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Design & Development of Railway Track Crack Detection System

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Abstract: *Unlike Road accidents, train accidents do not happen as often, so they are not usually shown as a major threat. But when one occurs, it usually results in serious injuries or death. There is a possibility of train derailments caused by faults in rail tracks. These derailments are caused by improper maintenance and current irregular & manual track line monitoring as well as human errors. This project is based on the idea that we must develop a system that can detect faults in the railway track before an incident occurs. The main objective is to develop a bot capable of detecting cracks and unwanted faults in the railway tracks. In a country like India, where transportation is primarily provided by railroads, this paper discusses a detection system in which a microcontroller based smart robot is used to detect any cracks in the railway track. Trains carry most of the goods from one region to another due to their low transportation costs. People prefer trains for travelling long distances over roadways due to their comfort and lower fare. Thus, it is vital to ensure the safety of the railway tracks. Therefore, a robot that can detect faults or cracks in the tracks would be able to protect the trains from accidents.*
Key Word*: Railway track, microcontroller, robot, crack detection, sensors.*

I. INTRODUCTION

The Indian Railways has one of the world's largest railway networks. As of 31 March 2020, IR's network spanned 126,366 kilometers, while its route length was 67,956 kilometers. Traveling through the railways in India is very economical. As India's growing economy experiences ever-increasing needs for transport infrastructure, rail plays a prominent role in providing it. Rail derailments can be caused by faults in rail tracks. These derailments can occur due to insufficient track maintenance and manual track monitoring, mistakes made by workers have can also cause accident. Manual detection of tracks is cumbersome and not fully effective owing to much time consumption and requirement of skilled technicians. The proposed system here will provide a more modern and secure railway track monitoring system. The main issue is that there is no reliable and affordable equipment to diagnose train track problems and that proper maintenance isn't done. Maintaining effective and efficient transport infrastructure, however, has significant economic implications. The objective in this paper is to use IR sensor to detect cracks in rail roads, and then to send the latitude and longitude values to nearby stations by using GPS and GSM, respectively. Furthermore, proximity sensor is used for detecting objects on the track, because natural disasters can throw any object on the rail track. If the system could detect any object or barrier and inform the control room, they may be able to avoid accidents.

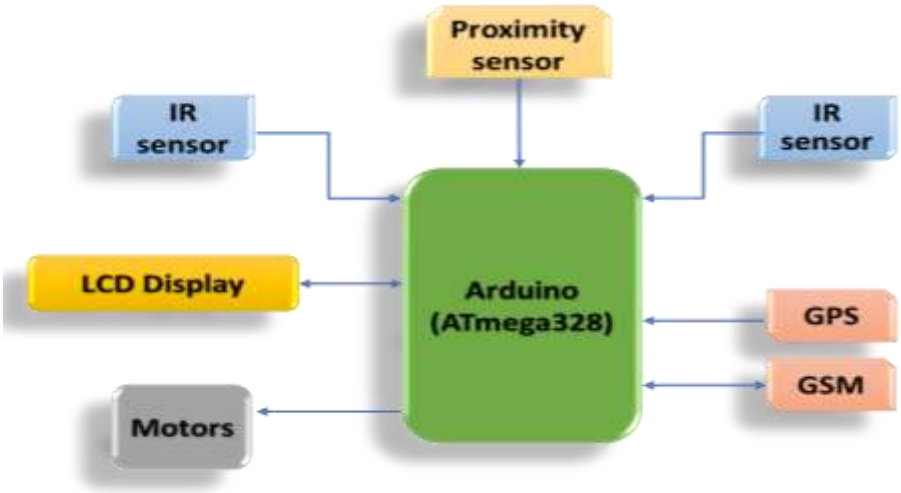
II.LITERATURE SURVEY

During the survey, it was found that there are various causes of train accidents, which increase from Human error to Equipment Failures to Sabotages, etc. In more than 85% of all accidents, human error was responsible. Of these, 41% of accidents were caused by failures of railway staff because of many difficulties they face in keeping updated information about the track throughout the country. Few published papers were studied where the authors have attempted to design the track maintenance system. Additionally, the literature survey enabled to find out the take-out message from previous studies concerning various aspects of the results, which helped to enlighten the problem statement as well. In the paper [5] "Detection of Cracks and Railway Collision Avoidance System" by Prof. S. Ramesh. He worked on developing an embedded system for crack detection & collision avoidance using Zigbee mesh and vibration sensors. On the basis of the literature review it was found that many of the system designs had problems: not detecting any obstacles, Zigbee mesh technology is very expensive to use & some systems are not sending crack location information.

III. PROPOSED SYSTEM

In the proposed system the idea is to develop a robot vehicle which will move on the track autonomously to inspect the track with the help of various sensors. Where IR sensors for the detection of cracks, a proximity sensor to detect the objects in front of the bot. Additionally a GPS module for the detection of the location of the bot and a GSM module for sending the location to the rail authorities
will be added. In this system the Arduino board is used for interfacing the input & output devices.

IV. BLOCK DIAGRAM OF THE SYSTEM



V. COMPONENT USED

GSM module

Fig.2 – gsm module

Using the SIM800L, you can send and receive GPRS data transmissions, SMS and make and receive voice calls. The small footprint, low cost, and quad-band frequency capability make this the ideal solution for long-range connections.

GPS module

Fig.3 – gps module

Using this module, you can add GPS functionality to a microcontroller system, and the inbuilt NEO-6M system provides better precision than most other GPS modules. The module has a built-in cell that allows you to set the real-time clock settings.

Arduino

Fig.4 - arduino

An Arduino Uno development board uses ATmega328P as its main microcontroller, making it easy to interface with its pins, while

adding additional functionality not offered by the standalone microcontroller. Interactive electronic objects can be created using this open-source prototyping platform.

