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ADVANCED RAILWAY TRACK FAULT DETECTION USING INTERNET OF THINGS (IOT)

Dinakumari[1], Shrinivas Gaddad[2]

[1]*Student, Dept. Electronics and communication engineering, VTU CPGS, India.*

[2]*Assistant Professor, Dept. Electronics and communication engineering, VTU CPGS, India*

ABSTRACT

System advancement in railway sector has also resulted in the increase of railway traffic. Because of this the number of accidents in trains/railways have also increased. Every year, almost 11 million passengers travel by train. It is therefore very much important Railway is the backbone of transport system in India. Rail accidents occur more due to derailments than collision or fire in trains. These derailments are due to cracks in the railway tracks. Therefore, there is an immense need of crack detection and security system. This paper proposes the crack detection system in the rail tracks. This is to avoid rail accidents by using latest communication technologies. In this project GSM communication protocols are used to convey the message of crack detection via SMS. Crack detection is achieved by using the concept of eddy current losses implemented in the terms of Darlington pair circuit. With the detection of cracks, the system also alerts the railway authorities facilitating the security to involve such kind of technology which reduces the train accidents and hence human's life. This paper is the analysis of various critical and unwanted situation, accidents, occurs in train system and how to prevent those accidents. In our paper we have included various approaches done by various researchers in order to avoid train accidents.

Keywords: IOT, Fault Detection, Railways.

INTRODUCTION

The main aim of this paper is to develop an embedded system to identifying rail track fault sending message to near station. The Transportation of train always depends on railway tracks (rails) only. If there is a crack in these rails, it creates a major problem. Most of the accidents in the train are caused due to cracks in the railway tracks, which cannot be easily identified. Also, it takes more time to rectify this problem. In order to avoid this problem, we are using the crack detector, which detects the crack in the rails and gives an alarm. The main aim of this paper is to develop an embedded system to identifying rail track fault sending message to near station through SMS.

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This system involves the design of crack finding for finding cracks in railway tracks. This system uses controller for interfacing the crack detection sensor and distance measuring sensor for object or human detection. The sensing device senses the voltage variations from the crack sensor and then it gives the signal to the microcontroller. The microcontroller checks the voltage variations between measured value and threshold value and controls the robot according to it. The model is interfaced with the microcontroller with the help of SPDT relays and driver IC. If any crack occurs in the rail, the system will be stopped and sends an alert message will be raised. This project uses regulated 5V, 750mA power supply. 7805 three terminal voltage regulator is used for voltage regulation. Bridge type full wave rectifier is used to rectify the ac output of secondary of 230/18V step down transformer.

1.2 Objective

1. Detect Cracks and Defects: Accurately detect cracks and defects in railway tracks.
2. Real-time Monitoring: Monitor railway tracks in real-time.
3. Automated Inspection: Automate the inspection process to reduce manual effort.
4. Improve Safety: Improve safety by detecting potential faults before they cause accede
5. Reduce Maintenance Costs: Reduce maintenance costs by detecting faults early and preventing major repairs.

CHAPTER-2

2.1 LITERATURE REVIEW

[2.1]. KALPANA SHARMA, JAGDISHKUMAWAT, SAURABH MAHESHWARI AND NEETI JAIN PAPER INTL. JOURNAL OF COMPUTER APPLICATIONS, VOL 96, JUNE 2014, PP.32-35

In this paper the following things have been studied. Like various techniques for detecting the cracks in the railway tracks. Method of inspection and maintenance with the help of a basic algorithm which uses the wireless sensors for detecting the cracks and breakages in railway tracks. which is used for the examination of foot of rails especially in those area where corrosion is likely to be occur.

[2.2]. V. SARAVANA MOORTHY AND G.N. MURUGANANTHAN PAPER —IDENTIFICATION OF OBSTACLE AND CRACK FINDING‖

Railway includes the techniques for the identification of obstacles and cracks finding techniques in ay system. According to their research, the train and the trolley would include a GPS receiver which sends the location to microcontroller placed in the train. —trolley‖ is the safety vehicle which will travel along a railway. If somehow, due to natural cause, trolley derail, stops or slows down due to any of the reason, then the CPU will generate commands to reduce the sped of the train so as to avoided derailing or colliding with the trolley. All this process will be enhanced by using wireless communication devices like ZigBee or RF transmitter.

