

Study of Railway Track Crack Detection System

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Abstract: - Train accidents are not as common as road accidents. Indian Railway is the third-largest railway network in the world. This technology is robust, efficient, and stable for both crack and object detection in railway tracks. We have some problems with our railway track cracks. For example, the track contracts and expands due to changes in season. And the manual inspection and detection of cracks are very tedious processes. Rail surface defects such as abrasion, scratch, and peeling often cause damage to train wheels and bearings. Monitoring the inspection methods are visual inspection, ultrasonic inspection. The GSM and GPS (IR and Ultrasonic sensor) with microcontroller is used to identify the crack and objects on the rail track. The GPS pinpoints the location and GSM sends the message to the authorities and they alert the train driver and nearest station master about the problem. The importance of this paper is that it is applicable in detection during both day and night. We mainly focused on safety. This project makes the Indian Railway more Reliable.

Keywords— GPS, GSM, IR sensor, Microcontroller, Reliable, Ultrasonic Sensor.

I. INTRODUCTION

To provide real-time monitoring and structural conditions for railway track “vision-based”. The crack and other problems are generally ignored due to irregular maintenance and currently, uneven and hand-operated methods are being carried out. The system performs two main functions. The first one is detecting the crack on the railway track by using the IR sensor/TSOP sensor which transmits sine waves for the ideal tracks. And the second one is detecting the object by using an ultrasonic sensor.

When a crack is found then the sensor will give a message to the Arduino UNO that will stimulate the GPS. The GPS will give the related location. The Wi-Fi module is used to send these location coordinates in the form of a short message service (SMS). This system can be operated in tunnels without any interruptions. This is a very simple scheme and very economical method with sufficient potency to the world scenario to the geometry of the track survey by using sensors which proved to be advantageous as compared to existing methods.



Figure 1: Cracks in Railway Track.

II. LITERATURE REVIEW

The principal goal of the track crack detection and fitness tracking in base station among indicators any track are broken, reduce the track, and any fault manner sign is transmitted to sign engineer, due to the fact strength can be passing to track This method used best for base station. The railways infrastructure like wagons, rail tracks, bridges, gadget having tracking gadget that use wi-fi sensor. For enlargement and upgrading of railway this gadget is useful. They supply constant tracking for motionless structure. Author targeted on sensor era producing situation tracking facts to permit sensible situation and additionally the work to recognize current tracking the use of clever sensor.

This robotic consists of ultrasonic sensors, GPS, GSM modules, and Arduino Mega primarily based totally crack detection meeting that is value powerful and strong to facilitate higher protection requirements in railways. As quickly because the robotic exceeded via a crack that could reason the derailment of a educate, the ultrasonic sensors feel that and generate a signal. Then this sign is fed into the Arduino Mega. At that point, with the help of GSM and GPS modules, an alert SMS include the geographic coordinate of that broken track is dispatched to the close by railway authority who can effortlessly take vital steps to clear up the hassle earlier than any most important coincidence occurs. This will shop numerous trains from an undesirable discontinuity from the rail track. The proposed gadget may be networked with more than one robots and vital laptop gadget can manage these types of robots, in order that whole track may be scanned for detecting any

crack earlier than on every occasion educate passes via track.

III. PROBLEM IDENTIFICATION

The principal problem has been the shortage of cheap and efficient technology to detect problems within the rail tracks and of course, the shortage of proper maintenance of rails which have resulted within the formation of cracks within the rails and other similar problems caused by antisocial elements which jeopardize the security of operation of rail transport. Within the past, this problem has led to several derailments resulting in a major loss of life and property.

IV. METHODOLOGY

The system involves a model of a crack-finding robot for locating cracks in railway tracks. this system uses a controller for interfacing the robotic model and crack detection sensor. The sensing device senses the voltage variations from the crack sensor so it gives the signal to the microcontroller. The microcontroller checks the voltage variations between the measured value and threshold value and controls the robot in step with it. If any crack occurs within the rail, the robot is going to be stopped then an SMS are stopover be sent.

In our project, there are two sets of IR sensor units installed to the two sides of the vehicle. This unit is occupied to activate/deactivate the GSM transmitter unit when there are any cracks within the track. The IR transmitter and IR receiver circuit are used to feel the cracks. The IR sensors directs the situation of the tracks. In normal condition, the motor, LDR, Serial transmission is within the initial stage. When the battery power supply supplies the microcontroller then it's starting the motor in an exceedingly forward direction and serial transmission is used to send the messages to the microcontroller. When the crack is identified by the IR sensor the vehicle stops directly, and also 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 finished by the microcontroller. The GSM module sends the text message to the predefined number with the help of a SIM card that's inserted into the module.

At Normal Condition: -

The IR transmitter sensor is transmitted infrared rays. The Transistors are used as an amplifier section. At normal conditions, Transistor is OFF condition. At that time relay is OFF, that the vehicle running continuously.

