

RAILWAY TRACK INSPECTION SYSTEM

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Abstract---The Railways is the most common mode of public transport preferred for long distance travel. However, rail tracks have a tendency to develop various defects including cracks, loose packing etc., which can cause accidents. Most railway accidents happen due to cracks developed within the railway track, which causes the train to derail. To minimize these accidents, we developed a security vehicle, which consists of a microcontroller connected to IoT module, motor, LCD, and IR sensor that moves along the railway track employing a set of wheels rotated by the DC motor. If the controller perceives a split, it instantly gets the situation and sends it to the station using the IoT module. This method is employed to means the crack location and avoids major accident.

Keywords —IoT, Railways, Track, Crack, IR, Accidents, Derailment

I. INTRODUCTION

The Indian Railways has one of the world's biggest rail line networks, containing a track length over a course of 67,312 Km spreading to practically all the zones of the country. Be that as it may, concerning dependability and traveller security. There are areas where upgrades can be made and modern techniques can be implemented to diminish the plausibility of mishaps occurring on the track. Among different components, cracks created on the railway track is the reason for mishaps in a portion of the cases. Because of the nonattendance, timely detection of the crack leads to potential loss of life and damage to public property which reduces the trust in the security of rail transport. A new report uncovered that more than 25% of the track length needs substitution because of the advancement of cracks on it.



Fig. 1 Cracks on railway track

II. RELATED WORK

A. Autonomous Railway Track Inspection System

The main objective of the model is to detect the location of the crack and send the location data to the railway board. This module consists of an Arduino microcontroller, DC motors, LCD, IR sensor and Wi-Fi module. The IR sensor emits IR radiation and the controller observes the voltage received from the IR sensor and whenever a crack is detected, the voltage to the microcontroller falls below the threshold value which triggers the further process. The DC motors are connected to the microcontroller through a relay and a relay driver circuit to ensure that the motor is maintained at the correct speed. The LCD is used to indicate the current condition of the module. The main advantage of the module is that it is efficient, low cost and it reduces human interference.

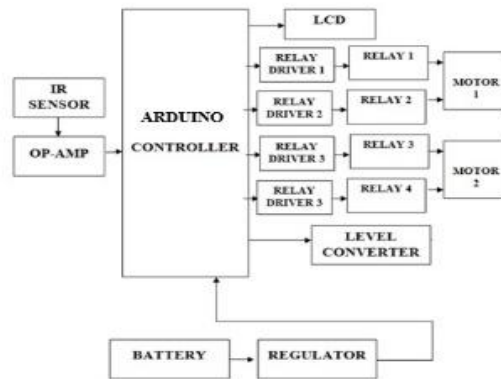


Fig. 2 Block diagram

Table 1

| S. No | Year | No. of accidents due to cracks | Percentage of accidents due to cracks |
|-------|------|--------------------------------|---------------------------------------|
| 1 | 2014 | 3 | 50 |
| 2 | 2015 | 3 | 90 |
| 3 | 2016 | 6 | 75 |
| 4 | 2017 | 6 | 60 |
| 5 | 2018 | 0 | 0 |
| 6 | 2019 | 3 | 60 |
| 7 | 2020 | 2 | 100 |

B. Arduino Controller

Arduino is a microcontroller intended to make the application more open which can interact with sensors and its surroundings. It is an open-source equipment board implemented around an 8-bit Atmel AVR microcontroller or a 32-bit Atmel ARM. Current models comprise a USB interface, 6 analog input pins and 14 advanced I/O sticks that allows the user to connect different extensions. It contains 6 to 16 channel onboard A/D converter. The IR sensor, LCD, DC motors, Level converters and WiFi module are connected the analog and digital pins of Arduino microcontroller.

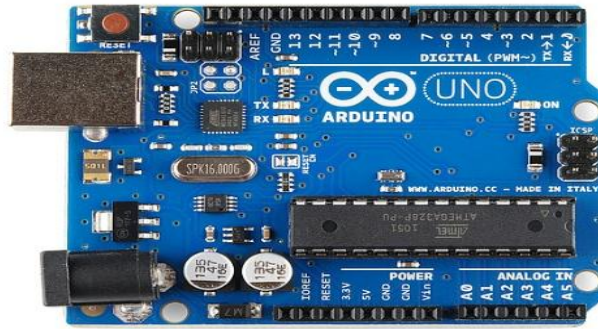


Fig. 3 Arduino microcontroller

C. IR sensor

The IR sensor is a combination of an IR transmitter and an IR receiver where the IR transmitter emits Infra-Red Radiation which is invisible to the naked eye. The emitted radiation bounces off the nearby surface which is received by the IR receiver. The IR sensor is connected to Arduino through an op-amp to reduce the noise in the analog signal. Voltage remains constant whenever the transmitted IR radiation is collected by the receiver. Once, the IR sensor passes the crack on the railway track, the voltage drops below the threshold value which initiates the further process.



