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Railway track fault detection system

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Abstract: The main objective of this project is to design and develop an automatic rail crack detection system to identify any crack or deformation on the railway track based on electromagnetic induction technology using eddy current probe. When the vehicle is powered ON, it moves along the model track. The eddy current probe monitors the condition of the tracks and IR sensor is used to detect the obstacle if present. When the crack or the obstacle is detected by the respective sensor the vehicle stops and the GPS receiver triangulates the position of the vehicle to receive the Latitude and Longitude coordinates of the vehicle position from satellites. The Latitude and longitude coordinates fetched by GPS are sent to control room with the help of Wi-Fi Module. The complete setup is powered by battery.

Keywords: Eddy current probe, Ardiuno-uno, Wifi Module.

I. INTRODUCTION

In April, Indian Railways celebrated a hundred sixty-five years since its initial rider trains went into service within the country. As Indian Railways (IR) celebrates the one hundred and sixty fifth day of its initial rider service, we have a tendency to take a glance back at a number of its major highlights and chart its course to changing into one amongst the foremost prestigious rail suppliers within the world. Major reason for train accidents in Asian Country Accidents involving trains are usually the results of mechanical failures and human error, and sometimes it is a combination of each. There are a range of different reasons that these railroad accidents occur, and a few of those include Train derailment. Improper maintenance of the train tracks. A derailment occurs once a train runs off its rails. This doesn't not essentially mean that it leaves its track. Though several derailments are minor, all end in temporary disruption of the right operation of the line, and that they are doubtless seriously dangerous to human health and safety. Usually, the mishap of a train may be caused by a collision with another object, associate degree operational error, the mechanical failure of tracks, like broken rails, or the mechanical failure of the wheels.

II. PROPOSED METHOD

The major cause of derailment of the train is the broken track. And before understanding the methodology of this proposed method, let's recall how this track gets break. Firstly, minute thread like crack occurs and (these cracks are not dangerous at the beginning) when these cracks are subjected to continuous mechanical stress which might be due to the heavy weight of the wagon gets enlarged and result into metal fatigue or the broken track. This project focuses on alerting the system at a point where the breaking up of track has just begun i.e. the point where the cracks has just emerged so that track can be replaced which will reduce the derailments in our country. The model proposed uses 2 bots namely Robo-1 (the front robot) and Robo-2 (the rear robot).

Robo-1 comprises of Eddy current probe, Arduino-Uno, Wi-Fi module, buzzer, 3 battery of 4V each, 4 DC Motor.

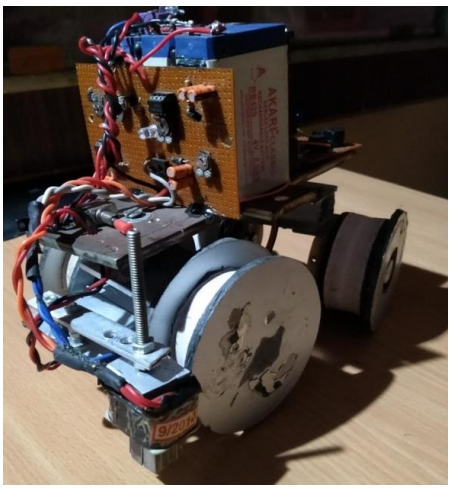

Figure 1. Robo 1

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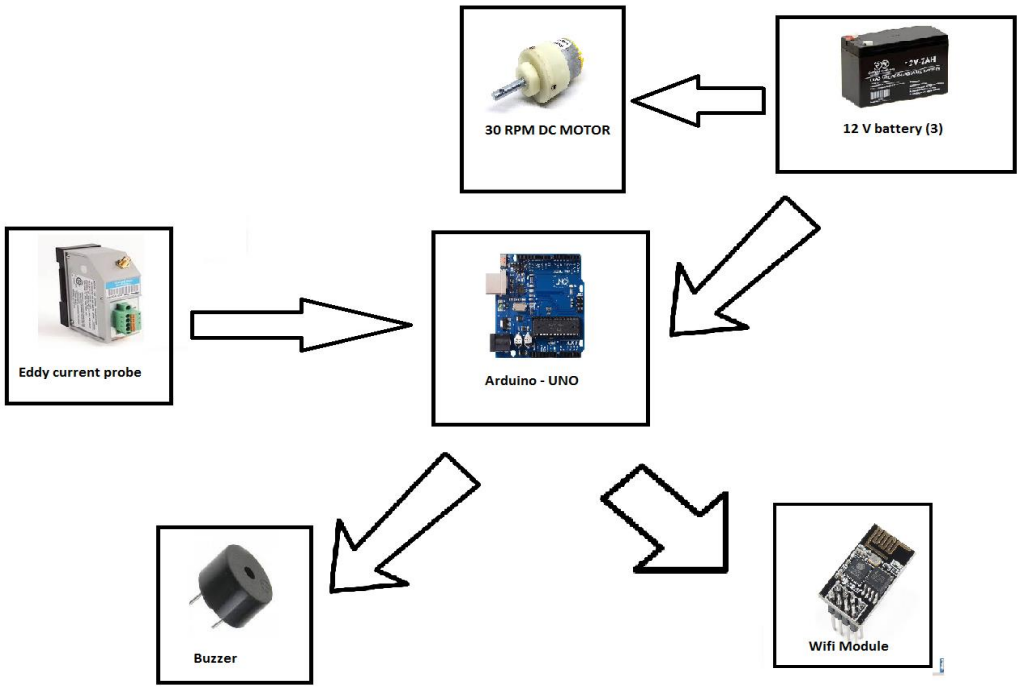

