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Experimental Study of Railway Track Crack Detection Using Arduino

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Abstract - *Railway transportation in Indian service is the most economical and convenient media of passenger transport for long distance and as well for suburban traffic. More than 80% of the transport used in India by railway network. The main reason for most of the accidents taking place in railways, most of time is due to public crossing the railway track and unnoticed damage or crack in rail tracks. More than 60% accidents taking place at railway track are due to unidentified crack in the track of rail resulting in loss of precious life of travelers and damages caused. From the present study, there is a demand to have other alternate solution in which, technology is more efficient, robust and also stable for finding the crack in track as well as for object detection. In the present design, we are trying to search for a familiar technology which helps at designing and developing new modernized railway crack detection scheme (RCDS) using which IR SENSOR with other assembly parts helps to find and detect cracks and prevent the train accidents by easily finding the cracks and other obstacles on the ways of railway tracks. An Arduino based Microcontroller is a technology which we are focusing to control and coordinate the cracks on the track which will save several trains in India from accidents and other types of incidents from the rail track.*

Key Words: **Motor, Arduino, IR Sensor, RoboBot, Wheels**

1. INTRODUCTION

In India, the track length of railway network is 113,617 kilometers (70,598 mi) and a route of 63,974 kilometers (39,752 mi) over 7,083 stations which is the fourth largest network of the entire railway network in the world. In India, Rail transport is growing at a faster rate. It is one of the major modes of transport but still our facilities is not that accurate, safer as compared to international standards?. A survey on the browser, states that around 60% of all the accidents in railways are due to derailments. Recent measurements shows that about 90% of accidents are due to railway cracks

Hence, it is not safer for Human Life which needs to be overlooked with utmost attention. The proposed system has a robot which will run automatically on the tracks. As there is fast development taking place in Indian Railways, high-speed trains are increased and rail transportation has become a day to day need. Most of the people make use of railway for moving from one place to another, it is necessary for transferring the passengers and goods from one place to another. And also, the railway system is providing facility such as high speed, with economical, environment friendly, safety, and better characteristics of railway systems. These nature and characteristics can be overdriven by time-to-time maintenance and control system measurements. But depending on different factors, deformations and derailment may occur on the superstructure of railways. The derailments and some of the other problems of railway system such as improper maintenance, irregular and manual track line monitoring mistake from workers. Such derailment and deformation are determining very offenly and hence forth taking precautions is very much important for the preventive and safety of railway systems. Therefore, solution for this problem is adopted in the present work.

2. OBJECTIVES:

In India, railways are one of the widely used and busiest network in the world which is nearly covering track network of 1, 27,000 sq.km. More than 2/3rd of the Indian population uses the railway network for fulfilling their daily work. Around 60% of the train accidents are occurring due to the railway track crossing and which results in the crack of railway tracks causing loss of precious life and loss of economy. The very purpose and objective of the present system is to detect the tracks and avoid the future incidents like accidents. The defect in crack can be found out easily and the preventive measures will be taken immediately. The proposed system not only replaces the human inspection but also is beneficial in terms of time and money , makes the inspection very much easier and accurate. Basically, the workings of the present system start with motor initiation. Firstly, the motor of the system starts, which sends the signal and actuates the ultrasonic sensor. Ultrasonic/IR sensor is used to detect the cracks in the track. Hence, the operation of the motor is to drive the vehicle forward. IR sensor does the operation such as scanning and finding the large cracks and obstacles on the track, such that when the crack is detected, it will stop moving the vehicle.

2. Components and specifications:

2.1 Arduino Uno

Arduino system is an open- source easily accessible programmable circuit board which is based on easy-to-use hardware as well as software. Figure 1 is an Arduino-uno.It is centered on ATmega328. Arduino Uno has 14 digital input/output pins, 6 analog inputs pins with also USB connection, a power jack with ICSP header and a reset button.