Proximity sensor

Fig5- proximity sensor

The E18-D80NK infrared switch is a proximity sensor used ideally in projects involving obstacle avoidance. The adjustable infrared switch is a set of transmitter and receiver in one of the photoelectric switch sensors. The sensor can detect obstacles up to a distance of 3-80cm. The infrared sensor switch has a quick response time of less than 2 seconds and can detect both transparent and opaque objects.

IR Sensor Module

Fig.6- infrared sensor

VI. PROCESS FLOW DIAGRAM

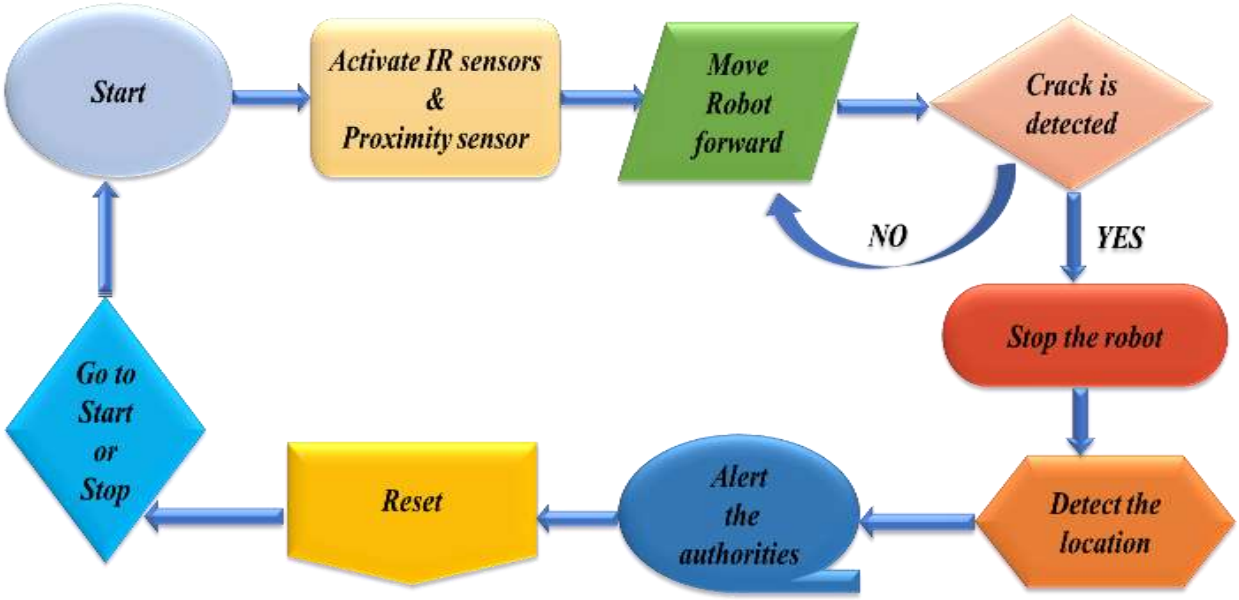


Fig.7- Process flow diagram

sensor has been used for crack detection. It consists mainly of the IR Transmitter and Receiver, Op-amp, Variable Resistor (Trimmer pot), output LED along with few resistors. The LED in the module blinks whenever crack is detected.
Other than that, the system has been integrated with a buzzer, motors, motor driver, relay switch, batteries to the prototype system for it to properly function.

VII. WORKING

Initially after starting the robot, IR sensors & Proximity sensor will be activated, If the sensors don't detect any obstacle or crack

then the bot will keep on moving forward. But if the sensors detect any obstacles or cracks on the track then it will stop, detect the location with the help of GPS module and send the location with the help of GSM module and alert the authorities. After that the robot will be reset and the maintenance team will start the bot again.

This alert message will be sent to the authorities:

VIII. DEVELOPED SYSTEM PROTOTYPE

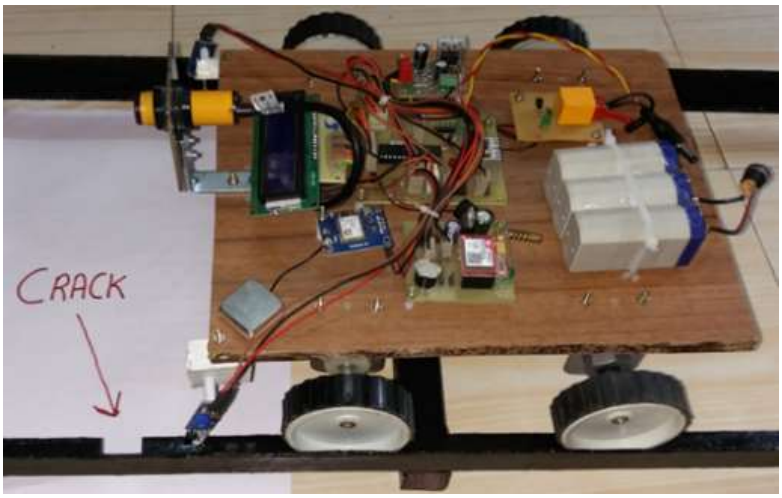


Fig.9 Prototype model

IX. CONCLUSION

Cracks in the railway track has been identified as the main cause for derailments. Hence, this project was designed and a model was developed which can be used to detect the presence of a crack or any obstacle on the railway track. This system does this automatically without any human intervention. The proposed system not only detects the crack or an obstacle on the railway track but also sends the exact location of the crack to the authorities. Also, this system was tested under different circumstances such as foggy weather and it worked successfully in that condition too. This system has many advantages over the traditional railway inspection methods as it is more accurate and faster. The project was effectively designed and a prototype of the proposed system was successfully developed.

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