[2.3]. KOHILAWAMAM AND R. BALAMURUGAN PAPER —THE SYSTEM TO PREVENT TRAIN ACCIDENTS USING ANDROID SUPPORTED EMBEDDED SYSTEMS

Proposed the system to prevent train accidents using android supported embedded systems. Such systems would be used to avoid collisions in the trains. A track ID will be given to all the railway track. Whenever the train travels it will communicate its track ID with the help of a transmitter. The train which nearest to the existing train will receive a signal through receiver. So, if two trains by mistake travels on the same track then an alert signal will be generated and given to both the railway drivers in order to stop the tram.

CHAPTER-3

3.1 METHODOLOGY

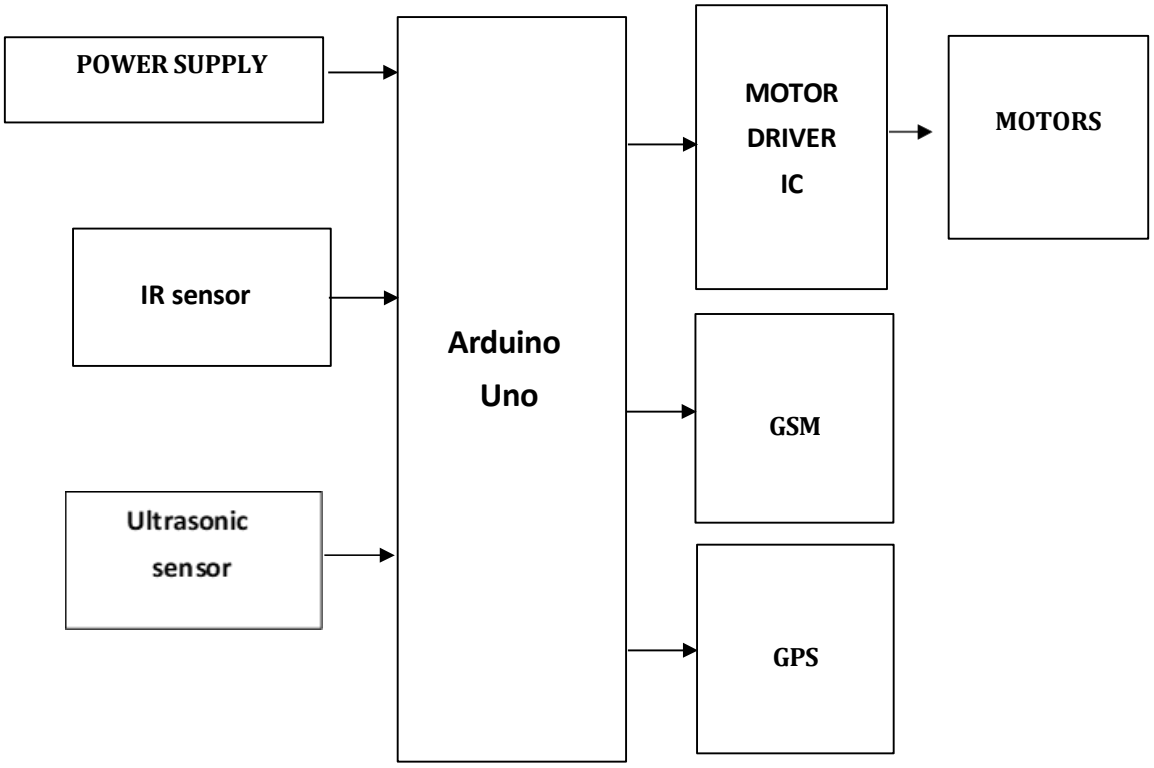
This system involves the design of crack finding for finding cracks in railway tracks. This system uses controller for interfacing the crack detection sensor and distance measuring sensor for object or human detection. The sensing device senses the voltage variations from the crack sensor and then it gives the signal to the microcontroller. The microcontroller checks the voltage variations between measured value and threshold value and controls the robot according to it. The model is interfaced with the microcontroller with the help of SPDT relays and driver IC. If any crack occurs in the rail, the system will be stopped and sends an alert message will be raised. This project uses regulated 5V, 750mA power supply. 7805 three terminal voltage regulator is used for voltage regulation. Bridge type full wave rectifier is used to rectify the ac out put of secondary of 230/18V step down transformer

3.2 Existing Model

In the existing system, techniques such as visual inspection, video transmission, and Magnetic field methods can identify the cracks on the railway tracks. Physical checking is one of the earliest methods in which all the necessary components will be scanned manually. This process is commonly used in India, despite generating the worst outcome. A camera is used for continuous monitoring of the track while streaming content. In this procedure small cracks and a high-cost system cannot be seen. The current passes through the railway track for detection of flaws in the eddy current method and the results produced are not accurate. Many of these techniques require a lot of processing power and an extremely long period of time

3.3 Proposed System

Block Diagram



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CHAPTER-4

4.1 Hardware Description

4.1.1 Power Supply

The power supply section is the section which provides +5V for the components to work. IC LM7805 is used for providing a constant power of +5V.