The power required to run the Arduino Board can be supplied through making a connection to laptop using a USB cable or hooking an ACDC power supply.

Fig -1: Arduino Uno

2.2 Light-emitting diode (LED):

A light-emitting diode (LED) is a bulb and a semiconductor device which emits light when current is passed through it. The working principle behind this is, Electrons in the diode of semiconductor recombine with holes of electrons and release energy which is in the form of photons. The color emitted by these lights which is related to the packets of energy, photons found by the energy which is required for electrons to jump the gap of band system of the semiconductor.

Fig -2: LED Bulb

2.3 Buzzer:

An audio sound signaling device like a buzzer or beep ,is an electromechanical device or piezoelectric device or mechanical type of device. The important function of this is to convert the signal from arduino to sound. Usually, the buzzer is on through DC voltage which will be used in alarm devices, timers, computers, printers etc. Based on the various types of designs, it can be used to generate different sounds like siren, bell, alarm and music.

Fig -3: Buzzer

2.4 Johnson Geared DC Motor Grade-B:

300 RPM with 12V Johnson Geared DC Motor of Grade-B is a simple DC motor having a featuring metal gearbox for rotating and driving the shaft of the motor, so that it is a mechanically combined electric motor powered from DC supply. The uniquenes of The Johnson Geared Motors is compact size with massive torque and speed characteristic. Johnson Motors are having side shaft which are also known as off-centered shaft and is having six M3 mounting holes. The shaft is equipped with metal bushes and it makes these DC gear motors as Shaft wear resistant. The shaft is having a hole for better moving and coupling. It is one of the best motor between DC Geared Motor and Side shaft Motors at the economical cost. The geared DC motor which is commonly used ,will run smoothly and uniformly in the approximate average voltage range 6 to 18 V DC and shaft rotates 300 RPM at 12V supply which also provides the torque of 2.5 kg-cm at an RPM of around 300.

Fig -4: DC Motor

2.5 IR sensors:

Infrared sensors are a type of motion sensors which use infrared radiations. The importance of this device is within physical security and also in particular is used for intrusion detection. Usually 2 main types of sensors which are used in the design are active infrared sensors and other passive infrared sensors in which passive sensor is being preferred in the scenario of physical security.

The functioning of the IR Sensor depends on the, sensor is active or passive (PIR).

Active infrared sensors are used to work with radar technology which emits and receive infrared radiation .the radiation hits the objects moving in front or nearby and returns back to the receiver of the sensor. This technology not only detects movement in the surroundings and environment but also helps to find how far the object is present from the device. This is most commonly useful in robotics to find proximity.

Fig -5: IR Sensor

2.6 Jumper Wires:

Jump wires are small metal connectors used to close or open a circuit. Jumpers have two or more connection points to regulate the power of electrical circuit board. The main function of jumpers is to configure or change the settings for computer peripherals, such as the motherboard. Suppose your motherboard supported intrusion detection. A jump wires can be used to enable or disable it. jumper wires are used to modify a circuit or find any problems in a circuit. They are also best used to bypass some part in the circuit which does not contain a resistor and is not required which includes a stretch of wire or a switch.

Fig -6: Jump Wires

3. Methodology:

The block diagram below shows "Railway track crack detection using IR sensor" .There are one set of IR sensor units fitted to the front sides of the vehicle.

IR transmitter and IR receiver circuit which is used to detect the cracks. It is usually fixed to the front sides of any vehicle or other instruments with a suitable arrangement.

At the time when vehicle is powered to drive, the vehicle tries to move in the model track. The Infrared sensors which are fixed in the front of the vehicle monitor the tracks for its damages.

When the power supply is given to the microcontroller, then it starts the motor in forward direction and serial transmission is used to send the messages to the microcontroller.

At Normal Condition

- The Infrared Ray sensor is transmitting the infrared rays. When any crack is found infrared rays are sent back by the IR receiver sensor.
- The Transistors are sent as an amplifier section. At normal condition Transistor is OFF condition. At that time relay is OFF, so that the vehicle running continuously.

