Railway - Track crack detecting system using ARDUINO

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Abstract— The objective of the project is to efficiently design a system to discover the crack faults if any on either of the track sides. This project has been brought in to create a fundamental solution which can therefore be improvised and spread out as a mere real time application. The ideology behind the developed prototype can be of a fine use to the railway administration. As of the recent times, the manual maintenance of the co – workers definitely went in vain. Eventually with the advancement of many open sources, the issue of inaccuracy seemed to be limited to a great extent. Having this as a better motivation, the attempted project proved a good way of organizing the discovery of rail cracks. ARDUINO, one of the most flexible controllers set a good platform with expected outcomes in accordance with the application aspects. GSM and GPS are the heavy working units for the entire system. This prototype can come over with critical impact.

Keywords— *ARDUINO, GSM, GPS*

I. INTRODUCTION

The proposed system makes it on with the ATMEGA328 microcontroller using the Arduino UNO board. Unlike the existing system, this takes in the responsibility of conveying the exact location of crack detected region using the GPS and sending the exact location to the respective railway department using GSM.

The prototype gets along the track for the cases of crack detection. The IR sensors which are collective unit of an LED and a photodiode clinched together are made to travel along the rails. The LED transmits the IR rays whereby which the photodiode senses the reflection. In case of a gap or crack, the alarm gets activated with a HIGH pulse. The IR sensors thereby communicate to the microcontroller indicating a crack and set the pulse to digital '1'. The microcontroller then communicates with the LCD, GSM modem etc., in a parallel manner. The GPS already tracks the location time to time and the crack location exactly will be conveyed using the GSM modem. The prototype halts for a while and then continues in search of track cracks thereon.

II. LITERATURE SURVEY

Taking into consideration an existing system with its methodology to find the crack position by formulating the distance from the origin, our intention was to come up with the direct streaming location unlike the earlier implementation. So, the usage of the GPS analogy is an added feather for the proposed system.

III. DESIGN OF THE SYSTEM

The block diagram of the design includes the power supply unit, micro controller, LCD display, MAX232, relay, GSM and GPS modems. The brief description of each unit is explained as follows.

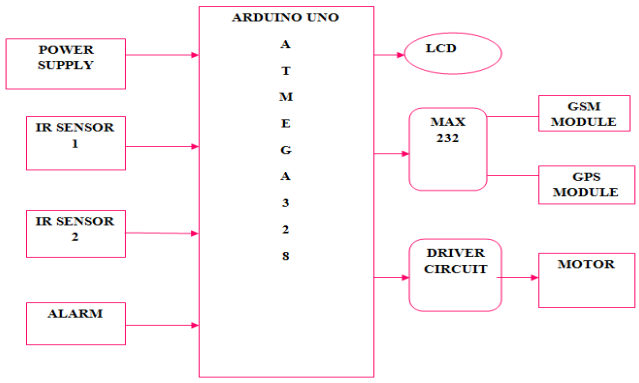


Fig (a) Block diagram of the proposed system

1. Power supply:

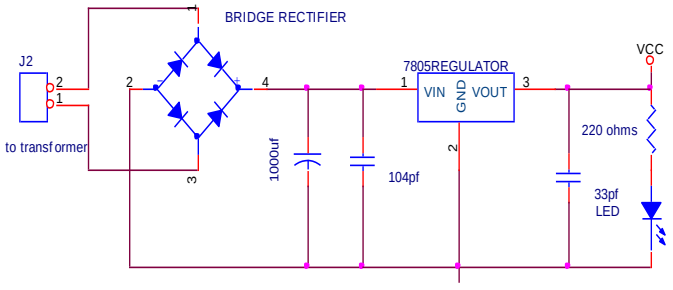
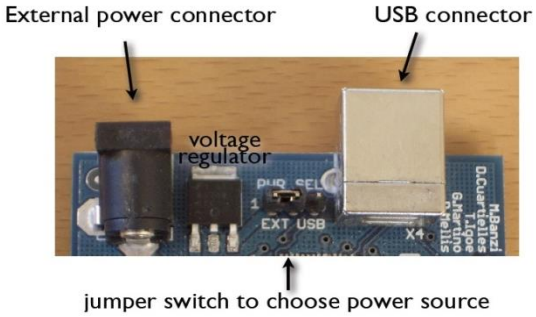


Fig (b) Power supply circuit

The power supply unit takes in an input of 220v. Bridge rectifier converts this ac voltage into 12v pulsating dc voltage. Beyond the rectifier, the voltage regulator limits the voltage to

5v. Different units starting from the diode to the dc motor keep ranging from 5v to 12v DC power supply.



