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RAILWAY TRACK CRACK DETECTION & OBSTACLE DETECTION SYSTEM

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Abstract: The Indian Railways has one of the largest railway networks in the world, crises- crossing over 1,15,000 km in distance, all over India. However, with regard to reliability and passenger safety Indian Railways is not up to global standards. Among other factors, cracks developed on the rails due to absence of timely detection and the associated maintenance pose serious questions on the security of operation of rail transport. A recent study revealed that over 25% of the track length is in need of replacement due to the development of cracks on it. Manual detection of tracks is cumbersome and not fully effective owing to much time consumption and requirement of skilled technicians. This project work is aimed towards addressing the issue by developing an automatic railway track crack detection system.

This work introduces a project that aims in designing robust railway crack detection scheme (RCODS) using IR SENSOR assembly system which avoids the train accidents by detecting the cracks on railway tracks.And also capable of alerting the authorities in the form of SMS messages along with location by using GPS and WiFi modules. The system also includes distance measuring sensor which displays the track deviation distance between the railway tracks.

Keywords: Node MCU ESP8266, MotorDriverL239D, IR Sensor, GPS.

I. INTRODUCTION

Transport is a key necessity for specialization that allows production and consumption of products to occur at different locations. Transport has throughout history been a spur to expansion as better transport leads to more trade. Economic prosperity has always been dependent on increasing the capacity and rationality of transport. But the infrastructure and operation of transport has a great impact on the land and is the largest drainer of energy, making transport sustainability and safety a major issue. In India, we find that rail transport occupies a prominent position in providing the necessary transport infrastructure to sustain and quench the ever- burgeoning needs of a rapidly growing economy. Today, India possesses the fourth largest railway network in the world. However, in terms of the reliability and safety parameters, we have not yet reached truly global standards. The GPS (Global Positioning System), Wifi Module and microcontroller based broken railway track detection when implemented is an efficient method of detection of cracks which is present in the tracks and thus avoiding derailment of the trains. This system is used in-between two stations which will detect the cracks present on the track using IR sensors which transmit sine waves for an ideal track. If a crack is detected then this sensor will send a signal to the Arduino Uno board which will activate the GPS receiver. The GPS receiver will pin point the exact location which will then be messaged to the authorities. Once the sensor sends a signal to the controller, the controller will initiate the webcam. The webcam will provide the live feed of the track.The live feed and the data from the GPS will be updated in the designed application of the wireless camera. This smart technology will be a part of the brave new digitalized world which will be able to prevent the loss of precious life or property as the above mentioned cases

II. LITERATURE SURVEY

This system is mainly concerned in identifying the cracks in railway tracks and helps to prevent the accidents without manual power. It's not only concentrated on finding damaged tracks but also helpful to find out the derailment and the exact place where it is. In this technical solutions offered by many companies in the detection of cracks in rails involve periodic maintenance coupled with occasional monitoring usually once a month or in a similar time frame. But the robotics possesses the inherent advantage off a cilitating monitoring of rail tracks on a daily basis during nights, when the usual train traffic is suspended. Further, that the simplicity of this idea and easy availability of the components make for implementation on a large scale with very little initial investment. The simplicity of this work ensures

