

Arduino Based Robust Railway Track Deviation and Rail Crack Detection System

Ch.Sampath Kumar

M.Tech Embedded Systems,
CMR College of Engineering,

Kandlakoya, Medchal Road, Hyderabad-501401.

Dr.M.Sudhakar M.Tech, Ph.D

Vice Principal,

CMR College of Engineering,
Kandlakoya, Medchal Road, Hyderabad-501401.

Abstract:

The paper introduces a project that aims in designing robust railway crack detection scheme (RRCDS) using TSOP IR RECEIVER SENSOR assembly system which avoids the train accidents by detecting the cracks on railway tracks. And also capable of alerting the authorities in the form of SMS messages along with location by using GPS and GSM modules. The system can also provide the Data logging of the traveled path into MMC/SD card. The system also includes Ultrasonic distance measuring sensor which displays the track deviation distance between the railway tracks.

Keywords:

Robust railway crack detection scheme.

1. Introduction:

Transport is a key necessity for specialization that allows production and consumption of products to occur at different locations. Transport has throughout history been a spur to expansion as better transport leads to more trade. Economic prosperity has always been dependent on increasing the capacity and rationality of transport. But the infrastructure and operation of transport has a great impact on the land and is the largest drainer of energy, making transport sustainability and safety a major issue. In India, we find that rail transport occupies a prominent position in providing the necessary transport infrastructure to sustain and quench the ever-burgeoning needs of a rapidly growing economy. Today, India possesses the fourth largest railway network in the world. However, in terms of the reliability and safety parameters, we have not yet reached truly global standards.

The principal problem has been the lack of cheap and efficient technology to detect problems in the rail tracks and of course, the lack of proper maintenance of rails which have resulted in the formation of cracks in the rails and other similar problems caused by anti-social elements which jeopardize the security of operation of rail transport. In the past, this problem has lead to a number of derailments resulting in a heavy loss of life and property. Cracks in rails have been identified to be the main cause of derailments in the past, yet there have been no cheap automated solutions available for testing purposes. Hence, owing to the crucial repercussions of this problem, an efficient and cost effective solution suitable for large scale application is required.

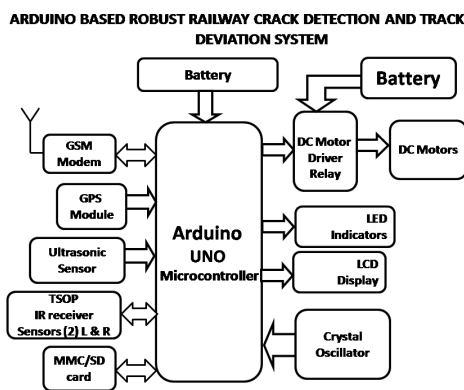
2. LITERATURE SURVEY:

Technologies and resources:

Qiao Jian-hua proposed a system that takes the linear charge coupled device (CCD) as image sensor, processes the image signal collected, judges out the crack signal, and displays the curve through the LCD, and gives off the alarm. The system essential modules such as, the CCD timing generator, A/D converter timing generator, address generator, RAM memory all are realized on CPLD. The whole system is fixed on the vehicle-hold system, traveling along the railway, then conveniently examines the crack position, thus may promptly carry through track maintenance, avoiding the accident. Moreover, the system can connect with the PC, transforming the sampling data to PC to further analysis. In another method K. Vijayakumar has investigated crack detection using microwave sensors.

It describes how a Microwave horn antenna can be used to detect the cracks in a rail track. Based on the simulation results obtained from the High Frequency Simulation Structure (HFSS), it has been shown that the design of the Microwave sensor has the potential for detecting defects in the rail surface including minor cracks as well as more serious as well as. In another method, Richard J. Greene have presented a new crack detection method, for rail which utilizes the change in infrared emission of the rail surface during the passage of a train wheel.

