RAILWAY TRACK CRACK DETECTION ROBOT

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INTRODUCTION

- Railway is one of the most significant transportation modes of our country but it is a matter of great sorrow that, railway tracks of our country are very prone. A vast number of accidents are occurring every year due to this primitive type of railway tracks and as the consequences of those accidents we lose huge number of lives every year.
- The main cause of the railway accidents are railway track crossing and unrevealed crack in railway tracks.
- This project discusses a Railway track crack detection and obstacle detection using sensors.
- It is a dynamic approach which combines the use of GPS tracking system to send alert messages and the geographical coordinate of location.
- Also when the crack is detected it will be displayed on LCD display giving indication.
- A camera is used for continuous monitoring of the track .
- Functioning of robot is carried out using Arduino Mega.

LITERATURE REVIEW

1. Railway track crack detection based on GSM Technique

- In this model op-amp play a vital role that to identify the cracks in railway line. Here we use LM358 op-amp that is connected to resistive network and in another terminal, we apply reference voltage.
- Suppose there is no crack in the main line then it gives us a predefined voltage, but due to crack in the line voltage changes. Output of op-amp is applied to microcontroller.
- Using GSM modem we can find out whole information of the track whether the track has gap, if there is gap then it will show on software that is designed in vb6.0. At software end, we can find out location where crack is.
- If there is any crack then on LCD there is pole message display. There is LED indication if there is crack then green LED turn RED. In these manners we can find out the crack. In this project we have used AT89S52 microcontroller.

Ref: "Railway track crack detection based on GSM technique" by Mr. Anand S. Muley,Mr. Siddhant B. Patil, Prof. A.H.Shelar, International Research Journal of Engineering and Technology,jan 2017

2. Detection of Damage and Crack in Railhead by Using Eddy Current Testing

- Two eddy current sensor probes were used. One was for detecting the signal from a rail. It was positioned on a tested sample and scanned along the rail length. Another was for reference. It was positioned in air far from a sample.
- Two detection coils in each sensor probe were connected in a differential circuit, which was common technique in magnetic sensor. The controller supplied an excitation current to a series connection of two excitation coils and amplified a signal from the detection coils.

Ref: "Detection of Damage and Crack in Railhead by Using Eddy Current Testing";by Zenglu Song1,Tsutomu Yamada, Hideki Shitara, Yasushi Takemura,Journal of Electromagnetic Analysis and Applications, 2011"

3.Automatic Broken Track Detection Using IR Transmitter and Receiver

- In this method the crack is detected by using the IR transmitter and receiver assembly.
- It includes a robot which will move on the tracks to detect cracks. The principle involved in this crack detection is that light reaching the IR receiver is proportional to the intensity of crack
- The IR transmitter will be attached to one side of the rails and the IR receiver to the opposite side.
- During normal operation, when there are no cracks, the light from transmitter does not fall on the receiver and hence the set value is low.
- When the light from transmitter falls on the receiver, the value gets increased and the amount by which it is incremented will be proportional to the intensity of the incident light.

Cont.....

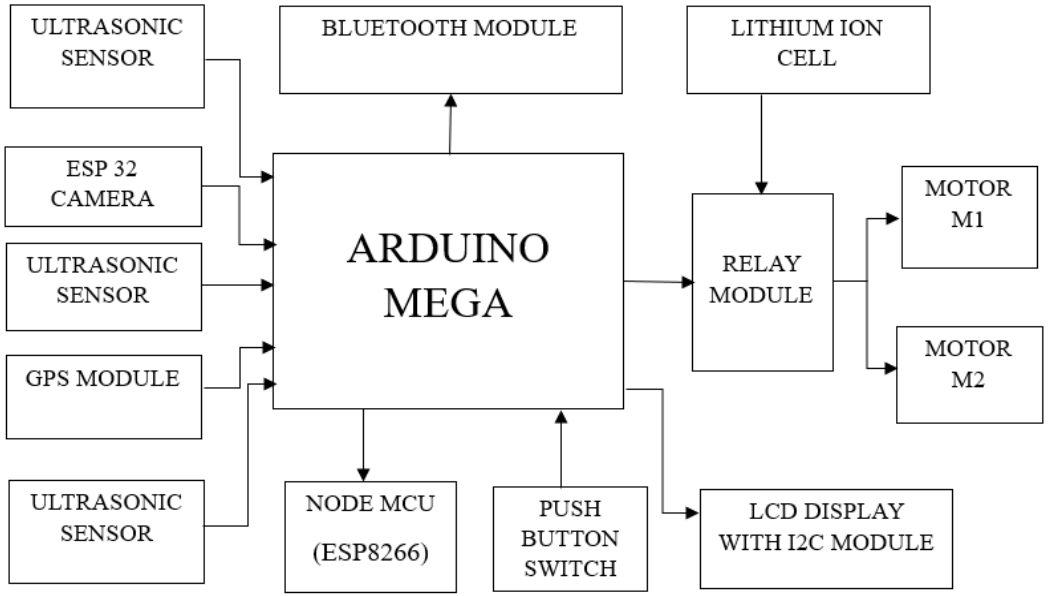
- As a consequence, when light from the transmitter deviates from its path due to the presence of a crack or a break, a sudden increase in the value can be observed.
- It uses a GPS receiver whose function is to receive the current latitude and longitude data.
- To communicate the received information, it make use of a GSM modem.