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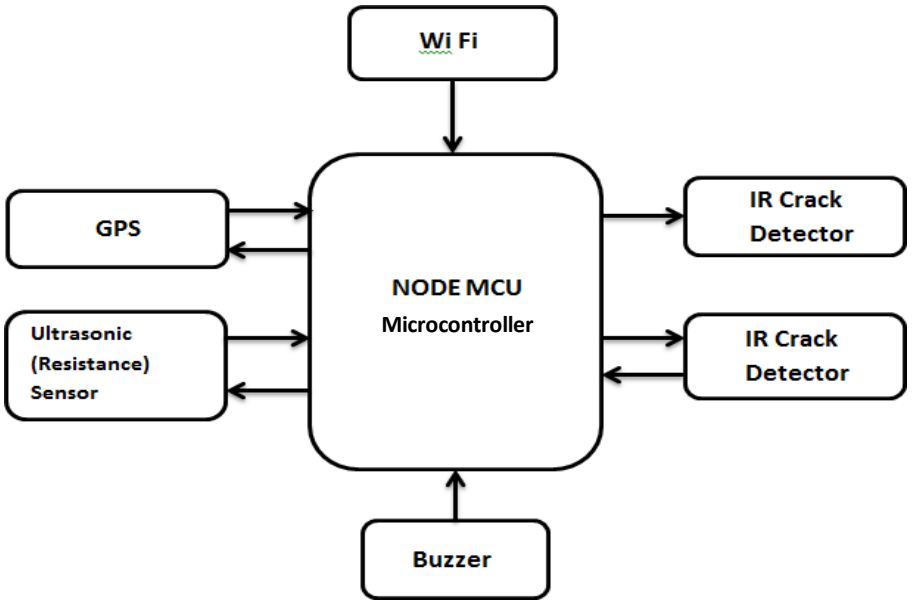
robustness of operation and also the design has been carefully modified to permit rugged operation. Another disadvantage that can be attributed to the conventional commercially available testing equipment's is that they are heavy which poses a practical limitation. This important disadvantage has been rectified in robotics project as the design is simple and sensible enabling the device to be easily portable. While designing the mechanical parts of the robot, due consideration has been given to the variable nature of the tracks and the unique challenges possessed by the deviations in the Indian scenario. For example, in areas near road crossings the outer part of the track is usually covered with cement. Also, there is always the problem of rocks obstructing the path on the inside parts of the rails. So the specialized wheels that have been provided in robot that has taken into account and are

Block diagram



1. Node MCU (ESP8266)-Node MCU is a low-cost open source IoT platform. Itinitially included firm ware which runs on theESP8266Wi-FiSoCfrom Es press if Systems, and hardware which was based on the Wifi module. Later, support for theESP3232-bit MCU was added. Node MCU is an open source firmware for which open source prototyping board designs are available. The name "Node MCU" combines "node" and "MCU" (micro-controller unit). The term "Node MCU" strictly speaking refers to the firmware rather than the associated development kits.

2. Ultrasonic Sensor (HC SR04)- Ultrasonic sensors are devices that generate or sense ultrasound energy. They can be divided in to three broad categories: transmitters, receivers and transceivers. Transmitters convert electrical signals in to ultra sound, receivers convert ultrasound into electrical signals, and transceivers can both transmit and receive ultrasound.

3. DC Motor- A DC motor is any of a class of rotary electrical motors that converts direct current electrical energy into mechanical energy. The most common types rely on the forces produced by magnetic fields. Nearly all types of DC motors have some internal mechanism, either electromechanical or electronic, to periodically change the direction of current in part of the motor. DC motors were the first form of motor widely used, as they could be powered from existing direct-current lighting power distribution systems. A DC motor's speed can be controlled over a wide range, using either a variable supply voltage or by changing the strength of current in its field windings

4. IRSENSOR-An infrared sensor circuits one of the basic and popular sensor modules in an electronic device. This sensor is analogous to human's visionary senses, which can be used to detect obstacles and it is one of the common applications in real time. This circuit comprises of the following components

- LM358IC2IRtransmitterandreceiverpair
- Resistors of the range of kilo ohms.
- Variable resistors.
- LED (Light Emitting Diode).

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5. Battery- The nine-volt battery format is commonly available in primary carbon-zinc and alkaline chemistry, in primary lithium iron disulfide, and in rechargeable form in nickel-cadmium, nickel-metal hydride andlithium-ion. Mercury-oxide batteries of this format, once common, have not been manufactured in many years due to their mercury content.

6. GPS Module- AGPS tracking unit, geo tracking unit, or simply tracker is a navigation device normally on a vehicle, asset, person or animal that uses the Global Positioning System (GPS) to determine its movement and determine its WGS84 UTM geographic position(geo tracking) to determine its location. GPS tracking devices send special satellite signals that are processed by a receiver. Locations are stored in the tracking unit or transmitted to an Internet-connected device using the cellular network (SMS), radio, or satellite modem embedded in the unit or WiFi work worldwide.

7. Motor Driver (L239D)- Motor drive means a system that includes a motor. An adjustable speed motor drive means a system that includes a motor that has multiple operating speeds. A variable speed motor drive is a system that includes a motor and is continuously variable in speed. If the motor is generating electrical energy rather than using it – this could be called a generator drive but is often still referred to as a motor drive. Sometimes this is confused with a Variable Frequency Drive(VFD) or Variable Speed Drive(VSD) which describes the electronic portion of the system that controls the speed of the motor. More generally,the term drive, describes equipment used to control the speed of machinery. Many industrial processes such as assembly lines must operate at different speeds for different products. Where process conditions demand adjustment of flow from a pump or fan, varying the speed of the drive may save energy compared with other techniques for flow control.