The ac voltage, typically 220V, is connected to a transformer, which steps down the ac voltage down to the level of the desired dc output. A diode rectifier then provides a full-wave rectified voltage that is initially filtered by a simple capacitor filter to produce a dc voltage. This resulting dc voltage usually has some ripple or ac voltage variation.

A regulator circuit removes the ripples and also retains the same dc value even if the input dc voltage varies, or the load connected to the output dc voltage changes. This voltage regulation is usually obtained using one of the popular voltage regulator IC units.

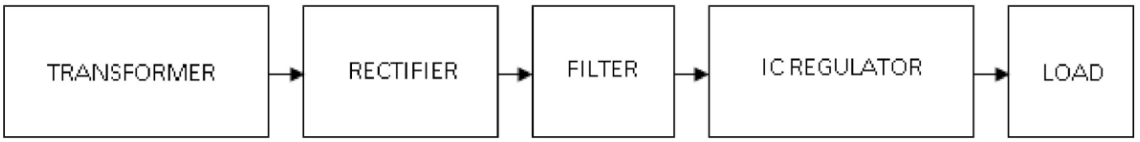

Fig4.1.1 Block Diagram of Power Supply

4.1.1 ARDUINO BOARD

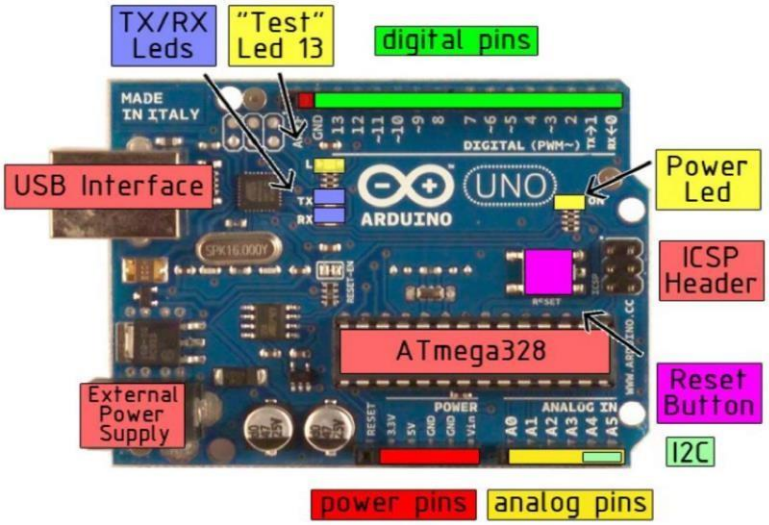

Fig 4.1.5 Arduino Board

Microcontroller ATmega328 Operating Voltage 5V
Input Voltage (recommended) 7-12 V Input Voltage (limits) 6-20V
Digital I/O Pins 14 (of which 6 provide PWM output) Analog Input Pins 6
DC Current per I/O Pin 40 mA DC Current for 3.3V Pin 50 mA
Flash Memory 32 KB of which 0.5 KB used by Boot loader
SRAM 2 KB

EEPROM 1 KB

Clock Speed 16 MHz

There are a couple of other pins on the board:

AREF. Reference voltage for the analog inputs. Used with analog Reference ().

Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to shields which block the one on the board. The Arduino Uno has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega8U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The '8U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, an .inf file is required.