Figure 2 Block diagram of Robo-1

Robo-2comprises of Relay Arduino-Uno, Wi-Fi module, buzzer, 3 batteries of 4V each, 4 DC Motor.

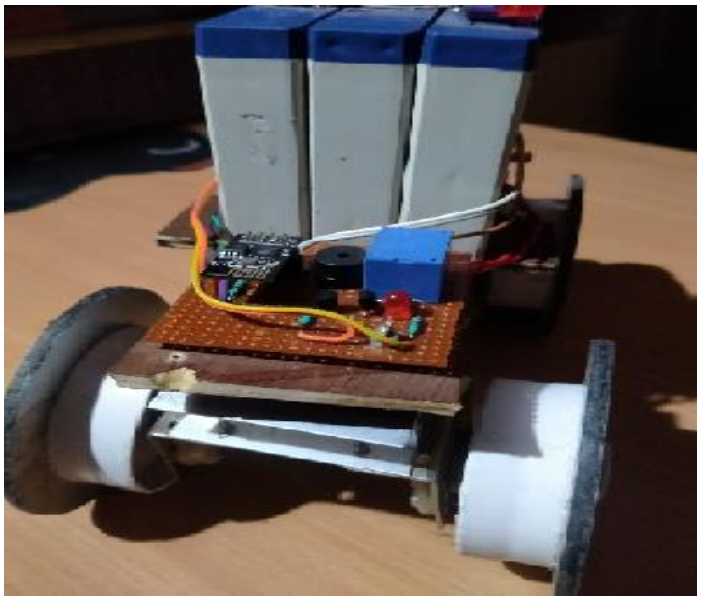

Figure 3 Robo-2

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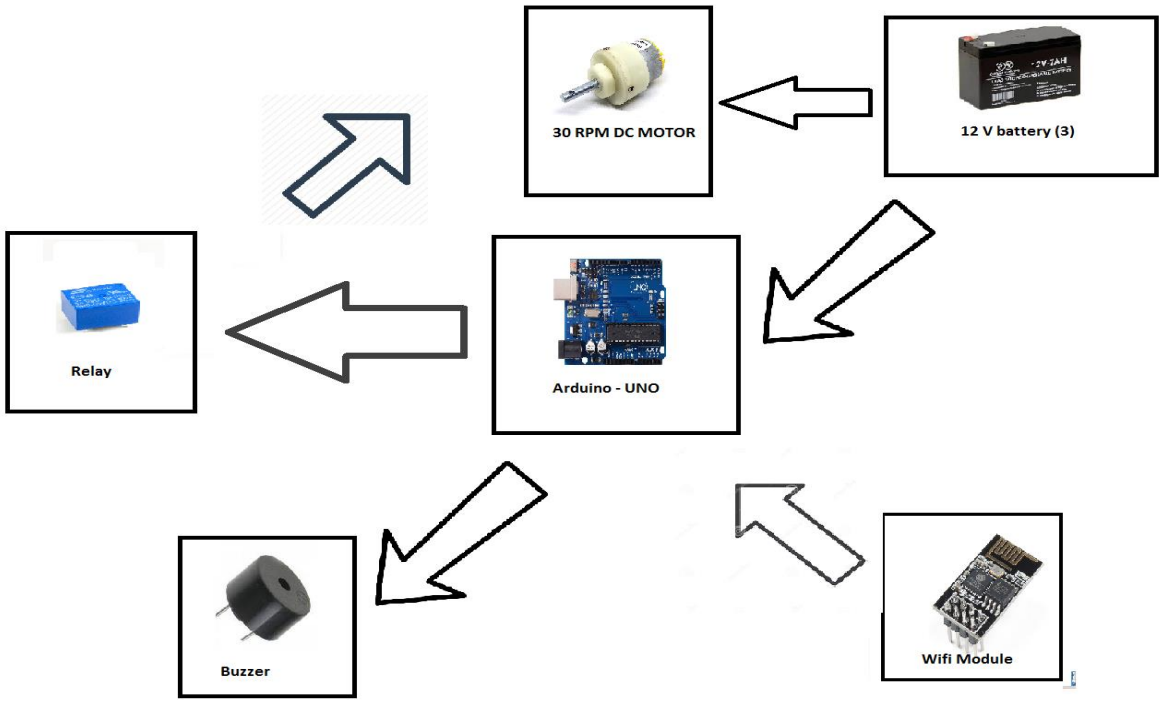

The following image gives a clear idea of the Robo-2.