At Crack Detection: -

In crack detection conditions, the IR transmitter and also the IR receiver, the strength through the transmitter and

receiver is high thanks to non-conduction. When the track is continuous with no cracks then the output of IR LED and Photodiode is visiting be high. Another TSOP sensor is used to look at perdition on the way of the railway track. When this output is high then it's concluded that there is no pit within the track. But if any pit is detected by the sensor the output of the sensor given to the microcontroller is zero and again the microcontroller will stop the robot. When a crack is detected by the IR sensor the vehicle stops directly, then 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 completed by the microcontroller. The GSM module sends the text message to the predefined number with the help of a SIM card that's inserted into the module to send the SMS.

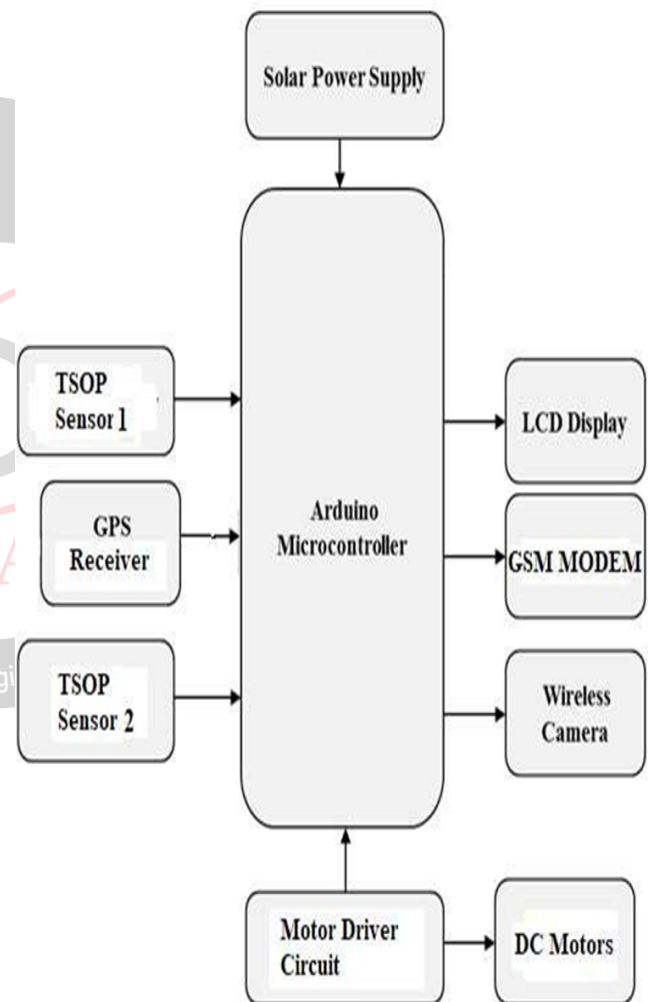


Figure 2: Block Diagram.

(Fig 2) shows the block diagram of the proposed work "railway track crack detection device". In this device we're the usage of Arduino Uno microcontroller, which acts as a brain of the device. This microcontroller controls the circuit function. Various components are interfaced with this microcontroller to carry out favored operation of the device.

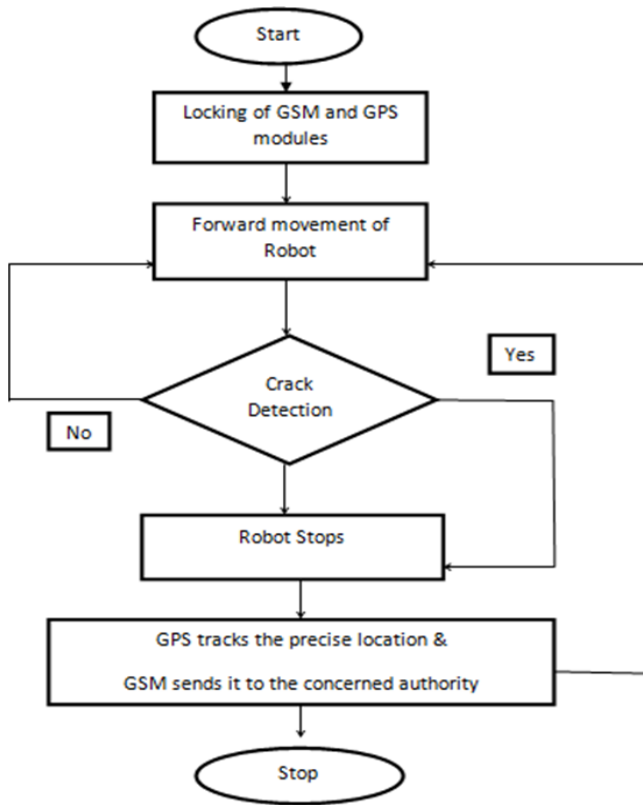


Figure 3: Flow Chart.

Table 1 shows statistics of the number of injuries caused due to train accidents in previous years in India due to various reasons.