At Crack Condition:

- As and when the crack is found by IR Sensor, the resistance change is high across the Transmitter and receiver because of the IR waves.
- When the track is not having any cracks then , output voltage of IR LED and Photodiode will be very high

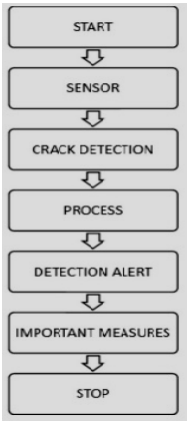

Fig -7: Flow Chart

- As and when the crack is detected by the system, the TSOP sensor reflection which will be almost equal to zero and the vehicle will stop automatically.
- Another TSOP sensor used in the vehicle is used to monitor the pit falls on the way of the railway track. When the output of the signal is high, then it is concluded that there is no pitfalls in the track. But if any pit(crack) is found by the sensor the output will send the sensor a signal given to the microcontroller which will be zero and again the Arduino microcontroller will stop the bot.But When a crack is found by the IR sensor the Robot stops.

4. Working

Figure 6 shows the pictorial diagram of "Railway track crack detection". The system consists of Arduino Uno, Buzzer , IR sensors, and DC Motor. The microcontroller Arduino Uno, acts as the brain of the system. The main work of the microcontroller is to control the circuit function. Various components are interfaced with this microcontroller. The component of hardware used in this bot requires regulated and uniform power supply for the operation. This power is provided by their chargeable battery connected in the system. In this present design, we have used 2 IR sensors with the Arduino Uno microcontroller for the distance, as

wel as to find and detect the cracks and obstacle which is present in the route of the track of the railway line. Most commonly 2 DC motors are used to move the bot in forward direction.

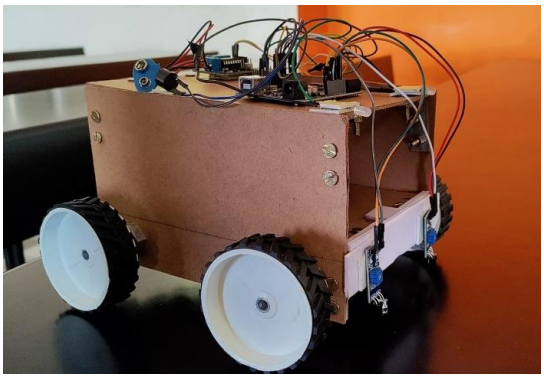

Fig -6: Railway Track crack detection Bot

Initially in the beginning, tracks are being continuously monitored or visualized with the help of sensor that is used to find the cracks on the track.

This monitoring is done by the help of Infrared ray sensor in order to detect the minor changes which can also be quite difficult to find with other sensors.

At the time when the crack is found by using IR sensor, an alert sound of crack found is signaled to the Arduino microcontroller.

The microcontroller will perform the necessary process assigned to Arduino accordingly. The process mainly includes alerting through the help of Buzzers module.

As message gets delivered to the Engine cabin, the alert is to be taken into account and important measures must be taken by them in order to avoid future incidents such as accidents and miss happenings which can lead to loss of innocent people such that we can stop major injuries.

5. CONCLUSIONS

As per the over view of the study, present systems are time consuming as well as time consuming and uneconomical. The first and foremost use of the proposed system is not only to solve the existing problems, but also can be used to improve the crack detection and accuracy in rails. It is the most feasible solution provided to achieve good results of train system of our country to minimize the number of accidents caused. So that it is possible to save precious lives of passengers and to minimize the damages. It provides security and saves the time and money by early identification of the crack. The “Railway Track Crack Detection” is used to identify the crack that is present on the track using IR Sensor. IR Sensor will checks either the crack is present or not and it will send the message which is displayed on LCD monitor. So, this proposed system reduces the railway accidents and saves the people life and also reduces the economical losses.

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