A System for Surveying Railway Track Geometry Using Multi-sensor

Mr. M. Suresh Reddy, Mrs. M.K. Srilekha

***Abstract*— In the proposed system the monitoring of the railway tracks is proposed which can reduce the human labor. By this system the cracks in the railway tracks are detected and also the condition of the track is monitored without any help of the human. When a crack is detected by the IR sensor then a message is sent to the specified person through an SMS. In this processes the location of the crack is obtained using the GPS module and the obstacles in the path are avoided using the ultrasonic sensor, the direction of the robot is obtained by the MEMS sensor.**

***Index Terms*— Bend detection, crack detection, nuvoton board, obstacle detection.**

I. Introduction

Now a day's the automated robots are used in every field to reduce the human labour and to reduce the cost of the processes. In this paper a robot is proposed which can monitor the condition of the railway track and the position where it needed to be repaired can be sent to a specific person using a GSM module. The cracks in the system can be detected using the IR sensor and the location of the crack in the track can be sent to a specific person through an SMS using GSM module. This location of the crack is obtained using GPS module, the direction of the robot can be obtained by the MEMS sensor, and obstacles in the path of the robot are detected by the ultrasonic sensor through which the distance between the obstacles and the robot can be calculated. This proposed system will be very useful to avoid the disasters which occur due to defective railway tracks.

II. HARDWARE DESIGN

Basically, the hardware of the proposed robot consists of the following components.

- Nuvoton board.
- Ultrasonic sensor.
- IR sensor.
- MEMS sensor.
- GPS module.
- GSM module.
- DC motors.

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Mr. M. SURESH REDDY, Department of Electronics and Communication Engineering (Embedded System Technology), SRM University, Chennai, India.
Mrs. M. K. SRILEKHA, Department of Electronics and Communication Engineering, SRM University, Chennai, India.

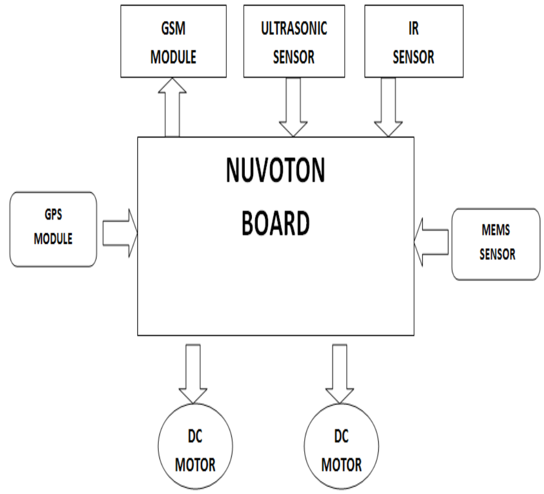

Fig. 1: Block diagram

A. Nuvoton Board

Fig. 2: Nuvoton Board

Here we have used Nuvoton board (NU-LB-NUC140) which uses ARM-Cortex M0 processor. The ARM processor serves as the brain of the project. It processes all the input signals applied to the GPIO pins and responds accordingly by giving control signals to the GPIO pins. Every sensor and module is connected to the nuvoton board. This board is the control unit of the robot.

B. Ultrasonic Sensor:

An ultrasonic sensor is used in this project to detect the obstacles present in its path. This sensor is connected to the controlled board of the robot. When an obstacle is detected by the robot the distance between the obstacle and the robot is calculated. And a message is sent to the user through the GSM module.

C. *IR Sensor:*

An IR sensor is used to detect the presence of cracks in the track; this IR sensor consists of transmitter and a receiver which are place in the opposite ends of the track. When the receiver does not receive any signal then it is considered as no crack detected and when it receives the signal then it is considered as crack detected.

D. *MEMS Sensor:*

MEMS sensor is used to detect the direction in which the robot is moving. When a robot is moved away from the path then a message is sent to the user to specify the change in the direction of the robot. This MEMS sensor is connected to the controller board where the direction of the robot is frequently checked by the controller board.

E. *GPS Module:*

A GPS module is used to check the position of the robot where it is actually located. When a crack is located the location of the crack is sent to the user by the using the GPS module. This module is connected to the controller board, and when a crack is detected this module is set on.

F. *GSM Module:*

The GSM module is used to send SMS to the user about the location of the crack, weather the robot is in the same direction or not, and when an obstacle is detected in its path.

G. *DC Motors:*

These Dc motors are controlled by the controller board using L298 driver board. By this driver board the movement of the wheel can be controlled.

III. Construction and Working

The proposed system has the features like obstacle detection, crack detection in the track, bend detection on the track. Here the robot is placed on the track and powered on and moves along the track. The working of each feature is as follows.

A. *Obstacle Detection:*

The obstacles along the path are detected by using the ultrasonic sensor which is connected to the controller board. When the echo pin detects a reflected wave a signal is passed to the controller board. And the distance between the obstacle and the robot is calculated by the time difference between the projected wave and the reflected wave. And when the obstacle is detected by the ultrasonic sensor a message is sent to the user about the location and how far the obstacle is from the robot through GSM module.