On the other hand, ARDUINO can run off with USB or external power.

2. ATMEGA328 (Microcontroller)

Features:

- 16 MHz
- 14 digital Input/ Output Port
- 8 Bit RISC Controller
- 28 Pin DIP IC
- 32 Kb Flash reprogrammable memory (ROM)
- 2Kb Internal RAM
- 1Kb EEPROM
- 6 ADC Channels
- 6 PWM Channels

3. IR Sensors:

This is the initial phase of the process in which the sensors are to trace the crack positions. The IR sensor is a collective unit of an LED (transmitter) and a photodiode (receiver). The IR rays transmitted by the LED are to be detected by the photodiode concluding the status of finding a crack. The sensor arrangement can be done in two ways. One, method is by placing the sensors above the track.

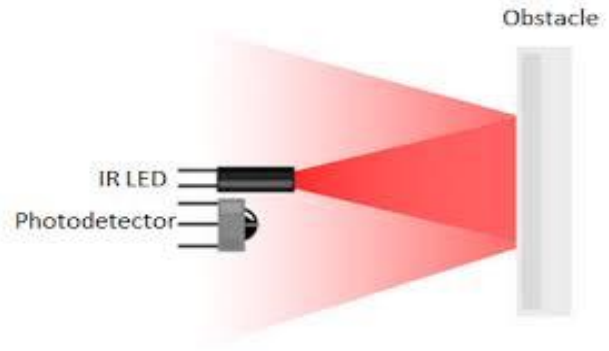


Fig (d) Sensor operation

The other way of placing is the line of sight method. Both the modes of sensors take different placements on the track. A crack is said to be found when the photodiode cannot be able to receive the reflected rays. This proves that a crack has occurred and with this acknowledgement a high pulse is sent to the microcontroller. The microcontroller then starts it parallel communication with the other units.

4. MAX232:

With the contents like GSM and GPS modems the microcontroller finds it difficult to set its path in communicating with them. The controller has its voltage levels in the format of TTL logic and the GSM, GPS modules take up the RS232 format. This situation is handled by the MAX232 circuit forming to be an interface between them. MAX232 is otherwise said to be a voltage regulator in adjusting the voltage levels whenever needed while the communication involves different format systems. It can be defined as a voltage "DOUBLER" as well as a voltage "INVERTER" with an intake of 5v.

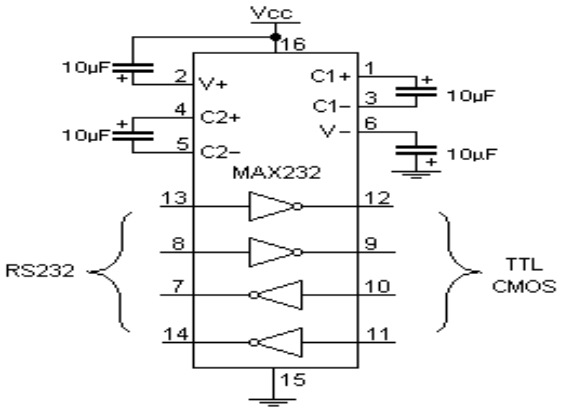


Fig (c) MAX232 circuit set - up

5. Relay:

This is used as a driving circuit for the DC motor. The internal set up of the relay initially has its control pin connected to NC (normally closed) pin which means that the motor is supplied with power and is in motion. The crack intimation is done by the controller's A_0 pin that provokes the control pin to connect with the NO (normally open) pin halting the motor. Hence the switching of the power supply is done by the relay operation.

6. DC Motor:

A uni – directional gear motor is used for the prototype to move along the track. The operating voltage of the motor can range anywhere from 5v to 12v.

