INTERNATIONAL JOURNAL OF RESEARCH IN MECHANICAL, MECHATRONICS AND AUTOMOBILE ENGINEERING (IJRMMAE)
ISSN: 2454-1435 (Print) | 2454-1443 (online)
Volume 4 Issue 2 – www.ijrmmae.in – Pages 39-44

Robot Based System for Railway Track Damage Detection and Garbage Disposal Using ZIGBEE Technology

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***Abstract*–**In India, almost 50% of the commercial transport is carried out by the railway network and therefore, if any problems occurs then it has the capacity to cause major damage to the economy and not-withstanding the societal impact of loss of life or limb. The 60% of accidents in railways are due to track problems, which lead to derailment. This paper presents the system for automatic crack detection and trash collection in railway tracks. This paper can help to detect the cracks or breakages in railway tracks during maintenance work, if any before the train passes and the alert signal is sent to the railway sector and also trash is collected between the railway track.
KEYWORDS-*LDR, LED, LCD,UART, Zigbee module, GPS Receiver.*

I.INTRODUCTION

RAIL transport, as a means of conveyance of passenger and cargo, plays an important role in our daily life. The building of rail infrastructure has experienced a sustainable growth in the past decade, especially in some developing countries. However, in remote area it is difficult to ensure cleaning and maintenance of railwaytracks because of the manual cleaning, maintenance method and automatic mechanism is not available for the railways deployed in the locations. It is also a big challenge for the maintenance and replacement of manual work in remote area or in inaccessible locations. It is therefore necessary to develop a new strategy , The development of automatic robotic mechanism , which can be used for monitoring the railway infrastructure such as bridges, turnout, rail tracks, cuttings and tunnels, and track beds. This motivates us to develop an Automatic robotic mechanism. For performing these functions (LED)-Light Dependent Resistor (LDR) assembly that works as the rail crack detector and by using an automatic trash suction mechanism, we can easily collect the waste materials from the bridges, turnout, rail tracks, cuttings tunnels, and track beds .Here by using ULTRASONIC sensor we can measure the level of trash in the container.

II.EXISTING SYSTEM

The finding of cracks in railways tracks takes indefinite period of consumption due to manual checking. It reduces the accuracy too and still now, there is a no automatic trash collection mechanism. This method of design is having limited intelligence and time consuming.

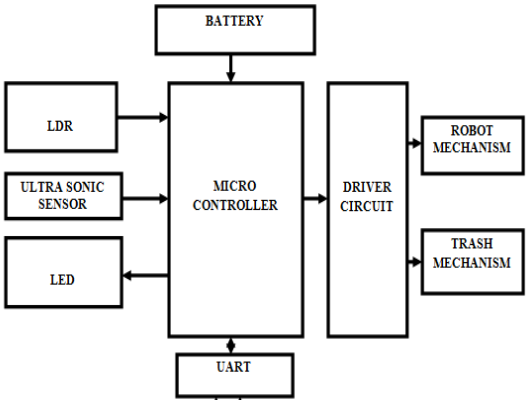

Fig 1: Existing system block diagram

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III.PROPOSED SYSTEM

A. BLOCK DIAGRAM

The core of the proposed is crack detection & trash segregation scheme with the help of the robot mechanism. It consists of a Light Emitting Diode (LED)-Light Dependent Resistor (LDR) assembly that functions as the rail crack detector. The principle involved in crack detection is the concept of LDR. In the proposed design, the LED and LDR has been attached in parallel to each other, which tends to move along the track during the mechanism. During this mechanism, when there are no cracks detected, the LED light rays does not fall on the LDR and hence the LDR resistance is high and does not decreases . Subsequently, when the LED light falls on the LDR, the resistance of the LDR gets reduced and the amount of reduction will be approximately proportional to the intensity of the incident light. Therefore, when light from the LED deviates from its path due to the presence of a crack or a break, a sudden decrease in the resistance value of the LDR ensues. This variation of value in resistance indicates the presence of a crack or some other similar structural damage in the railway track. In order to detect the current location of the device in case of detection of a crack, a GPS receiver whose function is to receive the current latitude and longitude data is used. Along with that, we implement an automatic trash collection process on the railway track. By using an automatic trash suction mechanism, we can easily collect the waste materials. Here by using ULTRASONIC sensor we can measure the level of trash in the container. Once it reaches the particular threshold level, it will send message intimation to particular authorized person. To communicate the received information, a Zigbee module is utilized. The function of the Zigbee module is to send the current latitude, longitude & trash collection data to the relevant authorized person in the railway sector. By interfacing the GPS module, LED-LDR, ULTRASONIC sensor and Zigbee module arrangement with a microcontroller we could achieve the prior mentioned functionality. Direct Current (DC) motors drive the robot and relays were used to control the motors.