Ref: “Automatic Broken Track Detection Using IR Transmitter and Receiver”; by Reenu George, Divya Jose, Gokul T G, Keerthana Sunil, Varun A G ;International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, April 2015

OUR PROPOSED PROJECT

- In this project, a camera is used for the proper evaluation of the crack that is occured.
- Ultrasonic sensor is used for obstacle detection.
- The location where the crack has been detected will be send to the respective mobile number with the help of GPS and NodeMCU.

BLOCK DIAGRAM



WORKING

- Here we are using Arduino Mega 2560 microcontroller.
- Two ultrasonic sensors are fitted on either side for detection of the crack. One more ultrasonic sensor is placed at the front of the robot for obstacle detection in the path.
- Lithium cell is used here as power source.
- ESP32 Camera is attached in order to get visual details regarding the progress of the work.
- Relay module is used for controlling the wheels of the robot.
- We get the details related to position to the respective mobile number with the help of GPS and NodeMCU.
- LCD display is there for showing the status of the track.
- Movement of robot is controlled using Bluetooth module. An application is created for controlling the robot via the Bluetooth module.

COMPONENTS AND SPECIFICATIONS

- ARDUINO MEGA :

The ATmega2560 is a Microcontroller with operating voltage of 5v.
The recommended Input Voltage will range from 7volts to 12volts.
The digital input/output pins are 54 and analog pins 16.
The clock speed is 16MHz.

- ULTRASONIC SENSOR :

Power Supply: DC 5V
Working Current: 15mA
Working Frequency: 40Hz
Ranging Distance : 2cm – 400cm/4m
Measuring Angle: 15 degree

○ CAMERA (ESP 32 MODULE) :

WIFI module: ESP-32S

Processor: ESP32-D0WD

Built-in Flash: 32Mbit

RAM: Internal 512KB + External 4M PSRAM

Output image format: JPEG (OV2640 support only), BMP, GRAYSCALE

IO port: 9

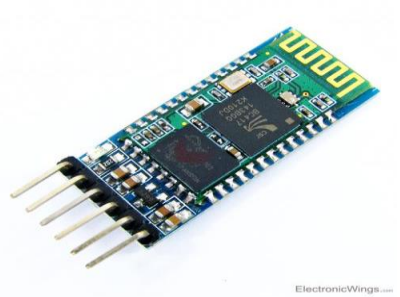
UART baud rate rate: default 115200bps

Power supply: 5V

○ BLUETOOTH MODULE :

Operating voltage: 3.3V to 5V DC

Operating current: less than 50mA



- GPS MODULE:

Input supply voltage : 2.7~6

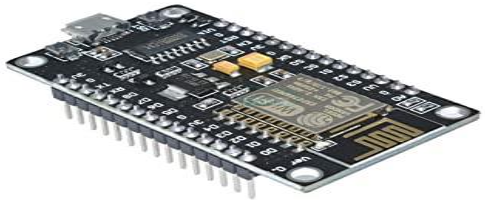
Frequency : 1575.42 MHz ± 1 MHz

Sensitivity : -138 dB for tracking

- NODEMCU (ESP8266) :

Operating Voltage: 3.3V

Input Voltage: 7-12V



○ LCD DISPLAY:

The operating voltage of this display ranges from 4.7V to 5.3V

The operating current is 1mA without a backlight

LED color for backlight is green or blue

Number of columns – 16

Number of rows – 2

Number of LCD pins – 16

○ RELAY MODULE :

Supply voltage – 3.75V to 6V.

Trigger current – 5mA.

Current when the relay is active - ~70mA (single), ~300mA (all four)

Relay maximum contact voltage – 250VAC, 30VDC.

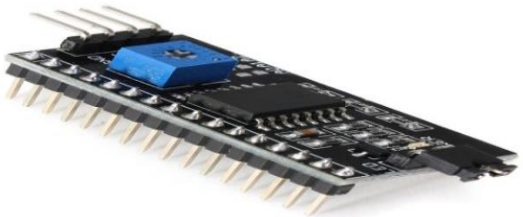
Relay maximum current – 10A.