8. Buzzer-A buzzer or beeperis an audio signaling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

III. HARDWARE WORKING

In our project, there are two set of IR sensor units fitted to the two sides of the vehicle. This unit is used to activate/deactivate Node MCU transmitter unit when there is any cracks in the track. The IR transmitter and IR receiver circuit is used to sense the cracks. It is fixed to the front sides of the vehicle with a suitable arrangement. When the vehicle is Powered On, it moves along the model track. The IR sensors monitor the condition of the tracks. In normal condition the motor, LDR, Serial transmission is in initial stage. When the battery power supply supplies the microcontroller then its starting the motor in forward direction and serial transmission is used to send the messages to the microcontroller. When a crack is detected by the IR sensor the vehicle stops at once, 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 received by GPS are converted into a text message which is done by microcontroller. The Wifi module sends the text message to the predefined number with the help of SIM card that is inserted into the module.

At Normal Condition:
The IR transmitter sensor is transmitting the infrared rays. These infrared rays are received by the IR receiver sensor. The Transistors are used 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:
At crack detection conditions the IR transmitter and IR receiver, the resistance across the Transmitter and receiver is high due to the non-conductivity of the IR waves. When the track is in continuous with out any cracks then output of IR LED and Photodiode will be high. As soon as the crack detected by the system the IR sensor reflection will be equal to zero and the robot will be stopped automatically. Another IR sensor is used to monitor the pit on the way of the railway track. When this output is high then it is concluded that there is no pit in the track. But if any pit is detected by the sensor the output of the sensor given to the microcontroller will be zero and again the microcontroller will stop the robot. When a crack is detected by the IR sensor the vehicle stops atonce, 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 received by GPS are converted into a text message which is done by microcontroller.

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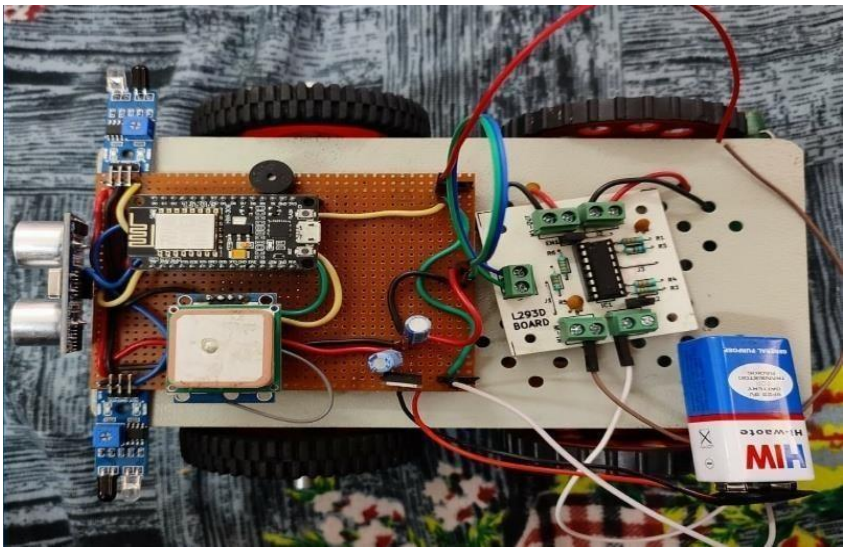
IV. HARDWARE DIAGRAM



V. CONCLUSION

The purpose of this Automatic Crack detection system is to provide a low cost, at the same time an accurate automated system to detect all kinds of the crack present in the railway track. Our automated robot was able to detect the outer cracks present on the track using an ultrasonic sensor, then it gets the exact location through the GPS module and is sent to a mobile phone as an SMS via a Wifi module. The data received is stored in a cloud database. This automated system can detect cracks developed on the outside as well as inside thereby avoiding derailment of trains which results in a huge number of fatalities every year. The uniqueness of our system is that it detects the outer surface crack as well as the inner surface cracks, making it a very accurate system to detect, monitor and maintain railway tracks. Implementation of this system in our Indian Railways will prove to be revolutionary and increase the safety of train movements.

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