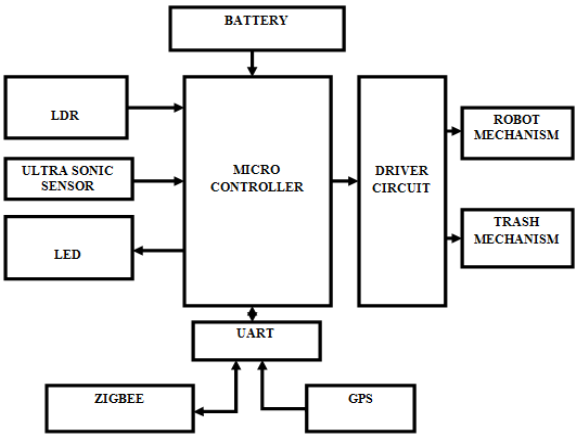

Fig 2: Block diagram of Transmitting Section

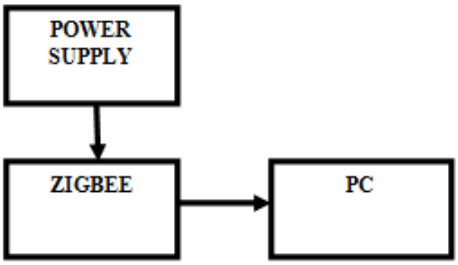

Fig 3: Monitoring section

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IV.SOFTWARE REQUIREMENT

The software used is **Microsoft visual studios** and **Proteus v8.6.**

A.Zigbee

The ZigBee (cc2530) is a true system on chip (SoC) solution for IEEE 802.15.4 applications. The CC2530 has various operating modes, making it highly suited for systems where ultralow power consumption is required. Short transition times between operating modes further ensure low energy consumption. It combines the excellent performance of a leading RF transreceiver with an industry-standard enhanced 8051 MCU, in system programmable flash memory, 8kB RAM, and many other powerful features.The CC2530 comes in four different flash versions: CC2530F32/64/128/256, with 32/64/128/256 KB of flash memory, respectively.

a) Features of Zigbee module

Supply voltage: 5v DC
RS232 output
Output power: up to 4.5dBm–
Detection range: (10-20) m
Frequency: 2.4GHz
Ultra-low power consumption.

B. CIRCUIT DIAGRAM

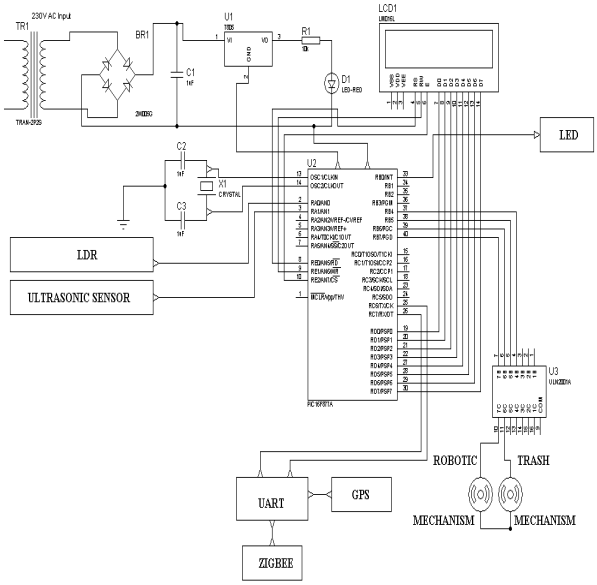

Fig 4: Circuit Diagram

V.HARDWARE DESCRIPTION

The hardware requirements are as follows:

A. DC MOTORS

A 5v 3A DC Motor is used as the air pump for sucking up water. This motor is controlled by L293d motor driver which is controlled by relay connected to Arduino.

