

Automatic Railway Track Crack Detection Using Ultrasonic Sensor and GSM Modem

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ABSTRACT

In our project "AUTOMATIC RAILWAY TRACK CRACK DETECTION USING ULTRASONIC SENSOR AND GSM MODEM" begins with an introduction to railway track inspection and its various applications. The sensors are used to detect the crack in the railway track automatically and this signal is given to FM transmitter unit. FM receiver unit is fixed to the nearest railway station. The transmitted signal is received by the receiver unit, and gives the information to the station master by alarm with indication. This is a very efficient method of checking the cracks in the railway track and this is to be used in modern engineering industries. The manual efforts can be completely avoided by using this modern equipment

Keywords: Ultrasonic sensor, gsm modem, FM receiver, FM transmitter, railway track.

I. INTRODUCTION

This is an era of automation where it is broadly defined as replacement of manual effort by Electronics in all degrees of automation. The operation remains an essential part of the system although with changing demands on physical input as the degree of mechanization is increased.

Degrees of automation are of two types, viz.

- Full automation.
- Semi automation.

In semi automation a combination of manual effort and mechanical power is required whereas in full

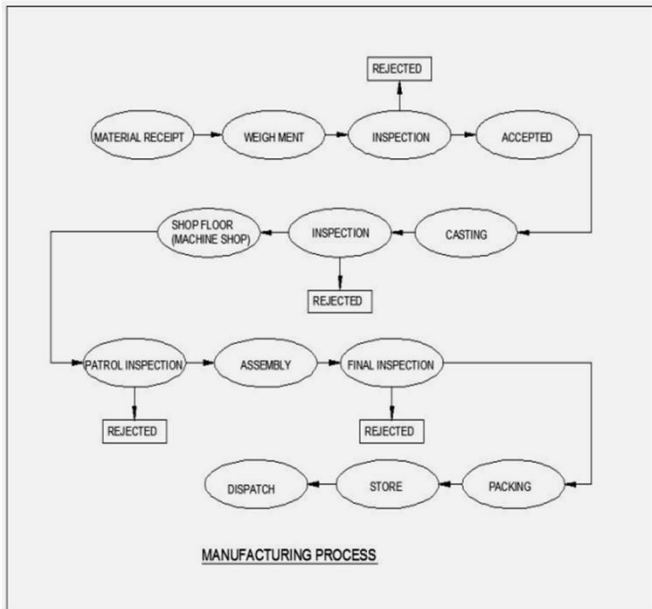
automation human participation is very negligible. In our project is fully automation one.

II. NEED FOR AUTOMATION

Automation can be achieved through computers, hydraulics, pneumatics, robotics, etc., of these sources, form an attractive medium for low cost automation. The main advantages of all automation systems are economy, accuracy and simplicity. Automation plays an important role in all industries.

III. MANUFACTURING PROCESS

Manufacturing processes are the steps through which raw materials are transformed into a final product. The manufacturing process begins with the creation of the materials from which the design is made. These materials are then modified through manufacturing processes to become the required part. Manufacturing processes can include treating (such as heat treating or coating), machining, or reshaping the material. The manufacturing process also includes tests and checks for quality assurance during or after the manufacturing, and planning the production process prior to manufacturing.



INSPECTION:

Critical appraisal involving examination, measurement, testing, gauging, and comparison of materials or items.

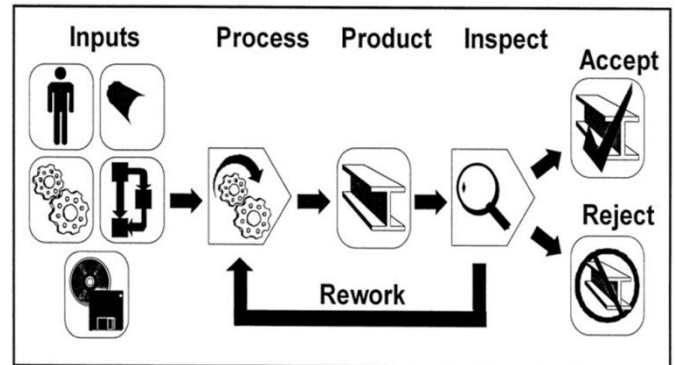
An inspection determines if the material or item is in proper quantity and condition, and if it conforms to the applicable or specified requirements.

Inspection is generally divided into three categories:

- 1) Receiving inspection,
- 2) In-process inspection, and
- 3) Final inspection.

In quality control (which is guided by the principle that "Quality cannot be inspected into a product") the

role of inspection is to verify and validate the variance data; it does not involve separating the good from the bad.



ASSEMBLY:

An assembly line is a manufacturing process (most of the time called a progressive assembly) in which parts (usually interchangeable parts) are added as the semi-finished assembly moves from work station to work station where the parts are added in sequence until the final assembly is produced. By mechanically moving the parts to the assembly work and moving the semi-finished assembly from work station to work station, a finished product can be assembled much faster and with much less labor than by having workers carry parts to a stationary piece for assembly.