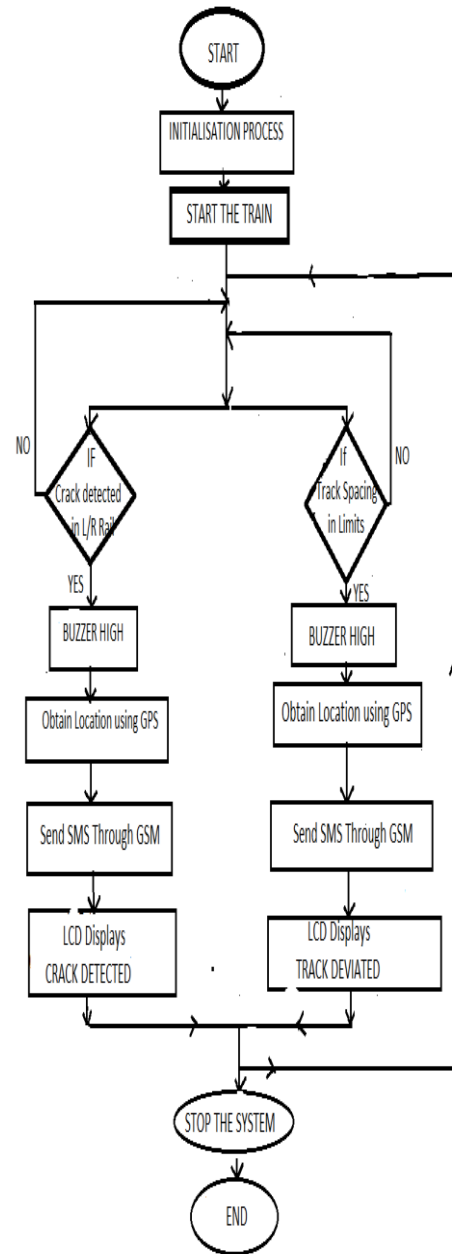
3. IMPLEMENTATION:



In this project, let us consider the two tracks; each track will have one TSOP IR RECEIVER SENSOR. Like this two tracks have 2 TSOP IR RECEIVER SENSOR. Whenever there is a crack on the track, then the IR transmitted rays reflected to the receiver deflects and it given to the Arduino Microcontroller.

This tracking system is composed of a GPS receiver, Arduino Microcontroller and a GSM Modem. GPS Receiver gets the location information from satellites in the form of latitude and longitude. The Arduino Microcontroller processes this information and this processed information is sent SMS to the authorities using GSM modem. The system also has a special feature of logging the traveled path into the MMC/SD card for further usage.

4. FLOW CHART:



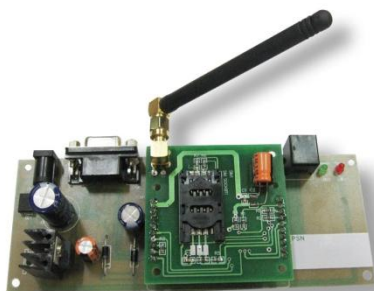
ARDUINO BASED ROBUST RAILWAY TRACK DEVIATION AND RAIL CRACK DETECTION SYSTEM

5. RELATED WORK:

The brief introduction of different modules used in this project is discussed below:

GSM:

GSM, which stands for Global System for Mobile communications, reigns (important) as the world's most widely used cell phone technology. Cell phones use a cell phone service carrier's GSM network by searching for cell phone towers in the nearby area. Global system for mobile communication (GSM) is a globally accepted standard for digital cellular communication. GSM is the name of a standardization group established in 1982 to create a common European mobile telephone standard that would formulate specifications for a pan-European mobile cellular radio system operating at 900 MHz. It is estimated that many countries outside of Europe will join the GSM partnership.



USB to Serial Converter:

This USB to Serial converter allows you to connect a RS-232 serial device such as a modem to a USB port on your Desktop or Laptop PC.



A USB adapter is a type of protocol converter which is used for converting USB data signals to and from other communications standards. Commonly, USB adaptors are used to convert USB data to standard serial port data and vice versa.

Ultrasonic sensor:



Ultrasonic sensors emit short, high-frequency sound pulses at regular intervals. These propagate in the air at the velocity of sound. If they strike an object, then they are reflected back as echo signals to the sensor, which itself computes the distance to the target based on the time-span between emitting the signal and receiving the echo.

