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An Enhanced System for Detecting Railway Track Crack Using TSOP Sensor

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***Abstract*: Indian Railway is one of the major transport media in the world, which covers over 1,15,000 km distance. The major problem is that crack in railway track led to a number of train accidents resulting in heavy loss of life and property. Our work presents a system which detects crack on railway track using TSOP sensor module. It also consists of GSM and GPS module which sends location of crack detection to nearest railway station. Reed switch is used to stop our model at specified destination. Solar panel and Battery both are used as power supply so that we can use our system at day and night time.**

***Keywords*: Railway track crack.**

1. Introduction

Transport is an important aspect that allows to carry passengers and goods from source to destination. Economic level of country also depends on level of transport. Although, in India, rail transport system is 4th largest railway network in the world but its safety is not up to global standards.

In our system, crack in the track is noticed instantly and information is sent to railway authorities which results reduced train accidents. A robot in our system is made to run on track between two consecutive stations. It consists of TSOP sensor which detects the crack on the track, GPS module which is used to find the exact position using latitude and longitude of the crack and GSM module which sends the obtained information to railway authorities in the form of SMS.As soon as Railway people got the information, they reach at that location to repair the crack. In this way, our system helps to reduce possible train derailments with less manual efforts and more efficiently.

2. Literature survey

We did survey regarding railway track crack detection system of two international conference papers.

The author of paper [1] discusses a Railway track detection system using image processing which combines the use of GPS tracking system and WIFI module to send alert messages and geographical coordinate of location. This project prevents derailment by detecting a crack in railway track using internet of things technology. In India, Wi-Fi i.e. Internet is not available everywhere and every time so it is not efficient at present scenario.

Paper [2] proposes a solution to the problem of railway track crack detection utilizing LED-LDR assembly which track the location of faulty track which then mended immediately so that many lives will be saved. However, LED-LDR cannot check for surface and near surface cracking where many of the faults are located.

After survey, we compared both papers with our project and found that here we are using GSM which do not require internet connection and TSOP sensor is used which accurately detects crack of railway track.

A. Existing System

The primary issue has been the lack of cheap and efficient method to find problems in railway track. This is because of, the lack of proper maintenance of railway track which lead to formation of cracks and other similar issues. In existing system, this railway transport leads to number of railway accidents. These accidents result in a heavy loss of human life and our government property. Yet there have been no any cheap and automated method to stop derailment which identify crack using fewer manual efforts and reliable. Instead of this, still in our developing country has an earlier inefficient and unreliable method which need more manual effort to run those systems to identify fault.

3. Proposed System

Our system consists of a railway track crack identifier robot model. In this system, we have used an AVR microcontroller that is ATmega 328 for interfacing the robot and TSOP sensor module. The sensing device in our system sense voltage variation from TSOP sensor. These voltage variation values are given to the microcontroller and the variation between measured value and threshold value is checked. The robotic vehicle controls according to the variation in voltage values. These voltage variation values are displayed on LCD display. Motor driver circuit is used to help robot to interface with microcontroller. The robotic model will stop if any fault occurs in path and LCD display will show “Track fault Detected”. Location of that crack is detected using GPS module in the form of latitude and longitude coordinates and then a message is sent to railway authority present at source and destination stations via. GSM in the form of SMS. If the crack is not detected, then robot will stop at next specified station by placing a permanent magnet on railway track between two rails which is detected by reed switch placed at the bottom of our robot.

A. Block Diagram

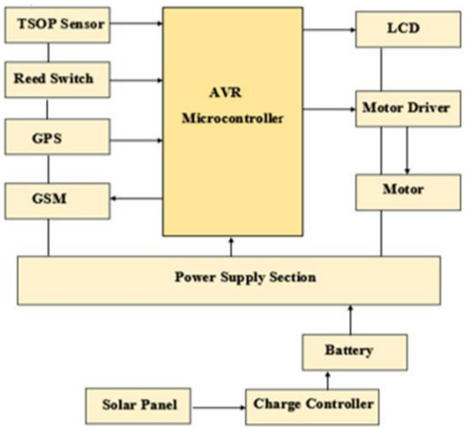

Fig. 1. Block diagram

Above figure show the block diagram of proposed system. The main components are TSOP sensor which is used for detecting crack, GPS to find exact location of the crack in the form of longitude and latitude coordinates, GSM for sending SMS to railway people for knowing crack location, AVR microcontroller for interfacing sensor with robotic vehicles, solar panel as a power supply during daytime and to store charges for use at night time as well as day time at cloudy environment. Reed switch is used to stop vehicle at specific station.

B. Required Components

1) Power Supply

Photovoltaic solar panels are used to generate direct current electricity to charge battery. Voltage regulator circuits are used to convert voltages required for microcontroller (5V), LCD (5V), GPS (12V), GSM (3V to 4.2V), TSOP sensor (5V), Reed switch, motor, etc. Rechargeable Battery is used to power the system and one battery level indicator to indicate amount of power remaining in the battery.

2) Microcontroller (ATmega-328)

Atmega328 is an AVR microcontroller which supports data up to 8 bits having 32 Kb internal built-in memory. As it has 1 Kb EEPROM, it can store the data even if the electric supply is made off and can provide results after providing it with the supply. Moreover, ATmega 328 has 2 Kb SRAM. This feature consists of advanced RISC architecture, low power consumption, good performance, six PWM pins, programmable lock for software security, real timer counter having separate oscillator, programmable serial USART, throughput up to 20 MIPS, etc.