Year	No. of Train accidents	No. of death/Injuries	No. of death due to Rail cracks
2013-14	20	275	156
2014-15	15	196	124
2016-17	17	249	150
2017-18	29	57	58
2018-19	59	37	108
2019-20	19	-	-
2020-21	4	-	-

Table 1: Train Accident Statics From 2013-2021.

Number of train accidents across India from financial year 2014 to 2021

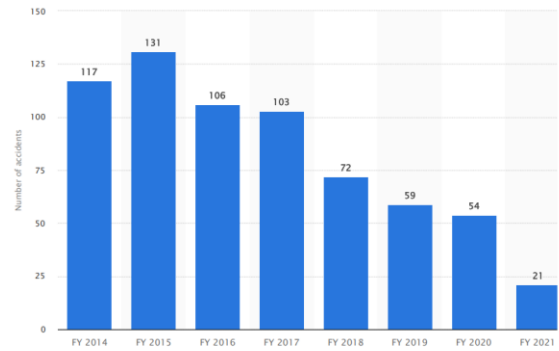


Figure 4: Number of Train Accident Across India from financial year 2014-2020.

V. COMPONENTS DESCRIPTION

1. Arduino UNO

Arduino/Genuine Uno can be a microcontroller board supported the ATmega328P (datasheet). it is 14 virtual input/output pins (of which 6 are regularly used as PWM outputs), 6 analog inputs, a sixteen MHz quartz, a USB connection, a power jack, an ICSP header and a resetting button. It consists of the whole lot had to help the microcontroller; absolutely join it to a laptop with a USB cable or electricity it with a AC-to-DC adapter or battery to set off started.



Figure 5.1: Arduino UNO.

2. Ultrasonic Sensor

An ultrasonic sensor is an digital tool that measures the gap of a spot item via way of means of emitting ultrasonic sound waves, and converts the meditated sound into an electrical signal. Ultrasonic waves journey quicker than the velocity of audible sound (i.e., the sound that human beings can hear). Ultrasonic sensors have principal components: the transmitter (which emits the sound the usage of piezoelectric crystals) and the receiver (which encounters the sound after it has travelled to and from the spot).



Figure 5.2: Ultrasonic Sensor.

3. GPS (Global Positioning System)

NEO-6M GPS Receiver Module. Global Positioning System (GPS) uses indicators dispatched with the aid of using satellites in area and floor stations on Earth to as it should be decide its coordinate on Earth. The NEO-6M GPS receiver module makes use of USART communicate to connect with microcontroller or PC terminal.



Figure 5.3: GPS Module.

4. GSM (Global System for Mobile communication)

GSM is an global widespread for cellular telephones. It is likewise once in a while known as 2G, as it's far a second-era mobile network. The Arduino GSM guard permits an Arduino board to connect with the internet, ship and obtain SMS, and make voice calls the usage of the GSM library. The guard will connect with the Arduino Uno out of the box. The guard will connect with the Mega, Mega ADK, Yun, and Leonardo forums with a minor modification.



Figure 5.4: GSM Module.

5. IR Sensor (infrared sensor)

An infrared detector (IR sensor) may be a radiation-sensitive optoelectronic element with a spectral sensitivity within the infrared wavelength vary 780 nm ... fifty μm . IR sensors are currently wide utilized in motion finders, that are used in building services to change on lamps or in alarm systems to detect unwelcome guests.



Figure 5.5: IR Sensor.

VI. RESULT

The project “Railway track crack detection system” was designed such that to design locating system with using GPS communication module. Project offers an module area function very quickly after the detection of the crack within side the railway track and additionally within side the instances of impediment detection. Due to the shortage of an present rail line that consists of non-stop scars and crack defects, choose specific tracks, respectively, at specific speeds via the disorder area, to detect the accuracy of statistics. The system permits localization of the detection using base station network through GSM modem tower signals and transmitting the position to the microcontroller the controller takes the responsibility to transmit the location using the GSM_SMS services. The major distinction among simulation and hardware evaluation is within side the simulation we used potentiometers as ultrasonic sensors for sensing crack and digital terminal to reveal the place coordinates of the cracks accumulating from GPS module and show the alert SMS of GSM modem. If any crack is discovered on rail traces the robotic stops and sent the area coordinates to the authority in an effort to take crucial steps. The robot continues its crack detection if no crack is found.

VII. CONCLUSION

It saves more than thousands of lives by doing a very important yet unexplored work. It is the most economical solution provided in order to achieve good results of railways of our country in order to minimize the stats of accidents caused. The “Railway Track Crack Detection Using GPS & GSM” is a helping unit which identifies the crack that present on railway track using IR Sensor. We can prevent accidents of up to 70% by enforcing these functionalities in the real-time implementation. Areas where manual testing is not feasible with this vehicle, such as in shallow coalmines, mountainous areas and thick and deep forests regions, can be easily carried out. When this vehicle is used for railway inspections and breakage

detection, automatic SMS will be sent to a predetermined mobile number if cracks or abnormalities are identified by the device sensors. This will lead without errors to the management and control of the state of the railway tracks, and thus to the preservation of the tracks in good condition.

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