Fig. 4 IR sensor

D. Wi-Fi

The ESP8266 Wi-Fi Module is an independent SOC with an integrated TCP/IP stack that can give any

microcontroller admittance to your Wi-Fi network. All the ESP8266 modules are pre-programmed with AT command set firmware which can be used to easily connect to any microcontroller. When the crack is detected the microcontroller sends the location data to the Wi-Fi module which transfers the data through a secure gateway to the application page. The main advantage of the Wi-Fi module is its data transmission speed. The Wi-Fi module is the hardware which helps with remote management of the device.



Fig. 5 Wi-Fi module

E. MAX232

IC MAX232 is used to convert TTL/CMOS logic to RS232 logic. Most of the microcontrollers such as PIC/ATMEL/ARM uses TTL/CMOS logic which operates through 0 or +5v but the computers work on RS232 logic which operates on -12v to +12v or -24v to +24v logic level. Thus, to interface the microcontroller with the computer we need to convert TTL/CMOS logic to RS232 using IC MAX232. Pin (0) and pin (1) are Rx and Tx pins of the Arduino microcontroller which is connected to MAX232. These two pins ought to be associated with the T1 in (pin 10) and the R1 out (pin 13) pin separately. Thus, RS232 logic signals can be obtained from pins R1 in and T1 out of MAX232.

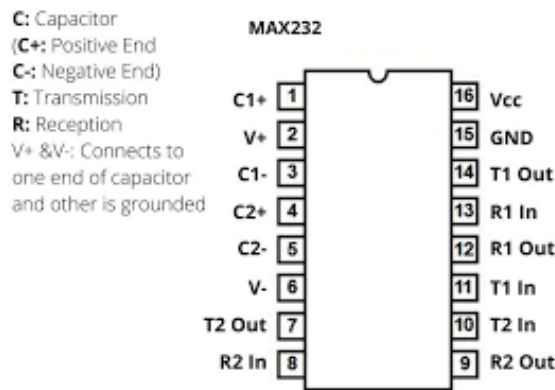


Fig. 6 MAX232 IC

F. DC motor

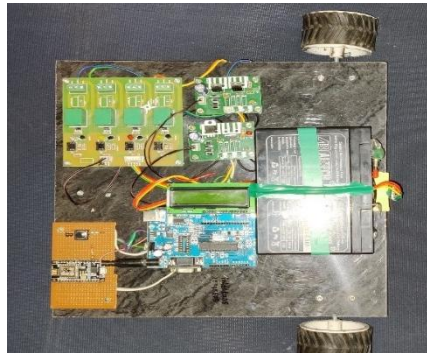
A direct current (DC) motor is an electrical machine that converts electrical energy into mechanical energy. DC motors take direct current and convert this energy into mechanical rotation which can be used for the movement of robots. The DC motor is connected to the wheels of the robot and microcontroller through a relay and relay driver circuit for the microcontroller to control the speed of the motor. A motor cannot be directly connected to a microcontroller so, a relay and driver circuit is used. Thus, the DC motor is used to provide movement of the robot.

G. Remote management

Remote management is 24/7 monitoring of sensors and gathering data for future use. The data sent from the hardware module of the railway track inspection system is stored in the cloud and the stored data can be accessed by a gateway that can be accessed only by the railway board. This data can be used for finding the location of the crack and the issue can be resolved.

III. RESULTS

The voltage drop from the IR sensor indicates the crack and the microcontroller process the data which



is sent to the IoT platform that can be accessed by the railway board.

Fig. 7 Experimental setup

Fig. 8 Normal mode



Fig. 9 Module when crack is detected

IV. CONCLSUION

Thus, IR sensor and Arduino are used to detect the crack. When the crack is detected the LCD displays the current condition of the module. Moreover, the previous crack and location data can be accessed by remote management of the sensors using webserver and cloud data centre.

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