I2C MODULE :

Operating Voltage: 5V

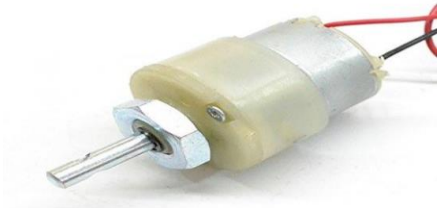
Backlight and Contrast is adjusted by potentiometer.

Serial I2C control of LCD display using PCF8574 .



GEAR MOTOR:

Motor Type	:	DC with Gear Box, Metal Gears
Base Motor	:	DC 3000 RPM
Max Load Current	:	~330mA at 12V
Maximum Torque:		~3 Kg-cm at 12V
RPM	:	45 RPM at 12



○ LITHIUM CELL:

Battery 3.7V-1750mAh – Lithium Iron Phosphate (LiFePO4 – LFP)

Stored Energy : 1.28 KWh.

New high performance sealed cylindrical cell.

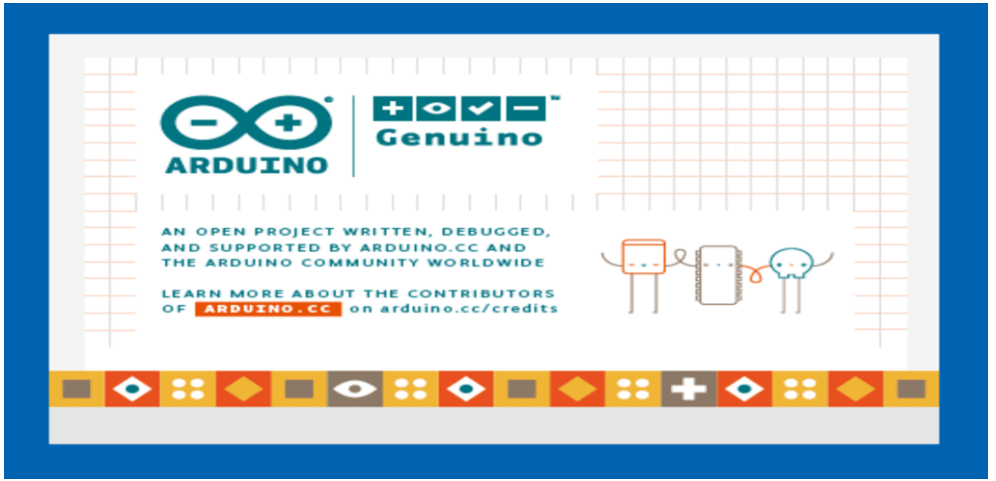
98% energy efficiency.

Weight : 11.5Kg.

