring the condition of rail. Train tracks and, more particularly, has the object of the identification of flaws discovered by monitoring equipment onthe tracks to be checked in order for maintenance staff to discover these flaws later. Each sensor will generate a signal according to its position on the rail. If the track is normal in itsposition, both sensors produce a consistent perceived output.If someone fails their output condition, there is flaw on that side it will notify you by sounding an alert [2]. The fundamental issue has been a lack of inexpensive and effectiveequipment to detect faults in train tracks, as well as a lack of proper rail maintenance. As a result of which fissures in the rails and other same issues produced by anti-social element endanger the safety of rail transportation operations [3]. So here preparing the low cost effective model by using the sensors which will sense the obstacles and send to NodeMCU then stops the DC motors and give the red indication and trackthe exact location using GPS module through the blynk application using IoT [4]. In this 12V rechargeable battery is converted to 5V to operate the NodeMCU and Wi-Fi chip requires 3.3V to run the robot circuit [5].

II. COMPONENTS DESCRIPTION:

A. GPS Module: To track the location of our robot we used global Positioning system (GPS) module. The Global Positioning System is a satellite based navigation system that delivers time and location data. Operator having a GPS receiver and an unobstructed line of sight to at least four GPS satellites can use the system. A GPS receiver determines its location by accurately timing signals transmitted by GPS satellites. GPS is currently widely utilized and has become an essential component of smart phones. Here we get theinformation about location of robot through blynkapplication using GPS.

Fig.1. GPS Module

A Ultrasonic sensor HC-SR04: The HC-SR04Ultrasonic Distance Sensor is a popular and reasonably priced alternative for non-contact distance measuring. It can measure distances ranging from2cm to 400cm with an accuracy of roughly 3mm. This module consists of an ultrasonic transmitter, an ultrasonic receiver, and a control circuit. We can determine the distance between the sensor and the object using this information. This distance sensor consists Vcc, Trigger, Echo, and GND (ground) are the four pins on the HC-SR04. For 10 microseconds, you transmit a high impulse on the Trigger pin. In this manner, the sensor sends sound waves and awaitstheir return. The sensor will then respond on the Echopin with a high impulse with duration directly proportional to the travel time of the sound waves. Toavoid interferences with the next measurement, you must wait at least 60 millisecondsbetween impulses.

Fig2. Ultrasonic sensor HC-SR04

A. Lead acid rechargeable battery: We utilized a battery with a voltage of 12 volts and a current capacity of
7.5 amps. The battery has enough power to power two DC motors, power to both power supply board and relay board. This battery is a sealed lead acid rechargeable battery. It has a 7.5 hour battery life, which means it can power a robot for roughly 6.5 hours. It can be carried along with robot for power supply. These characteristics, together with their low cost, make them more for use in our motor vehiclesto generate the high current required by starter motors.

Fig.3. Lead acid rechargeable battery

B. Alarm or Buzzer: A buzzer or beeper is an electrical signaling device. it is typically composed of a number of switches or sensors connected to a control unit that determines if and which button was pushed or if a preset time has elapsed, and usually illuminates a light on the appropriate button or control panel, as well as sounds a warning in the form of a continuous buzzing or beeping sound. If there is any discontinuity in the track, then the vehicle stops and buzzer beeps continuously.

Fig.4. Alarm or Buzzer

C. DC Motor: A motor is a device that turns electrical energy into mechanical energy. DC motors, ingeneral, use an internal mechanism, either electromechanical or electronic, to alter the direction of current in a portion of the motor. We are using two12V and 30RPM DC motors in this robot. DC motor speed can be varied across a large range by varying the supply voltage or current intensity.

Fig.5. DC Motor

D. Relay board: Relay boards are computer boards that contain a number of relays or switches. They aremeant to manage the voltage supply and have input and output terminals. Relay boards allow independently programmable, real time control of multiple onboard relay channels. It controls the voltage supply from power supply board to DC motors. Here we used four switched board which are connected to two DC motors.

