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Crack and Obstacle Surveillance Using Wireless Technology

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ABSTRACT: The current scenario of crack detection involves periodic maintenance coupled with visual inspection and laser methods. The requirement for automatic crack detection in railway tracks, by avoiding human intervention is a dire need. One of the major accidents in the railways networks are occurs due to track side faults.

This project intends to provide a cost saving and a potent solution by constructing an embedded electronic system that has the potential to detect a crack and also notify the nearest railway station about it. This project involves the use of Arduino board to interface the various modules- obstacle and crack detection.

KEYWORDS: Arduino UNO,GSM,GPS,IR sensor.

I. INTRODUCTION

In India, the most commonly used mode of transport is the railway network. India has a very vast railroad network, connecting all regions and states with one another .Indian rail network has an approximate track length of 115,000 kilometres over a route of 65,000 kilometres with 7,500stations. It is the fourth largest railway network in the world. In order to manage such large transits, it is required that the railroads are properly maintained so as to avoid any discrepancies which can lead to a fatal calamity.The current maintenance regime involves the usage of manual labour which carry out checking by physical testing or by visual inspection, other methods involve use of eddy currents and laser. But this maintenance regime is time consuming and not 100% reliable.

This project aims to solve the maintenance issue by developing an autonomous crack and obstacle detection robot powered by a battery, which can be used to check for cracks or discrepancies along the track. It also involves an obstacle detection circuitry in order to check whether the tracks are clear from any unwanted obstructions, which can lead to a mishap such as train derailment. It also consists of GPSand GSM modules so as to communicate the location of the crack or any obstruction along the track to the nearest authority centre.

II. PROPOSED IMPLEMENTATION

The diagram shown below is the block diagram of this model. It uses an Arduino UNO board to interface the motor driver, IR sensor and the GSM and GPS modules. The involvement of GSM and GPS modules was proposed to ease the process of communication with the authorized centre. The dual bi-directional motor driver allows the user to independently control two motors of 2A each.The movement of the wheels are controlled by these two motors. These motors are interfaced with the Arduino. Hence, an optimized usage of this proposed idea would be necessary to achieve the information related to crack and obstacle detection in the railways.

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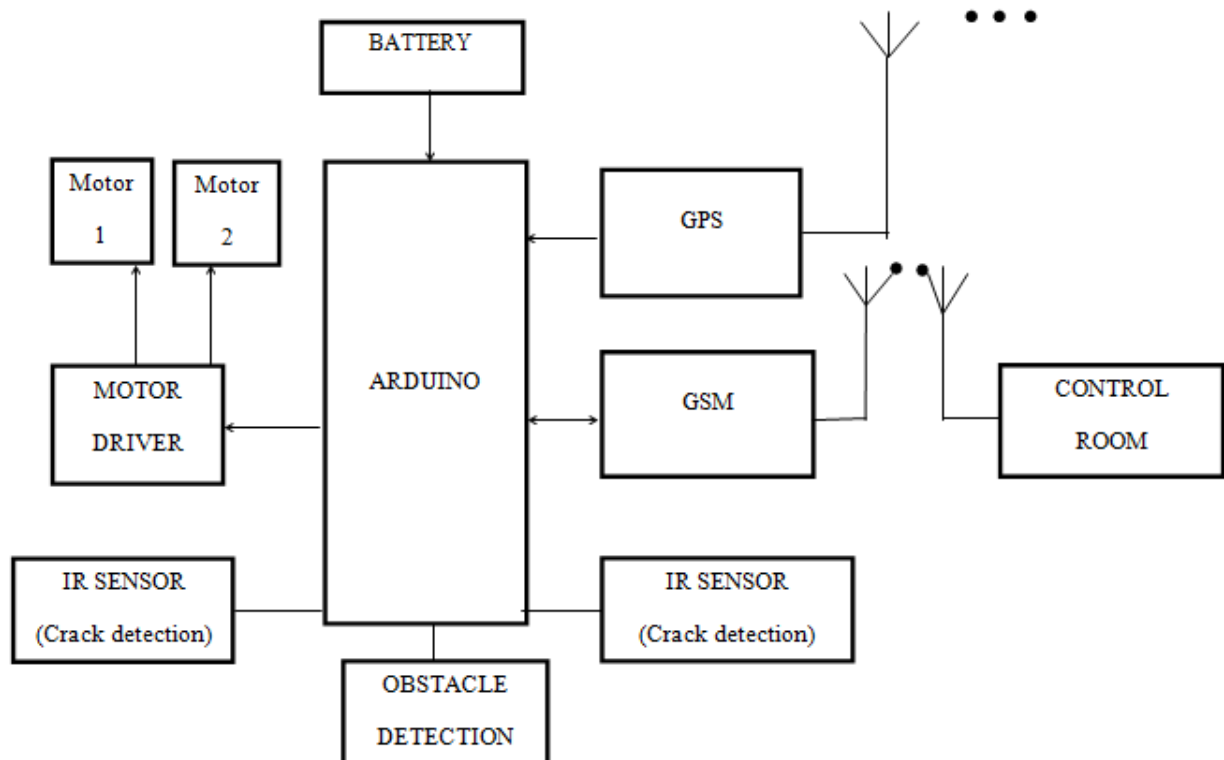


