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Solar Based Railway Track Fault Detection System

Kavya M, Tenin K Sen, V Vaisakh, Renjini G

B. Tech Student, Department of EEE, NSS College of Engineering, Palakkad, Kerala, India

B. Tech Student, Department of EEE, NSS College of Engineering, Palakkad, Kerala, India

B. Tech Student, Department of EEE, NSS College of Engineering, Palakkad, Kerala, India

Assistant Professor, Department of EEE, NSS College of Engineering, Palakkad, Kerala, India

ABSTRACT: This paper proposes the development of a faulty track detection system using ultrasonic sensors and powered by solar energy. Many accidents on the railway line are due to the pre.sence of a crack. Manual testing of the track has taken a lot of time and fatigue. In addition to the rechargeable solar battery, the proposed system introduces Bluetooth-based technology to prevent train accidents. Two ultrasonic sensors are mounted on the front end of the vehicle to monitor the track and provide the information to the Arduino controller. In the event of fault detection, the module immediately send.s the location af crack to the cell phone with the help of GPS and GSM module. The proposed railway track error detection system automaticall y detects faulty railway tracks without human interference. There are many advantages to the proposed system compared to the conventional detection strategies. The benefits include lower cost. , lower energy consumption, le.ss analysis time and also help improve railway sa[ety standards and provide more effective testing infrastructure.

I. INTRODUCTION

Transportation is a great need for action that allows the production and use of products to take place in various places. Economic prosperity has always depended on increasing the capacity and integrity of transportation. But the infrastructure and transport efficiency has a huge impact on the world and is a major source of energy, making transport stability and security a major challenge. Trains are very important to carry passengers and goods from one place to another. A better transportation system leads to more trade. It is very important to ensure the safety of these various transport systems especially in case the railway networks play a major role in India's economic and transport infrastrucmre. The Indian Railway network is the largest transit network and is now the backbone of the country's transport infrastructure. In India, most commercial transportation is made up of the railway network because it is the cheapest mode to travel before all other means of transportation such as buses, airplanes etc. India's fast-growing economy has led to increased demand for transportation in recent years, and this has resulted in a dramatic increase in traffic vo- lume on the Indian Railway network. In India, we find that rail transport plays a key role in providing the transport infrastructure needed to maintain and eliminate the ever-increasing needs of the fast-growing economy. Today, India has the fourth largest railway network in the world. However, we have not yet reached the in- ternational standard. Automation has affected every aspect of our daily lives. Further development is being introduced in almost every sector to reduce human efforts and save time. With this in mind we are trying to introduce automation into the field of rail-way track fault detection system. The railway line makes up the most critical part of any company's assets, as it provides them with the necessary business operations. Bad things that happen because of problems on the railway line need to be overcome. The latest method used by the Indian railway is a manual inspection that requires a lot of human effort and is time consuming. This paper is very useful in this scenario. The vehicle will move along the railway line inspecting the route and finding a fault if any. With the introduction of this automatic vehicle, we try to reduce human effort, save time and give a more accurate and direct re- sult. In this paper the error detection of a railway track is made by ultrasonic sensor modules mounted on a moving bot. The faults that the proposed vehicle can encounter are:

- Obstacles along the way
- Discontinuity
- Lack of nuts and bolts
- Incorrect alignment

Ultrasonic sensors are connected to the Arduino Uno microcontroller. When any error is detected on the track the sensor passes this information to Arduino. With this, the motion of the vehicle stops and the information regarding the

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fault is sent to control the room or train station via the GSM module. Thus the information regarding the location of the crack is received in the control room. This will help make tracking faster.

II. DESIGN OF SOLAR BASED RAILWAY TRACK FAULT DETECTION SYSTEM

Below diagram shows the block diagram of the proposed work that is "Solar based railway track fault detection system". In this system we are using Arduino Uno microcontroller that acts as the heart of the system. This microcontroller controls the circuit function. Various components are interfaced with this microcontroller to perform desired operation of the system. The hardware components used in this system requires regulated power supply for the operation. This power is provided by the rechargeable battery connected in the system. The battery will be charged through solar power with the help of solar panel connected.

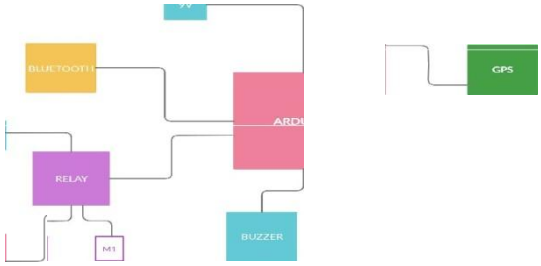

Fig. 2.1 Block diagram

In this system we have interfaced two ultrasonic sensors with the microcontroller for distance and detection of the crack present in the track of the railway line. The communication between the user and the vehicle is achieved by the GSM module. The GSM mod- ule is used to transmit the latitude and longitude coordinates to the relevant authority in the form of SMS. A GPS receiver is also interfaced with the microcontroller to pinpoint the exact location of the crack on the railway track. This GPS receiver will provide the longitude and latitude parameter values to the controller through SMS. Two DC motors are used to move the robot in for- ward direction. These motors are interfaced and controlled through the microcontroller. To operate these motors through a microcontroller two channel relays are required for interfacing between microcontroller and motors.