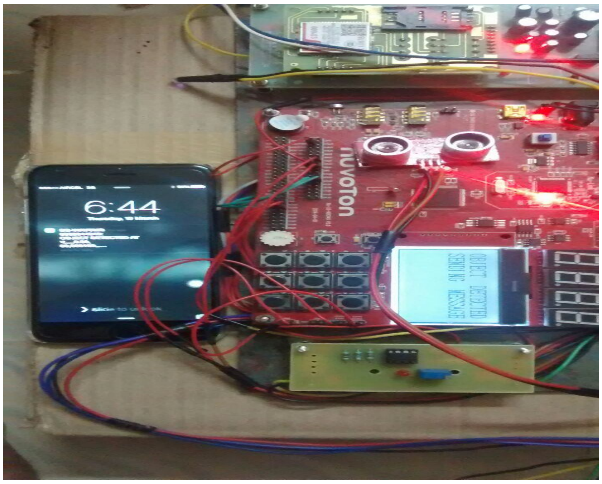

Fig.3: Output of Obstacle detection

B. *Crack Detection:*

The crack detection is done using the IR sensor. The transmitter and the receiver of the IR sensor are placed on the opposite ends of the track and whenever the IR receiver is low it is considered as no crack detected. And once when the IR receiver goes high it is considered as crack detected. These IR sensors are connected to the GPIO pins of the controller board. Once the GPIO pin is high a message is passed to the user by collecting the data of the location using GPS module. Through GSM module an SMS is sent to the user about the location of the crack.

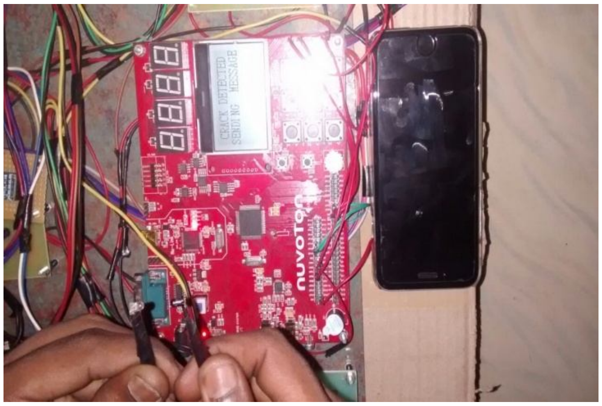

Fig.4: Output of Crack detection

C. *Bend Detection of Track:*

MEMS sensor is used to monitor the direction of the robot is there is any bend detected by the robot through the MEMS sensor a message is sent to the user which specifies the location. Here the MEMS sensor is connected to the controller board and when the bend is detected the values of the MEMS sensor change. If any change in the values of the MEMS sensor an SMS is sent to the user using the GSM module.

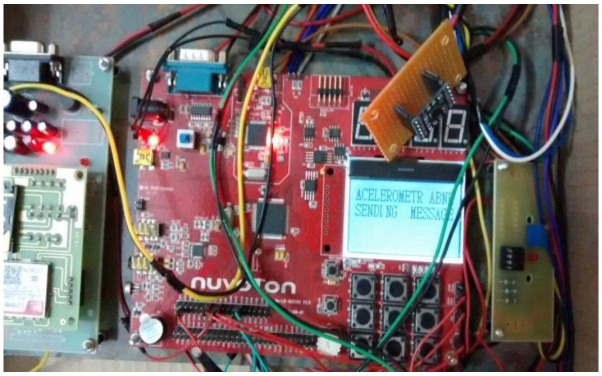

Fig.5: Output of MEMS Sensor

All these sensors are connected to the GPIO pins of the controller board. The GPS module uses the UART pins in the controller board to pass the data of the location. An UART read is used by the controller to collect the data from the GPS module. The GSM module is connected to the UART pins of the controller and the GSM module uses the UART write to write the date to the GSM module. The MEMS sensor is connected to the GPIO pins of the controller board**.**

In the construction of the robot a voltage regulator is used to convert the 12v dc to 5v as to power the sensors, controller board and the motors are powered by the 12v dc power supply.

IV. RESULT

The crack detection and the bend on the track are detected by the IR sensor and MEMS sensor and the values are passed to the controller board. The location of the abnormal condition is tracked by the GPS module and the coordinates are passed to the controller board from the GPS module. And an SMS is sent to the user using the GSM module.

Fig. 6 : System architecture

V. CONCLUSION

This robot can be useful in the detection the cracks and the bend on the railway tracks. It is very useful to reduce the human labour and time. This system can avoid the disasters caused by the irregularities on the tracks.

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Mr. M. SURESH REDDY, Master of technology in Embedded system Technology, Student, SRM University, Chennai, India

Mrs. M. K. SRILEKHA, Assistant professor in Department of Electronics and Communication Engineering at SRM University, Chennai, India.