IR SENSOR:



This sensor is a short range obstacle detector with no dead zone. It has a reasonably narrow detection area which can be increased using the dual version. Range can also be increased by increasing the power to the IR LEDs or adding more IR LEDs

GPS:

GPS satellites circle the earth twice a day in a very precise orbit and transmit signal information to earth. GPS receivers take this information and use triangulation to calculate the user's exact location. Essentially, the GPS receiver compares the time a signal was transmitted by a satellite with the time it was received. The time difference tells the GPS receiver how far away the satellite is. Now, with distance measurements from a few more satellites, the receiver can determine the user's position and display it on the unit's electronic map.



MMC Card:

A memory card or flash card is an electronic flash memory data storage device used for storing digital information. They are commonly used in many electronic devices, including digital cameras, mobile phones, laptop computers, MP3 players and video game consoles. They are small, re-recordable, and able to retain data without power.



Memory card pin outs:

Memory Stick description and PinOut Memory Stick is another type of Removable NAND-type small flash memory card format which was introduced in 1998. There are a few different Memory Stick formats: the Standard-size Memory Stick media measures 50.0mm x 21.5mm x 2.8mm [Width x Height x Depth], and the Memory Stick Duo media measures 31.0mm x 20.0mm x 1.6mm [Width x Height x Depth]. Pins 1 and 10 are longer than the other pins so ground is the first pin to make contact and the last to break contact. Pin 6 is recessed and make contact last as the stick is inserted. The pins are flat electrodes. The maximum transfer rate is 2.54MBps; with a maximum clock frequency of 40MHz. Memory Stick require power supply voltage of 2.7v to 3.6 volts.

Memory Stick Pinout:

Pin # Pin Name Signal Function

- 1)Vss Ground.2)BS Bus State.3)DATA1 Data Line 1.4) SDIO / DATA0 Serial Data In/Out, Data Line 0.5) DATA2 Data Line 2.6) INS Insertion Detection pin.7)DATA3 Data Line 3. 8)SCLK Serial Clock. 9) Vcc Power. 10) Vss Ground

Applications:

It used in railway departments to reduce the accidents

Future scope:

Although work can be done in order to provide a better speed to the automated vehicle robot. Also enhancement can be done to get better accuracy about the location of the place where the fault had occurred. Also the robot can be made large so that by using its weight track shiftiness i.e. stress and strain parameters of the track can be determined so as to make this system more effective. A zigbee module can also be incorporated for low cost short distance scrutinizing mechanism in order to provide good connectivity at a low input cost.

Advantages:

1. Highly efficient and user friendly design.
2. Easy to operate.
3. Low power consumption.
4. Location of the vehicle can be known using GPS.
5. To detect the crack using IR obstacle sensors
6. GPS and GSM based tracking details sending SMS
7. To avoid the accidents at a single track.
8. Efficient design.
9. Works anywhere in the world (GSM availability).

6. ACKNOWLEDGEMENT:

We would like to thank all the authors of different research papers referred during writing this paper. It was very knowledge gaining and helpful for the further research to be done in future.

**REFERENCES:**

- 1) Selvamraju Somalraju, Vigneshwar Murali, Gourav Saha, Dr.V.Vaidehi, "Robust Railway Crack Detection Scheme (RRCDS) Using LEDLDR Assembly," IEEE Int. Conf. on Networking, Sensing and Control, vol. 6, iss. 3, pg. 453-460 , May2012 [2].
- 2) Qiao Jian-hua; Li Lin-sheng; Zhang Jing-gang; "Design of Rail Surface Crack- detecting System Based on Linear CCD Sensor," IEEE Int. Conf. on Networking, Sensing and Control, vol. 14, no. 4, pp. 961-970, April 2008 [3].
- 3) K. Vijayakumar, S.R. Wylie, J. D. Cullen, C.C. Wright, A.I. Shammaa, " Non invasive rail track detection system using Microwave sensor," Journal of App. Phy., vol. 9, iss. 11, pg. 1743-1749, June 2009.