Working

In this paper all the components such as ultrasonic sensor, GSM, GPS, Bluetooth, buzzer and relay are incorporated to an Arduino module. When the motion of the vehicle is initiated, it starts to move along the track. The direction of rotation of motor can be controlled by an Android app using Bluetooth technology. When we select the direction of motion of motor in the app installed in our mobile phone, it will send signal to Arduino. Arduino will control the two channel relay in order to rotate the motor in speci- fied direction.
During this motion the ultrasonic sensor will continuously moni- tor the distance to the track. If there is any crack present, there will be an increase in the distance. Ultrasonic sensor can detect even the minority cracks since it has got an accuracy of 1mm. Whenever a crack or misalignment is detected by the sensor, the GPS module pinpoints the position of the vehicle in latitude and longitude coordinates from satellites. These coordinates received by GPS are converted into a text message by the microcontroller. The GSM module transmits this message as SMS to the prede- fined number. The entire system is powered by a rechargeable battery. Solar energy is used to provide alternate power supply. Hence the location of the crack can be identified without any hu- man effort.

III. SIMULATION OF BUCK BOOST CONVERTER FOR SOLAR ARRAY

The output voltage characteristic of a solar array is variable with time. This varying DC voltage cannot be directly connected to other components because the changing behavior of the voltage can cause damage. So the buck boost converter with feedback will continuously convert the out voltage of the solar to a prefixed constant voltage which can then be connected to other compo- nents in the system. The buck—boost converter is a DC-DC con- verter which has an output voltage magnitude either greater than or less than the input voltage magnitude. It can be controlled to give output greater or lesser than the input voltage. A 12V/l5W solar array and an inverting type buck boost converter with a sin- gle MOSFET switch and feedback control to give constant output is employed here.
Charging Current = Wattage of solar panel Voltage of solar panel = 15 -12 = 1.25 A

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Time taken for charging = 2.2 Ah = 1.25 = 1.76 hours
The Simulation output result when the voltage from solar array is lower than 12 is shown in Fig 3.2.The simulation output result when the voltage from solar array is greater than 12 is shown in Fig 3.3.

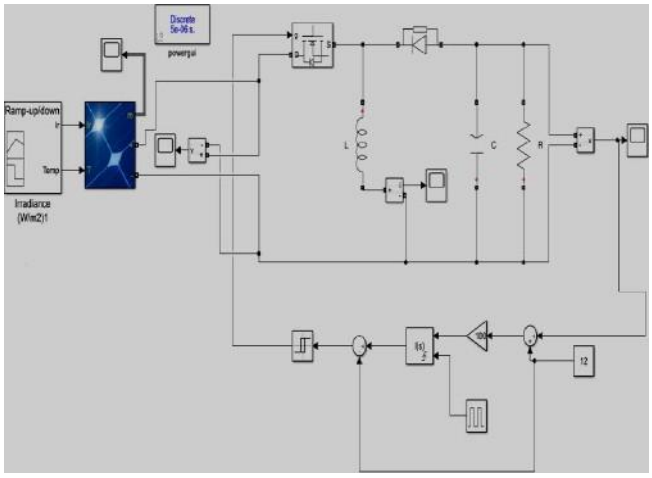

Fig. 3.1Buck Boost convertor

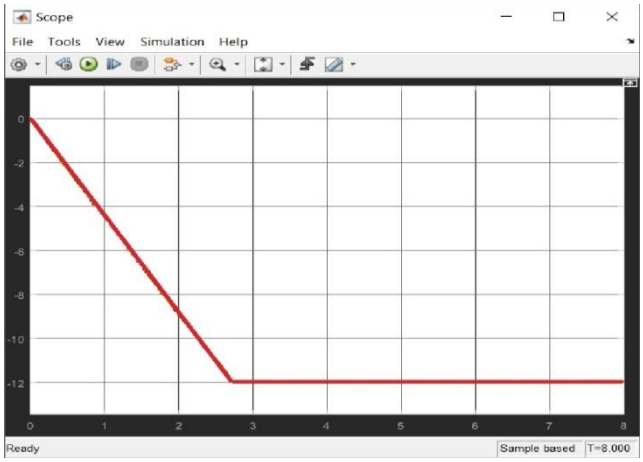

Fig. 3.2 Simulation output 1

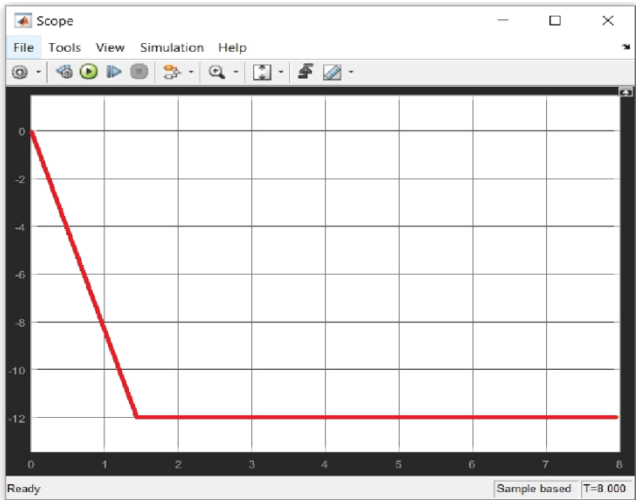

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Fig. 3.3 Simulation output 2

Flow chart

The flowchart drawn below describes the step by step procedure involved in the working of our model.