Fig: Block Diagram

2.1 HARDWARE DETAILS:

2.1.1 ARDUINO UNO Board: Arduino UNO is used as a controller instead of a conventional micro-controller because the interfacing of an Arduino board is simpler and more compatible with leading softwares. Also, for controlling a micro-controller it requires a programming board which helps to interface the same with a PC. Micro-controller consists of fixed number of pins and hence can be interfaced with limited number of devices whereas Arduino can be interfaced with many devices. Some of the general features of Arduino are- 64kb on-chip Flash program Memory with ISP and SPI with enhanced UART. It uses TTL and CMOS compatible logic levels. The characteristics of the output pins of an Arduino can be easily controlled using Arduino IDE.

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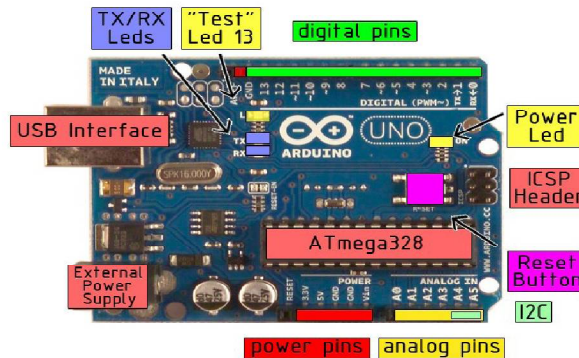


Fig 2.1.1(a) Arduino Board

2.1.2 GPS: This project uses SKG13BL GPS module. The signals obtained by the GPS receiver take note of the precise latitudinal and longitudinal parameters and connects it to the GSM module for the purpose of transferring the information to the respective authorized centre. The input voltages required. A GPS receiver must be locked on to the signal of at least 3 satellites to calculate a 2-D position (latitude and longitude) and track movement. With four or more satellites in view, the receiver can determine the user's 3-D position (latitude, longitude and altitude). Enhanced features include video features, trace mode, history track and network support.

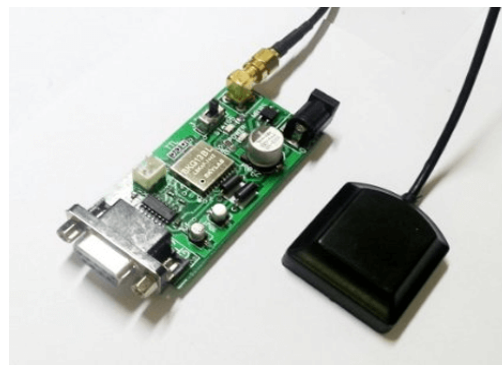


Fig 2.1.2 (a) GPS module with antenna

2.1.3 DC MOTOR: The two motors are used to control the speed of the robot. A DC motor's speed can be controlled over a wide range, using a variable supply voltage. To travel a distance of 11 Km in 2 hours, an average speed of 0.75 meters/sec will be required. This project uses 2 DC motors which control the wheels of the robotic vehicle. It works on the principle of relay operation. When relay 1 is ON and relay 2 is OFF, the motor runs in the forward direction. When relay 2 is ON and relay 1 is OFF, the motor runs in the reverse direction.

2.1.4 IR SENSOR: It is a short range crack and obstacle detector. It has a narrow detection area which can be expandable. Range can also be increased by increasing the power to the IR LEDs or adding more IR LEDs. It has a range of about 10-15cm (4-6inches) for any obstacle to be detected.

2.1.5 GSM: This project involves the use of SIM300. It is the element which sends the geographical locations of the crack as SMS to the nearest authority centre. It requires a SIM (Subscriber Identity Module) card to activate communication with the network. Also it has IMEI (International Mobile Equipment Identity) number for its