IV. NEED FOR AUTOMATION

Nowadays almost all the manufacturing process is being atomized in order to deliver the products at a faster rate. The manufacturing operation is being atomized for the following reasons.

- To achieve mass production
- To reduce man power
- To increase the efficiency of the plant
- To reduce the work load
- To reduce the production cost
- To reduce the production time
- To reduce the material handling
- To reduce the fatigue of workers
- To achieve good product quality
- Less Maintenance

V. COMPONENTS AND DESCRIPTION

The components that are used in the project AUTOMATIC RAILWAY TRACK CRACK DETECTING VEHICLE are as follows,

- Ultrasonic sensor,
- GSM
- DC motor,
- Wheel arrangement,
- Microcontroller
- Lcd

D.C.MOTER(PERMANENT MAGNET):

An electric motor is a machine which converts electrical energy to mechanical energy. Its action is based on the principle that when a current-carrying conductor is placed in a magnetic field, it experiences a magnetic force whose direction is given by Fleming's left hand rule.

When a motor is in operation, it develops torque. This torque can produce mechanical rotation. DC motors are also like generators classified into shunt wound or series wound or compound wound motors.

PRINCIPLE OF OPERATION OF DC MOTOR:

Figure I show a uniform magnetic field in which a straight conductor carrying no current is placed. The conductor is perpendicular to the direction of the magnetic field.

In figure II the conductor is shown as carrying a current away from the viewer, but the field due to the N and S poles has been removed. There is no movement of the conductor during the above two conditions. In figure III the current carrying conductor is placed in the magnetic field. The field due to the current in the conductor supports the main field above the conductor, but opposes the main field below the conductor

Ultrasonic Sensor

Introduction

The main purpose of this project is to measure the distance to unreachable objects, obstacles or places using a portable device.

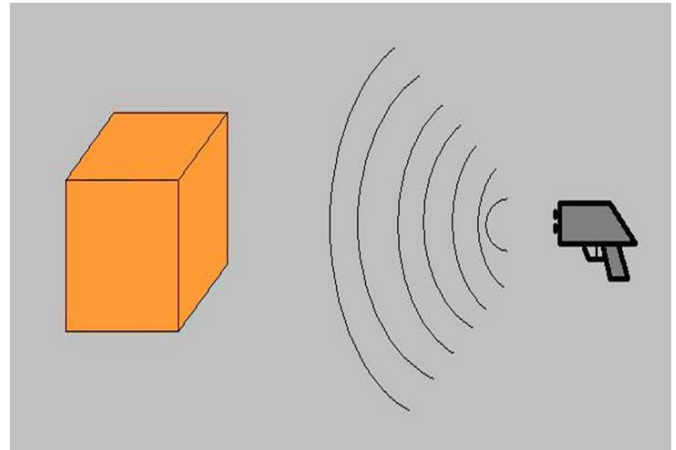
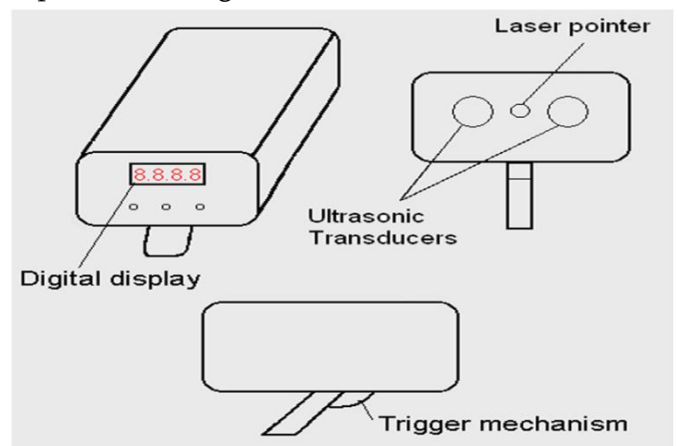


Figure 2.1: The hand-held ultrasonic range meter device.

Characteristics

This device detects the distance to an object and shows the result in centimeters. This device is activated by a trigger mechanism, pressing the trigger for one time will give us the distance to an object if there was no error like poor aiming. The distance to an object is displayed using a digital display with a high intensity in order to be seen in any lighting conditions.

It is a simple and portable device similar to a gun as shown in Figure 2.2 that uses a laser pointer to aim at a specific area to get the reflection at the receiver side.



Target range

The target range is the distance range between the person who is using the hand-held ultrasonic range

meter device and the targeted object. The target range consists of two boundaries, one is the minimum distance limit and the other is the maximum distance limit. If the operator of the hand-held ultrasonic range meter device exceeds these two boundaries, the hand-held ultrasonic range meter device may not detect the distance or may display a false detection.



VI. ARDUINO

Arduino interface boards provide the engineers, artists, designers, hobbyists and anyone who tinker with technology with a low-cost, easy-to-use technology to create their creative, interactive objects, useful projects etc., A whole new breed of projects can now be built that can be controlled from a computer.