Fig 4.1.6.b Uno PCB

Pin Diagram

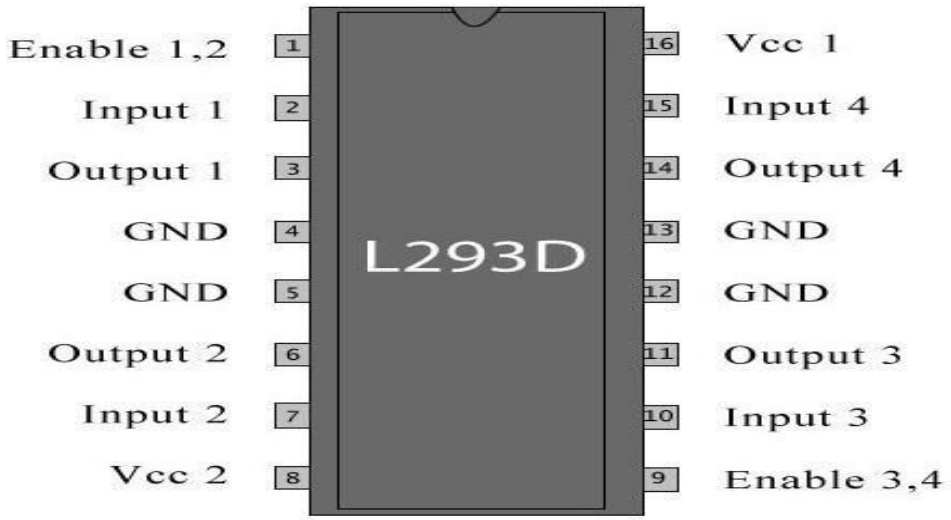

Fig 4.1.8 (a) showing pin diagram of L293D

Pin Description

Pin No	Function	Name

1	Enable pin for Motor 1; active high	Enable 1,2
2	Input 1 for Motor 1	Input 1
3	Output 1 for Motor 1	Output 1
4	Ground (0V)	Ground
5	Ground (0V)	Ground
6	Output 2 for Motor 1	Output 2
7	Input 2 for Motor 1	Input 2
8	Supply voltage for Motors; 9-12V (up to 36V)	Vcc_2
9	Enable pin for Motor 2; active high	Enable 3,4
10	Input 1 for Motor 1	Input 3
11	Output 1 for Motor 1	Output 3
12	Ground (0V)	Ground
13	Ground (0V)	Ground
14	Output 2 for Motor 1	Output 4
15	Input2 for Motor 1	Input 4
16	Supply voltage; 5V (up to 36V)	Vcc_1

Table Pin Description of L293D

Working of L293D

The 4 input pins for this l293d, pin 2,7 on the left and pin 15 ,10 on the right as shown on the pin diagram. Left input pins will regulate the rotation of motor connected across left side and right input for motor on the right-hand side. The motors are rotated on the basis of the inputs provided across the input pins as LOGIC 0 or LOGIC 1. In simple you need to provide Logic 0 or 1 across the input pins for rotating the motor.

4.1.4 IR Sensor

IR sensor is very useful if you are trying to make a obstacle avoider robot or a line follower. In this project we are going to make a simple IR sensor which can detect a object around 6-7 cm. IR sensor is nothing but a diode, which is sensitive for infrared radiation. This infrared transmitter and receiver are called as IR TX-RX pair.

Fig 4.1.9. IR Sensor

4.1.5 Ultrasonic Sensor

Ultrasonic sensors are industrial control devices that use sound waves above 20,000 Hz, beyond the range of human hearing, to measure and calculate distance from the sensor to a specified target object.