7. GPS (Global positioning system):

This part of the project plays a crucial role in intimating the exact location of the fault discovery. The module once initialized starts tracing the latitude and the longitude values of the adjacent positions while the body keeps moving. The accurate position of the fault is then recorded and is to be communicated to the GSM module. This is where the max232 structure is needed for the interpretation. This communication is done from the GPS structure to controller and then from the controller to GSM structure. The GPS modem operates at 12v. $GPRMC is the head command for reading the latitude and the longitude values.

8. GSM (Global system for mobile communication): SIM800 is the GSM module used here. The obtained GPS values are to be informed to the respective person in the railway department. The controller sends the serial data to the GSM via the max232 circuitry.

- AT - Returns a "OK" to confirm that modem is working
- ATD - Mobile originated call to dial able number
- ATH - disconnect existing connection
- AT+CMGS - send the SMS message to
- AT+CMGF=1 - Select format for incoming and outgoing messages: zero for PDU mode, one for Text mode.
- AT+CMGD=1 - delete the SMS message
- AT+CMGR - read the SMS message

The above commands are some of the commands used in implementing the working.

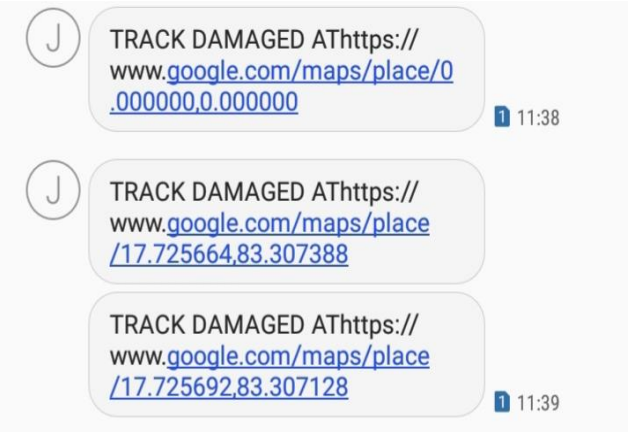


Fig (f) Location via message

The above figure is a sample display of the conveyed information indicating that the crack has occurred at the very position. The GSM technique is likewise used as a peculiar feature.

9. Liquid crystal display (LCD):

The 16*2 character lcd is an additional feature just for the sake of the display of the obtained location values. The operating voltage is 5v from the microcontroller. It has a duty cycle of 1/16 which means that it takes $1/16^{th}$ of the entire time taken to display a pixel part.

10. Buzzer:

The other nominal feature is the buzzer to form a beeper as soon as the crack is determined. The positive wire goes to the A_1 pin of the microcontroller.

IV. RESULT

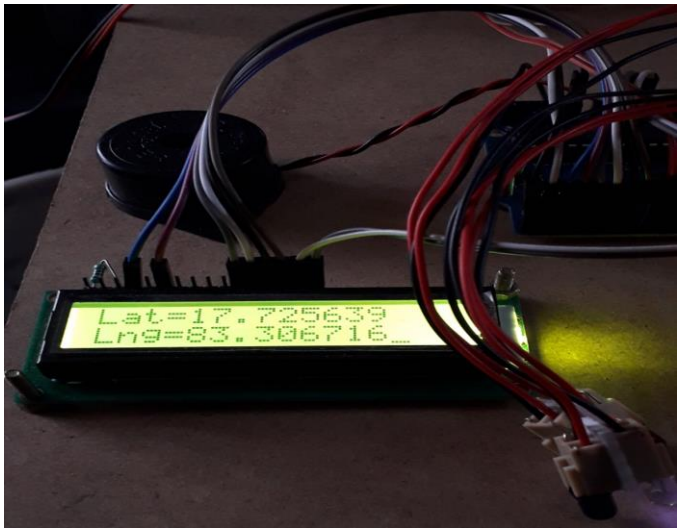


Fig (e) Display of the GPS values

CONCLUSION

This project we have undertaken has helped us gain a better perspective on various aspects related to our course of study as well as practical knowledge of electronic equipment and communication. Till now it has used the literatures for all the topics that include GSM automation system using SMS. Then main control program, hardware and automation system is built and sent through the GSM network (with SMS). A hardware implementation of the system was carried out to verify the reliability of the system. The implemented system was simple, cost effective and flexible that can be expanded and scaled up. It can be concluded that the design implemented in the present work provide portability, flexibility and the data transmission is also done with low power consumption.

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