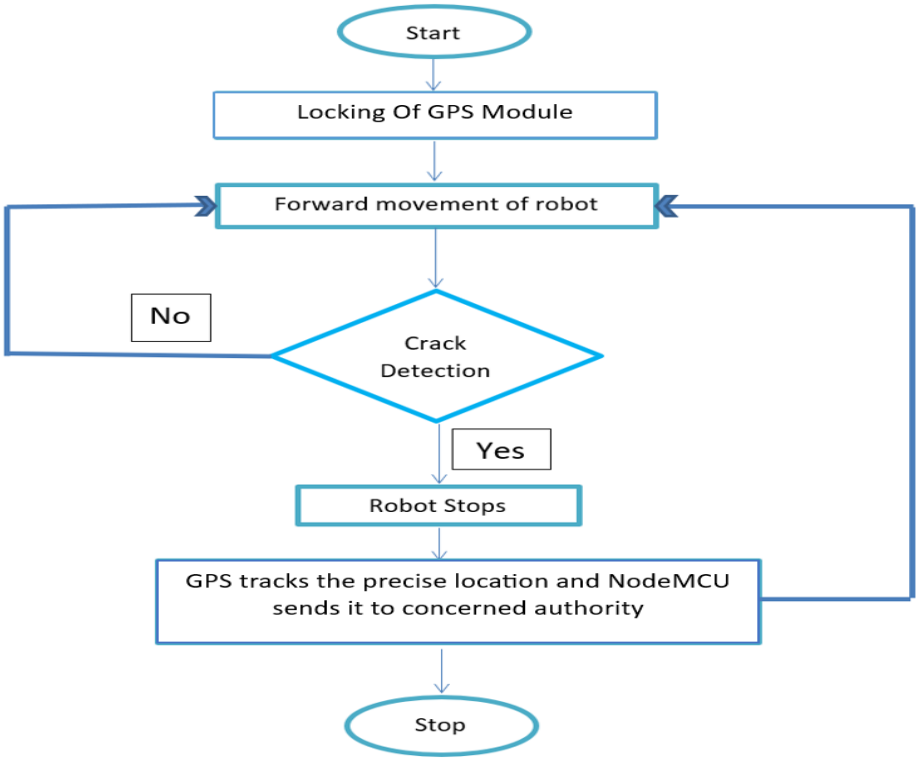
Dimensions : 260mm x 168mm x 212mm

SOFTWARE USED

- Arduino IDE



FLOW CHART


Start
Locking Of GPS Module
Forward movement of robot
No
Crack Detection
Yes
Robot Stops
GPS tracks the precise location and NodeMCU sends it to concerned authority
Stop

PRICE OF COMPONENTS

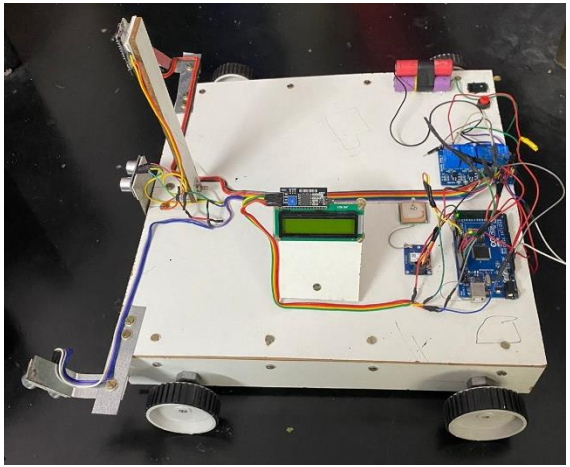
- ARDUINO MEGA - 4,195/-
- ULTRASONIC SENSOR - 56/-
- CAMERA - 679/-
- PUSH BUTTON SWITCH - 89/-
- GPS MODULE - 265/-
- NODE MCU - 415/-
- LCD DISPLAY - 119/-
- BLUETOOTH MODULE - 225/-
- RELAY MODULE - 138/-
- GEAR MOTOR - 149/-
- LITHIUM CELL - 2,100/-
- I2C MODULE -75/-

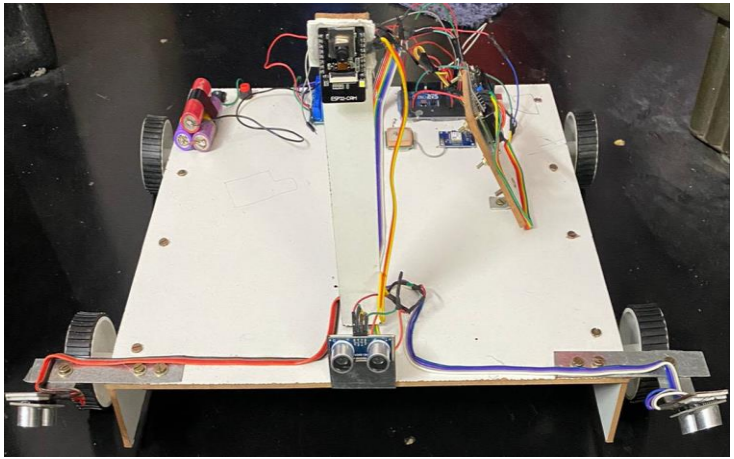
The total cost for the project is 8,800/-

CURRENT STATUS

- Hardware and software part of robot is completed.
- Completed work of track.
- Verified the movement of robot through the track.
- Verified the detection of crack and obstacles.
- Verified video streaming and location of crack was obtained.

RAILWAY TRACK CRACK DETECTION ROBOT





LCD DISPLAY WITH OUTPUT

CONCLUSION

- This project is a robot that detects the crack and obstacles in the path.
- This method proposed has lots of advantages over conventional detection approaches that include minimal cost, reduced energy consumption, efficient detection system without human involvement and shorter analytical times.
- This project help in reducing the number of rail accidents that occur due to cracks in the tracks.

REFERENCE

[1] “Railway track crack detection based on GSM technique” by Mr. Anand S. Muley,Mr. Siddhant B. Patil, Prof. A.H.Shelar, International Research Journal of Engineering and Technology,jan 2017

[2] “Detection of Damage and Crack in Railhead by Using Eddy Current Testing”;by Zenglu Song1,Tsutomu Yamada, Hideki Shitara, Yasushi Takemura,Journal of Electromagnetic Analysis and Applications, 2011

[3] “Automatic Broken Track Detection Using IR Transmitter and Receiver”; by Reenu George, Divya Jose, Gokul T G, Keerthana Sunil, Varun A G ;International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering, April 2015

THANKYOU