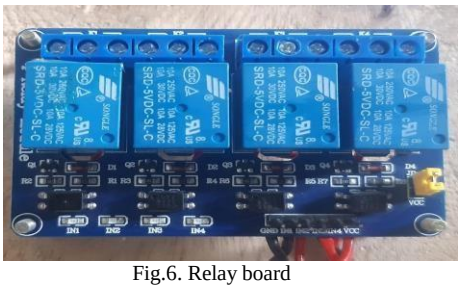


Fig.6. Relay board

E. Power supply board: This board is used to control supply of electrical power to the all other main components like Node MCU, ultrasonic sensors, relay board and buzzer. The power supply board has further components like Step down Transformer, Rectifier, Filter and regulator. The Step down Transformer is used to reduce the high AC main supply voltage to a lower amount. The Rectifier circuit is used to convert the alternating current voltage to the matching direct current voltage. By using this board we can avoid the damage of other components by high voltage supply.

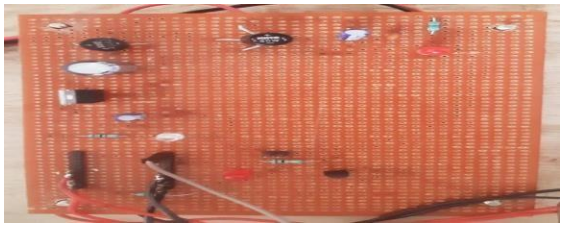


Fig.7. Power supply board

F. Wheels: In the robot, small cycle wheels with a diameter of 270 mm are used. The rim, hub, and spoke materials are all made of plastic. Plastic rubberis used to make the suitable tire. These wheels are strong enough to carry the robot. The robot's direction is controlled by two wheels in front two wheels in middle and two in back. The wheels will bepowered by a gearbox DC motor. They are linked to the DC motor through shafts, ball bearings, and a flange connection.

Fig.8. Wheel

G. Node MCU Development board: The ESP8266 Wi-Fi chip is included in the Node MCU Development Board. The ESP8266 chip includes GPIO pins, serial connection protocol, and other capabilities. ESP8266 is a low-cost Wi-Fi chip. The ESP8266 features are retrieved using the Node MCU Development board. Node MCU with Development board that includes ESP8266 chip integrates Node MCU Development board, allowing it to function as a stand-alone device in IoT applications.

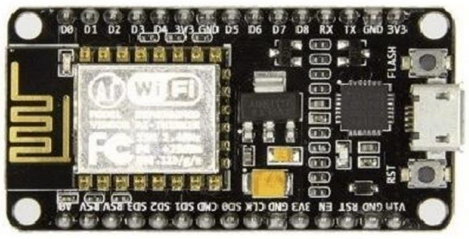


Fig.9. Node MCU Development board

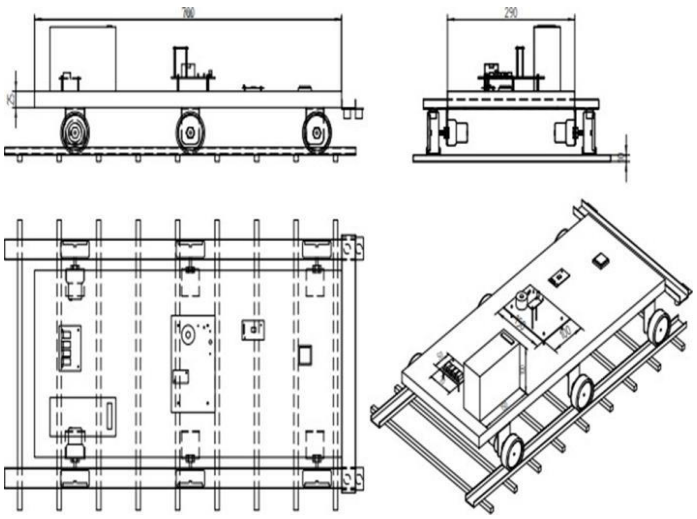
H. Track: The track is made with wooden bars and long plastic half square sheets. Wooden bars are used as sleepers and plastic sheets are used for rails on both side of track. We used two tracks of length 820mm and width 330mm for experimental purpose.square sheets. Wooden bars are used as sleepers and plastic sheets are used for rails on both side of track. We used two tracks of length 820mm and width 330mm for experimental purpose.