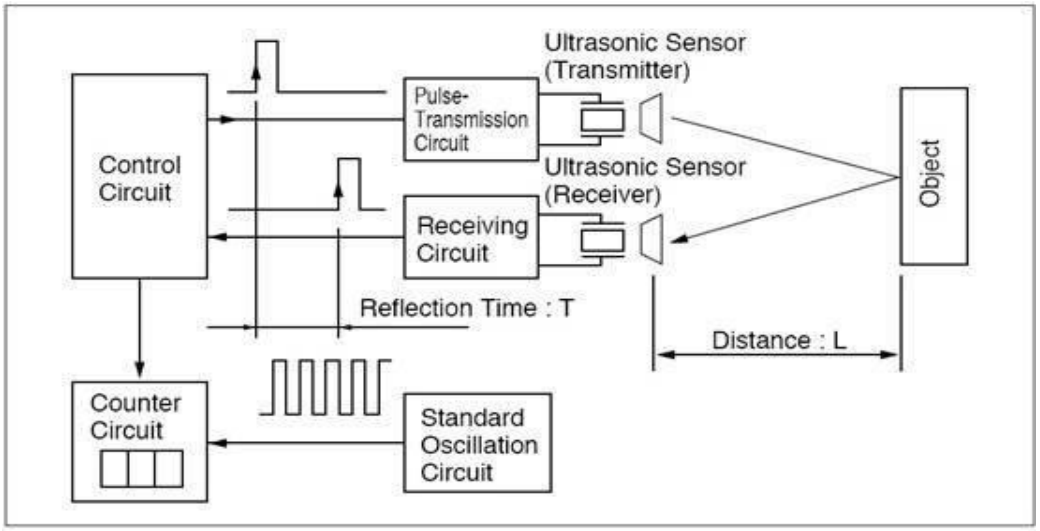

Fig 4.1.10 Block Diagram of Ultrasonic Sensor

Systems typically use a transducer which generates sound waves in the ultrasonic range, above 20,000 hertz, by turning electrical energy into sound, then upon receiving the echo turn the sound waves into electrical energy which can be measured and displayed.

Transducers

Sound field of a non-focusing 4MHz ultrasonic transducer with a near field length of N=67mm in water. The plot shows the sound pressure at a logarithmic db-scale. Sound pressure field of the same ultrasonic transducer (4MHz, N=67mm) with the transducer surface having a spherical curvature with the curvature radius An ultrasonic transducer is a device that converts energy into ultrasound, or sound waves above the normal range of human hearing. While technically a dog whistle is an ultrasonic transducer that converts mechanical energy in the form of air pressure into ultrasonic sound waves, the term is more apt to be used to refer to piezoelectric transducers that convert electrical energy into sound. Piezoelectric crystals have the property of changing size when a voltage is arterial. For example, foam on the surface of a fluid in a tank could distort a reading, thus producing very high frequency sound waves. The location at which a transducer focuses the sound, can be determined by the active transducer area and shape, the ultrasound frequency and the sound velocity of the propagation medium. The example shows the sound fields of an unfocused and a focusing ultrasonic transducer in water.

Range

This ultrasonic rangefinder can measure distances up to 2.5 meters at an accuracy of 1 centi- meter.

Fig 4.1.11 Pin Description and View of Ultrasonic Sensor VCC: 5V DC supply voltage is connected to this pin.

Trigger: The trigger signal for starting the transmission is given to this pin. The trigger signal must be a pulse with 10uS high time. When the module receives a valid trigger signal it issues 8 pulses of 40KHz ultrasonic sound from the transmitter. The echo of this sound is picked by the receiver.

4.1.7 Global Positioning System (GPS)

4.1.8 Global Positioning System (GPS)

The Global Positioning System (GPS) is a satellite-based navigation system that can be used to locate positions anywhere on earth. Designed and operated by the U.S. Department of Défense, it consists of satellites, control and monitor stations, and receivers. GPS receivers take information transmitted from the satellites and uses triangulation to calculate a user's exact location. GPS is used on incidents in a variety of ways, such as:

Fig 4.1.12 GPS Module

GPS is made up of three parts: between 24 and 32 satellites orbiting the Earth, four control and monitoring stations on Earth, and the GPS receivers owned by users. GPS satellites broadcast signals from space that are used by GPS receivers to provide three- dimensional location (latitude, longitude, and altitude) plus the time.

GSM Modem Application

Fig 4.1.13 GSM Modem Application

The GSM Network

GSM provides recommendations, not requirements. The GSM specifications define the functions and interface requirements in detail but do not address the hardware. The reason for this is to limit the designers as little as possible but still to make it possible for the operators to buy equipment from different suppliers. The GSM network is divided into three major systems: the switching system (SS), the base station system (BSS), and the operation and support system (OSS)