3) DC Motor

A DC motor's speed can be control over a wide range, using either a variable supply voltage. It actually converts the electric current into energy that drives the robot by applying torque to its shaft. It has highest starting torque so, here to run the robot on the track we use dc motor.

4) Motor Driver

Motor drivers are used to drive the motor. These are actually used for motor interfacing. It consists of following components:

- Controller: It can be microprocessor or microcontroller
- Motor driver IC: These are current amplifiers which converts the low current signal from the controller into a high current signal which helps to drive the motor
- Motor: It creates a motion.
- Power supply unit: It provides the required power supply.

5) LCD display

LCD display characters. It consists of 16 pins altogether that is 8 data pins, 3 control pins,3 power lines and 2 additional conditions (LED+ and LED-). We are using 16 *2 LCD display. We can easily interface LCDs with microcontrollers and most of the present-day compilers have in built library routines for them. In our system, LCD is used to display whether the crack is detected or not.

6) TSOP Sensor (1736)

The TSOP sensor 1736 belongs to IR remote control receiver series. TSOP 1736 works at 36 kHz frequency. It consumes low power. It is an active low sensor which gives +5 V. In our system, it detects fault as if light is not received at receiver that shows there is a crack present and if light is received then it shows that no crack is present.

7) Reed Switch

The reed switch works on the application of magnetic field. It consists of ferromagnetic contacts which are either open or close normally. As magnetic field is applied, the contacts get closed or open respectively. When the magnetic field is removed, contacts come back to their normal position. In our system, reed switch is used to stop robot at destination place by using permanent magnet at the destination point where we wanted to stop our robot.

8) GSM and GPS Modules

We are interfacing GSM and GPS modules to our microcontroller for communication purpose within mobile networks. GPS module detects the exact location of crack in the form of latitude and longitude coordinates by using Geosynchronous. Earth Orbit Satellites and GSM module helps to send that location in the form of SMS to railway authorities' mobile phone.

C. Flow Chart

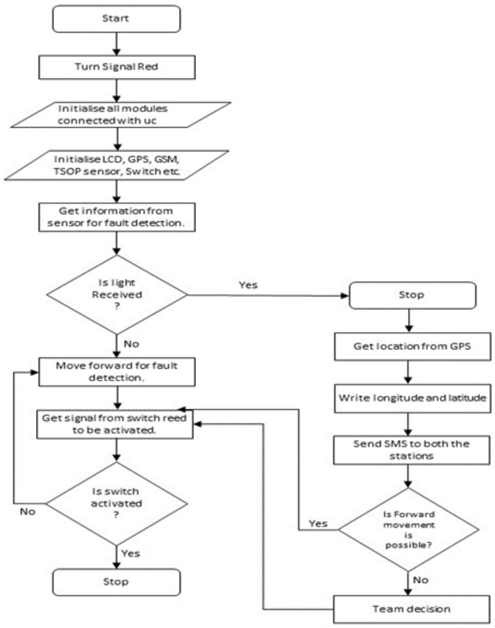

Fig. 2. Flow chart

D. Circuit diagram and it's description

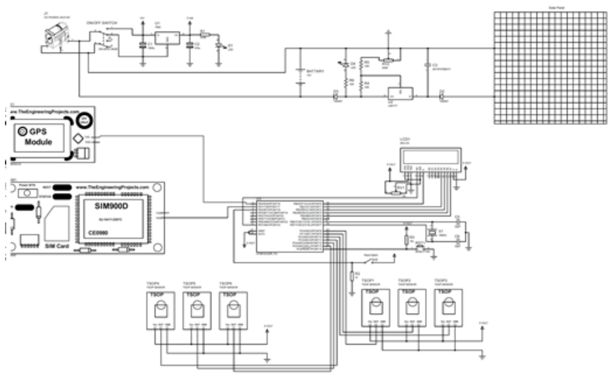

Fig. 3. Circuit diagram

In circuit diagram of our system consist of power supply circuitry which is basically solar panel and 12 V battery supply. Solar panel charges battery during day time and this stored energy utilize at night time and also during cloudy environment. The AVR microcontroller is used to interface robotic vehicle and sensors. The analog pins (23 to 28) is connected with six TSOP sensors. Reed switch is connected to pin 4 of microcontroller. GSM module is connected with TXD pin (pin 3) of microcontroller and GPS module has connected to RXD pin (pin 2) of microcontroller. Data pins (D4 to D7) of LCD display connected to pins (14 to18) of microcontroller.

E. Working

In our system we are using two sets of TSOP sensors in each side of the robot's wheels. When the power is on, robot moves along the model track. TSOP sensor checks the conditions on the track. In normal condition when no crack is detected robot runs continuously to the next specified station where permanent magnet is placed to stop the system. When the crack is detected by the TSOP sensor the robot stops at that location, and the GPS module activates to receive the latitude and longitude coordinates of the robot position, with the help of satellites. These coordinates are converted into a SMS using microcontroller. The GSM module sends this message to the mobile number of the railway authorities. As authorities get this message, repairing team arrives there to fix the crack.

4. Conclusion

Our proposed system is efficient, cost effective, user friendly, reliable, low power consuming system which provides facility for safety purpose by preventing derailments due to cracks on railway tracks. Our system effectively detects crack without any manual efforts. This idea can be implemented for better safety standards and can provide better results if used in real time in the future. In this way our proposed system is advantageous over traditional existing system.

5. Future Scope

Although our proposed system is good at rapid detection of crack on railway tracks, enhancement can be done to get better accuracy of the location where the crack has occurred. For detection of very minute cracks image processing can be used.

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