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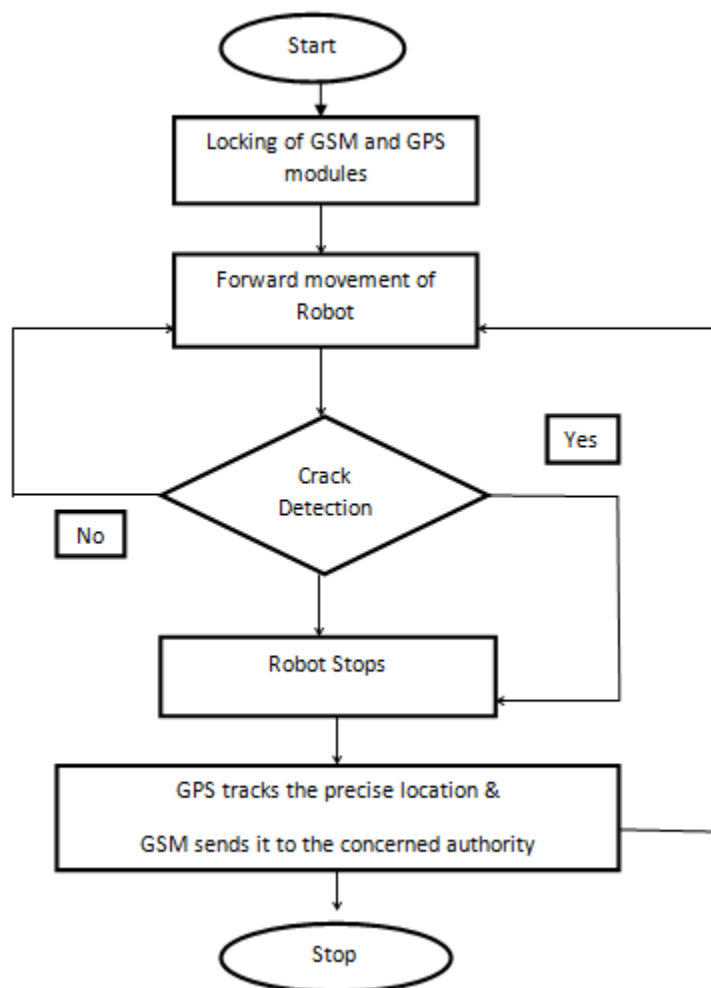
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identification. The Module needs AT commands which are communicated through serial communication. It can receive, send or delete SMS messages in a SIM.

2.2 SOFTWARE DETAILS:

2.2.1 FLOWCHART

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



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2.2.2 SOFTWARE ALGORITHM

STEP 1: Once the robot is placed on the track and is powered on, the GPS and GSM modules are locked after some period of time.

STEP 2: The robot starts moving on the track and the moment it finds a crack in the track it stops. The crack is detected according to its specifications given.

STEP 3: As soon as the crack is detected, the latitudinal and longitudinal values of the crack are captured by using the GPS antenna and are recorded.

STEP 4: The robot starts moving forward, once the values are recorded to detect further cracks if any. Meanwhile the values are sent in the form of SMS to the nearby railway authority centre with the use of GSM module.

STEP 5: The concerned authority receives the information of the crack being detected and its geographical values.

Also this project aims to detect any obstacles on the track and follows the same procedure of sending SMS to the authority centre. The robot works until the battery lasts and the battery is changed periodically.

III. RESULT

The Robot was thus created by programming the Arduino and synchronizing the two modules with it. The robotic arms were placed at the periphery of the moving robot. The assessment of this prototype was done on a simulated track made of aluminium on which cracks were duly made for observing the expected outcome. An uninterrupted movement of the robot along the track would connote that the crack is in good shape and has no obstacles along the path. It was seen that once the GSM and GPS modules were locked, it provided a precise end result. The glitch in the railway tracks needs to be solved in order to reduce the hazards, hence the project can be employed on a large scale arena. We can incorporate the crux of this project, in gas pipeline systems also with slight variations



Fig 3.1 (a) SMS received

Fig (a) shows the message received by the authorized centre giving the details about sensors being tripped and their geographical parameters. The geographical parameters include latitudinal and longitudinal positions. For example, when the sensor 3 is tripped the latitudinal value is 1915.3968 and longitudinal value is 7258.6804.

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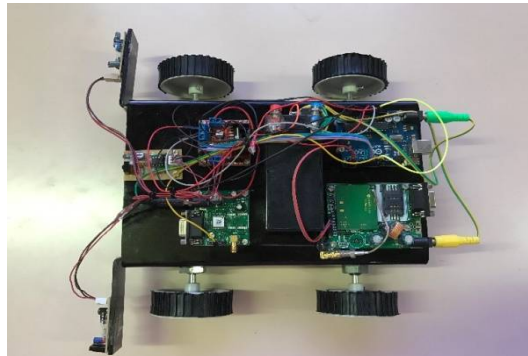


Fig 3.1 (b) Hardware Implementation

Fig(b) shows the robot which is a combination of various modules used in the system. Here, the modules are GSM and GPS. It also includes motors, IR sensors and battery. This robot is then placed between the tracks.

IV. CONCLUSION

Thus we implemented the proposed system as per the referred block diagram. Our algorithm detects the crack as well as obstacle of railway tracks and successfully transfers the required parameters to the authorized centre. Our project thus intends to smoothen the system by introducing humanless efforts.

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