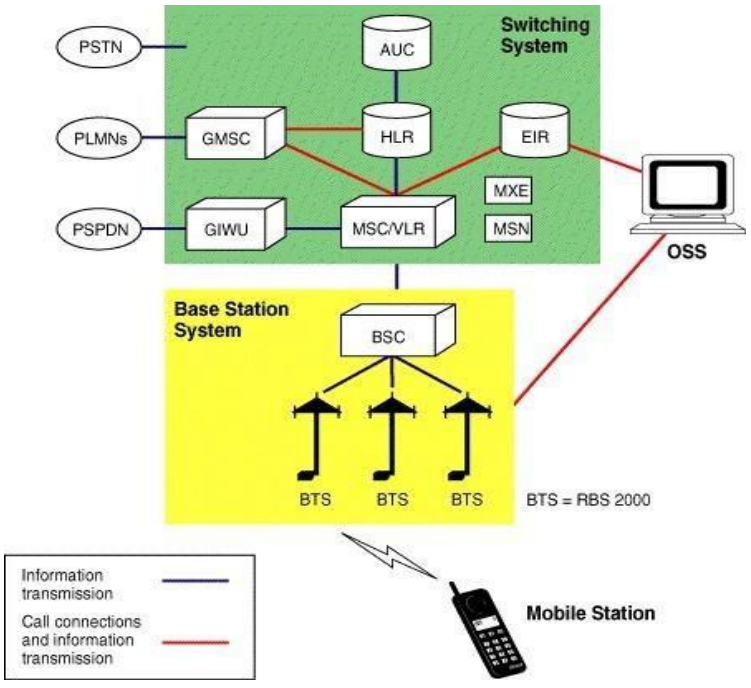

Fig 4.1.14 GSM Network Elements

4.2 Software Specification

4.2.1 IDLE

Arduino Software

You'll need to download the Arduino Software package for your operating system.

When you've downloaded and opened the application you should see something like this:

CHAPTER-5

ALGORITHM & FLOWCHART

5.1 Algorithm

Step 1 - Initialization I sensor, GSM and GPS

Step 2 – Motor on waiting for signal from the sensor

Step 3 – if sensor abnormal stop the train and send the location information Step 4 – Move the motor once sensor is normal
Step5 – Stop

5.2 Flowchart

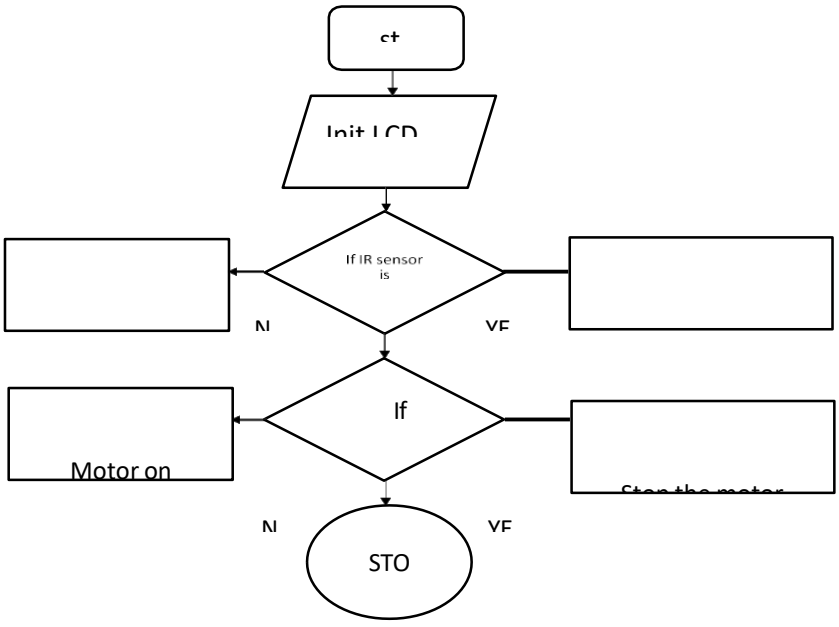

Fig5.2.1 Flow Chart

CHAPTER-6

ADVANTAGES AND DISADVANTAGES

6.1 Advantages

- Automation in railways
- Easy implementation.

6.2 Disadvantages

- Limited to GSM signal for sending and receiving information.
- Range of control.

CHAPTER-7

7.1 APPLICATIONS

- Automation in railways.
- Can be used for Railway Department.
- Can be used for industries.
- Used in detecting applications.

7.2 FUTURE SCOPE

- This system can be enhanced by implementing the GPS and welding system for prevention. This system can be enhanced by adding different sensor for more accurate readings

CHAPTER- 09

RESULT & ANALYSIS

9.1 RESULT

We have finally reached our goal. We have to implement the hardware as all equipment is at our hands. So, in a nutshell the whole procedure is as follows proposed system sets an example on how to use wireless network efficiently for railway track crack detection and the technology can be used at domestic and at commercial places. Instead of manual method of crack detection a m re advanced technology is used to alert the railway office about the detected cracks immediately.

9.2 PROCEDURE

Initialization Sensors, GSM, GPS and motors Checking for input signal from sensor
Trigger the motor on or off based on the senor abnormal.

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