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- Length of body -20mm
- Orientation of shaft– Inline
- Rated speed of load– 9000 rpm
- Diameter of body- 15.5mm

B. 12V/7.5 Ah BATTERY

Batteries can be charged manually with a power supply featuring user-adjustable voltage and current limiting. 12v 7.5Ah lead acid battery is a rechargeable battery that supplies electrical energy. These batteries are designed to release a high burst of current and then quickly recharged. Six cells are connected in series in this battery.

a) Features

- Output voltage: (12-12.6) V DC
- Current capacity: 7.5Ah
- Low self discharge
- Long life
- 7.5Ah Large lithium iron phosphate rechargeable battery

b) Applications

- Automobiles
- UPS
- Perfect for motorcycle starter, 12VDC Power, medical equipment, LED light power supply, solar power
- This has plenty of power to start the most smallest engine.

C. MICRO CONTROLLER

The microcontroller which is based on PIC16F877A comprises of 40 input/output pins, out of which 33 of them are I/O pins , 5 are I/O ports and 2 connections consists of VCC and ground . The LED is interfaced to an arm of robotic motor mechanism and is connected to the 33rd pin, ground and 5v supply pin of microcontroller. The LDR is also interfaced to a robotic arm on the other side on 3rd pin opposite to LED connection. GPS module is also connected to the UART-Universal Asynchronous Receiver/Transmitter (UART) controller to notify, send and receive the usage and abnormalities to the user. The Zigbee module is interfaced with controller through an UART module. The LCD is connected to display the digital value of LDR-LED connection. The robotic trash mechanism is interfaced to pin 37,38,39,40 through ULN2001A port.

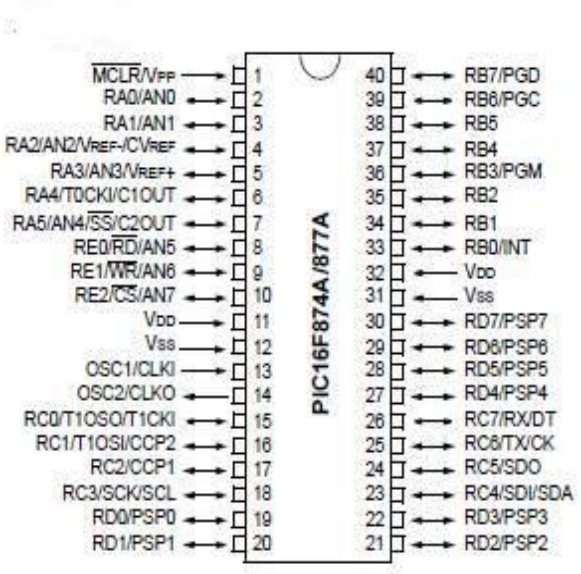

Fig 5: Pin Configuration

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D. MOTOR DRIVER IC

The motor driver ULN2001A which uses a Dual H-bridge integrated circuit is used to control the motor and is connected to output of relay. H-bridge is the simplest circuit for controlling a low current rated motor. The 16 pin IC is comprised of 1 internal voltage (5v), 1 motor supply and 4 ground pins. There are 1 Enable, 2 input and 2 output pins for each motor to be connected. Motor driver controls the 5v DC motor that controls the arm of robot and movement of robot on the railway track. ULN2001A act as an interface between controller and the motors.