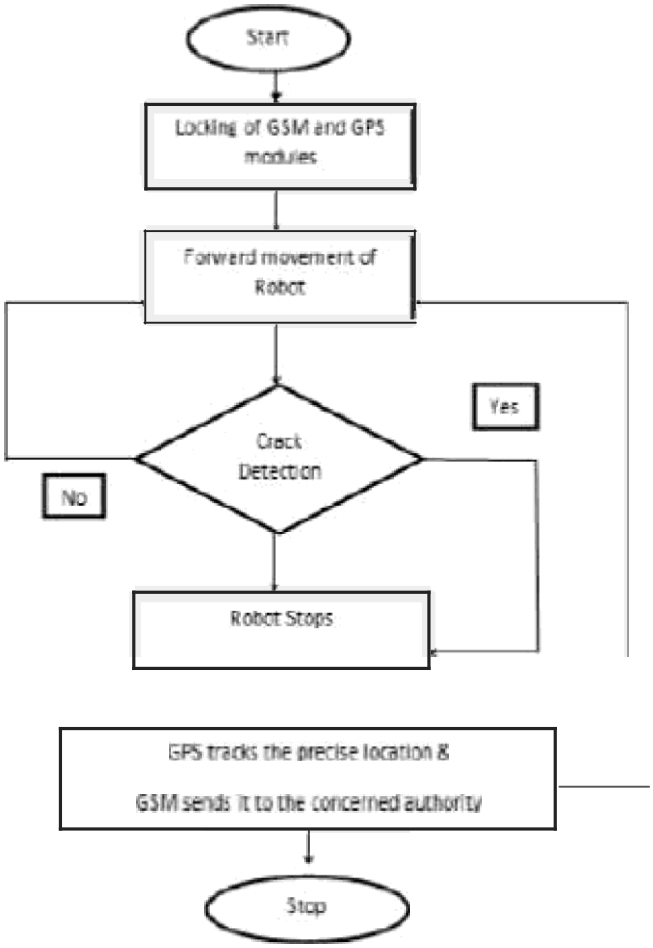

Fig. 3.4 Flowchart

IV. HARDWARE IMPLEMENTATION

The hardware implementation of the necessary prototype was done by incorporating all the components as shown in figure 4,1. The prototype was tested by running it through a mock track and was programmed to detect the crack if the distance from the sen- sor to the track is greater than 7cm. Whenever a crack is detected, (i.e.:- when the distance is greater than 7cm), the motion of the prototype was stopped and the alert signal was transmitted to the user in the form of SMS showing the location of the crack. The SMS thus received is shown in figure 4,2.

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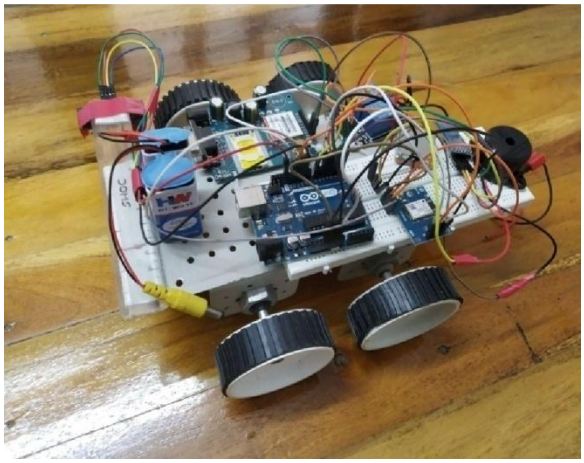

Fig.4.1 Prototype

Fig .4.2 SMS

V. CONCLUSION

This paper presents a Solar based railway track fault detection system for detecting railway track faults. This system helps in preventing railway accidents due to cracks and obstacles on rail way tracks. This prototype can efficiently detect cracks and ob- stacles on railway tracks. The system detects cracks and transmits that information automatically, which is a superior advantage compared to the existing manual system. Detection of the crack or misalignment is done with the help of an automated vehicle which moves along the track. The ultrasonic sensors in the vehicle detect even the smallest cracks present in the track and transmit the in- formation wirelessly through the GSM module. The smallest cracks are usually ignored or unidentified in the manual inspec- tion, which may gradually develop into major cracks and may even cause accidents. Hence it is important to identify the cracks at the initial stage itself and make the necessary amendments in the tracks at the earliest. The proposed idea can overcome the limitations or errors in the existing system of manual inspection. Hence this system will aid the authorities in the railway depart- ment in monitoring the status of the tracks in a more efficient manner.

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