Fig.10. Track

III. EXPERIMENTAL PROCEDURE

After the complete arrangement of robot setup, the robot is placed on the track along with rechargeable battery. The battery is connected to the power supply board which supplies power to the all other components of arrangement. The Node MCU board is connected to the Wi-Fi. The operator use the blynk application to operate the robot, in the application there is on and off options are provide which controls the movements of the robot on the track. Using this application operator can get red alert and location of the robot. When the operator click on the on option the robot moves on the track in forward direction and operator can stop the robot at any stage using off option. Otherwise the robot moves continuously on the track. When the crack or discontinuity detected by robot it stops automatically because the sensors will sense then send the signals to NodeMCU. The power supply will stop to the relay board hence motors will stops then immediately red alert is shown on the applications. The alarm beeps which are carried along with robot can alert labors if they worked aroundthat area otherwise the location of robot can also see on the application by using GPS module. The control room section can access the railway track's fracture detection information. Cloud services allow information to be accessed fromanywhere. The project's goal is to create an automatic railway track crack detecting vehicle using a Node MCU, Sensors assembly system that identifies fractures along its path. Ifthere is a break in the track, this device quickly sends a signal to the control room and prevents the train from proceeding. This system is built with the Node MCU. Distance Sensor is used to sense crack or discontinuity on railway tracks.

IV. 3D MODEL



V. RESULTS AND OUTCOMES

a. By this project gives an idea how IOT can be applied in the railways sector.
b. Using this mechanism the accident can be prevented due to fast detection of track discontinuity in therailway tracks.
c. This mechanism reduces the usage of man power.
d. More accuracy in the detection of cracks in tracks.
e. Less time consuming and more effective than manualchecking of tracks.
f. This mechanism saves the property damages for the train and also saves the human by preventing accidents.

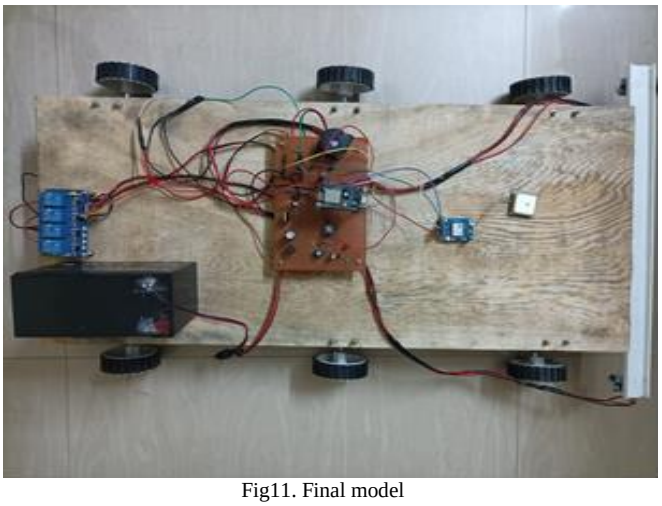


Fig11. Final model

VI. CONCLUSION

We conclude that railway track discontinuity detection robot helps to overcome from the track discontinuity by detecting cracks in the track. By using this mechanism we can reduce the labor cost for the checking of cracks in railway tracks.This robot can be controlled in the control room by using Blynk application. This mechanism is demonstration how the IOT can be applied in the railways department. Apart from this it does not requires any power while working the proper data will be collected using the sensors and Node MCU board for the data collection. This is a cost effective robot and it is one time investing model. The maintenance cost is low as compare to man power it all need is rechargeable battery. Self-recharging can also be done by designing the solar panels in the top of the robot. It is more importantly it requires less time for this process. More importantly it reduces the accident by detecting the cracks in early. This mechanism can beimplemented in the future days which is more effective in the railway department.

REFERENCES

[1] MrShridhar Doddmani, "An Inspection System for Detection of Cracks on the Railway Track using a Mobile Robot" International Journal of Engineering Research & Technology (IJERT) ISSN: 2278- 0181 Vol. 4 Issue 05, May-2015
[2] An Enhanced crack detection system for railway track, V.Muralidharan, V.Dinesh, P.Manikandan, IJETT, Volume 2, number 06, March 2015
[3] A model for the ultrasonic detection of surface-breaking Cracks by the Scanning Laser-Source technique,Irene Ariasa andJan D. Achenbach,Graduate Aeronautical Laboratories, California Institute of Technology, California
[4] Narate Vongserewattana, Wara Suwansin, Pattarapong Haruki, Punnavich Phatsornsiri "Validation of Acoustic Emission Railway Track Crack Analysis Using MFCC",2019
[5] Automatic Broken Track Detection Using LED-LDR Assembly, Avinash Vanimireddy,D Aruna Kumari,M Tech,ECM Department,KL University,India