E. ULTRASONIC SENSOR

The Ultrasonic sensor detects any obstacles on the railway track and intimation is given through zigbee module,which consists of 4 pins namely Vcc, Ground, Trigger and echo is used. Trigger And Echo pins are connected to the analog pins of the controller whereas ground and Vcc is connected to the 5v supply pin. The echo pin sends the signal to be transmitted, it is traversed at an angle when it hits on an object and the signal is received by the Trigger pin.

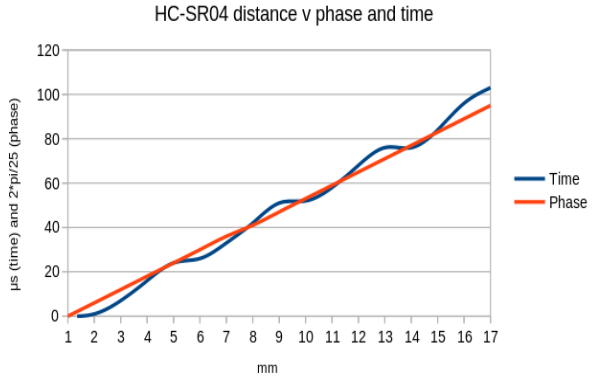

Fig 6: Graph between length and v.

The relation between reflected rays and output voltage is shown.

a) Features

Working Voltage: 5VDC
Quiescent Current: <2mA
Working Current: 15mA
Detecting Range: 2cm - 4.5m
Trigger Input Pulse width: 10uS

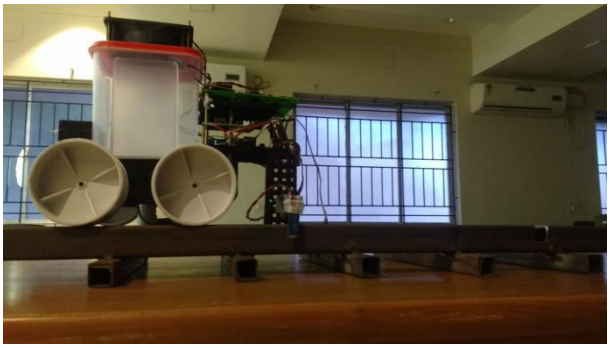

Fig 7: Side view

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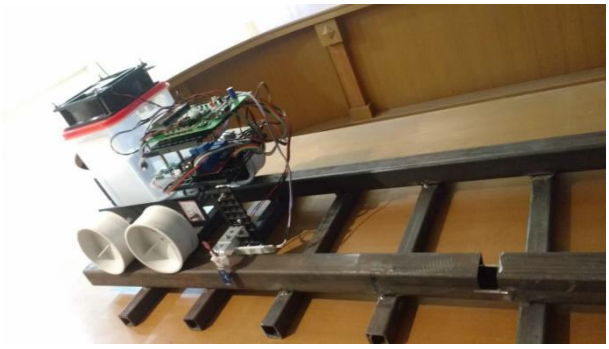

Fig 8: Front view

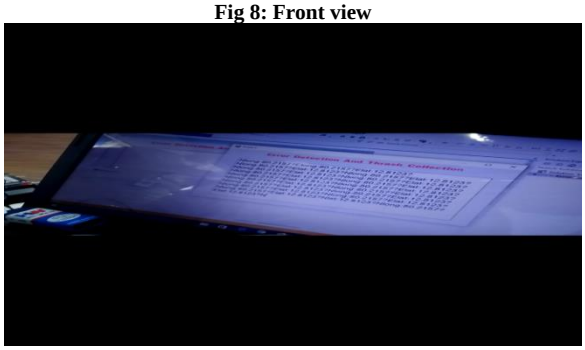

Fig 9: output

F. CONCLUSION

The crack on the railway track can be easily rectified to a greater extent and the trash collection mechanism between the railway track, has also been implemented in this method which will reduce the manpower, time wastage and improper work has been reduced. The exact location of crack is found easily which the naked eyes of human couldn't see or find so this method is well suitable for the current and future generation.

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