Figure 2 Block diagram of Robo-2`

As the Robo-1 start moving the eddy current probe induces eddy current in the track and probe records the amount of current in terms of magnetic field and then send it to microcontroller Arduino-Uno. Arduino-Uno is given a preset value = 400 and counter is for 12 micro-seconds and if the value goes beyond that Arduino detects the fault and send a signal to Wi-Fi-module and turn on the buzzer. Wi-Fi-module will update on IOT panel that the fault is detected. The Wi-Fi on Robo-2 will receive the signal from IOT panel about the upcoming fault, Wi-Fi module will send the signal to Arduino-Uno and Uno sends signal to relay to stop the Robo-2 immediately so that it cannot reach the faulty location.

III. COMPONENTS USED

1. EDDY CURRENT PROBE

Eddy current sensors are primarily used for displacement and position measurement of electrically conductive targets. They are generally used for measuring ferromagnetic and non-ferromagnetic materials. They are suitable for applications in harsh industrial environments due to their superior tolerance for oil, dirt, dust, moisture and magnetic interference fields.
Eddy current sensor operates based on the inductive eddy-current principle. It measures the distance based on the extraction of energy from an oscillating circuit, which is required to generate eddy current in an electrically-conductive material.

When the sensing coil is supplied with an alternating current, it causes a magnetic field to form around the coil. If an electrically conducting material is placed in this field, eddy current field is induced according to the Faraday's induction law. When the object moves, it causes the change in the impedance of the coil, which is proportional to the change in the distance between the sensor and the target.

2. WIFI MODULE

ESP8266 is Wi-Fi enabled system on chip (SoC) module developed by Espressif system. It is mostly used for development of IoT (Internet of Things) embedded applications.

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It employs a 32-bit RISC CPU based on the TensilicaXtensa L106 running at 80 MHz (or overclocked to 160 MHz). It has a 64 KB boot ROM, 64 KB instruction RAM and 96 KB data RAM. External flash memory can be accessed through SPI. The silicon chip itself is housed within a 5 mm × 5 mm Quad Flat No-Leads package with 33 connection pads — 8 pads along each side and one large thermal/ground pad in the center. **ESP8285** is a variation of ESP8266 with 1 MiB of embedded flash memory.

ESP8266 module is low cost standalone wireless transceiver that can be used for end-point IoT developments.

To communicate with the ESP8266 module, microcontroller needs to use set of AT commands. Microcontroller communicates with ESP8266-01 module using UART having specified Baud rate.

3. MICROCONTROLLER

Arduino is an open-source hardware and software company, project and user community that designs and manufactures single-board microcontrollers and microcontroller kits for building digital devices and interactive objects that can sense and control both physically and digitally.Arduino Uno is a microcontroller board developed by Arduino.cc which is an open-source electronics platform mainly based on AVR microcontroller Atmega328.First Arduino project was started in Interaction Design Institute Ivrea in 2003 by David Cuartielles and Massimo Banzi with the intention of providing a cheap and flexible way to students and professional for controlling a number of devices in the real world.The current version of Arduino Uno comes with USB interface, 6 analog input pins, 14 I/O digital ports that are used to connect with external electronic circuits. Out of 14 I/O ports, 6 pins can be used for PWM output.It allows the designers to control and sense the external electronic devices in the real world.

IV. CONCLUSION

By using this Autonomous vehicle for purpose of railway track inspection and crack detection, it will have a great impact in the maintenance of the tracks which will help in preventing train accidents to a very large extent. The regions where manual inspection is not possible, like in deep coal mines, mountain regions and dense thick forest regions can be easily done using this vehicle By using this vehicle for the purpose of Railway track inspection and crack detection and automated SMS will be sent to pre-defined phone number whenever the vehicle sensors detect any crack or deformation This will help in maintenance and monitoring the condition of railway tracks without any errors and thereby maintaining the tracks in good condition, preventing train accidents to very large extent Railway track crack detection autonomous vehicle is designed in such a way that it detects the cracks or deformities on the track which when rectified in time will reduce train accidents. The addition of solar panel is an added advantage, which also helps conserving the power resource.This chapter compares the propose method with the existing methods and tells why this proposed method is bettter than the present method.Method used in our model is far cheaper than each and every existing models that are being used today. Since our model is fitted on each and every track it covers large area in comparison to existing models. This device reduces man power and save life of gang man. Its accuracy is high cause its provide information at running time continuously also it saves money.

V. REFERENCES

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