Figure 1.1 ARDUINO UNO

Arduino is a open source electronics prototyping platform based on flexible, easy-to-use hardware and software. It's intended for artists, designers, hobbyists, and anyone interested in creating interactive objects or environments. It's an open-source physical

computing platform based on a microcontroller board, and a development environment for writing software for the board.

Microcontroller

Microcontroller can be described as a computer embedded on a rather small circuit board. To describe the function of a microcontroller more precisely, it is a single chip that can perform various calculations and tasks, and send/receive signals from other devices via the available pins. Precisely what tasks and communication with the world it does, is what is governed by what instructions we give to the Microcontroller. It is this job of telling the chip what to do, is what we refer to as programming on it.

However, the UC by itself, cannot accomplish much; it needs several external inputs: power, for one; a steady clock signal, for another. Also, the job of programming it has to be accomplished by an external circuit. So typically, a UC is used along with a circuit which provides these things to it; this combination is called a microcontroller board. The Arduino Uno that you have received, is one such microcontroller board. The actual microcontroller at its heart is the chip called Atmega328. The advantages that Arduino offers over other microcontroller boards are largely in terms of reliability of the circuit hardware as well as the ease of programming and using it.

VII. PLATFORM

HARDWARE

ARDUINO Board Layout

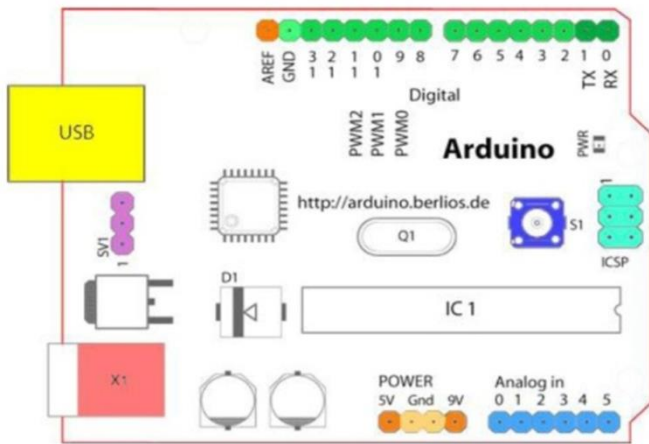
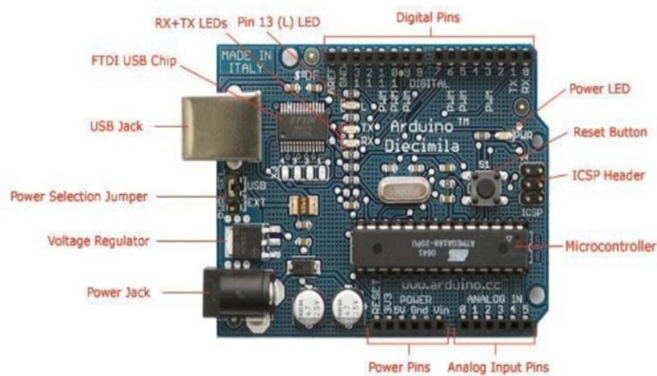
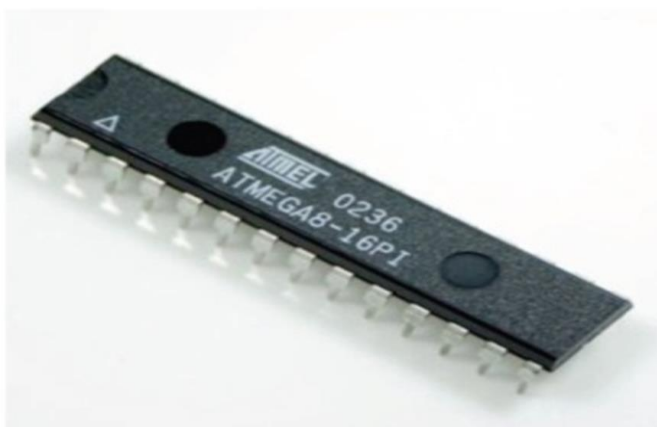


Figure 3 ARDUINO board layout
ARDUINO pin diagram



ATmega8(Microcontroller)

- 16 MHz
- 8 Kbyte Flash RAM(1K taken by the boot loader)
- 1 Kbyte RAM(eg. for auto/local variables and stack)
- 14 digital Input/Output Ports



Single chip USB to async. Serial data transfer interface



- USB2.0 compatible
- Transmit and receive LED frive signals
- 256 Byte receive,128 Byte transmit buffer
- Data transfer rate from 300bits/sec to 2 Mb/sec

BASIC TERMINOLOGIES IN ARDUINO:

1.Analog to digital converter(ADC)

The process of Analog to digital conversion is shown in figure.

The Arduino has 10 bits of Resolution when reading analog signals. 2 power 10=1024 increments Influence also by how fast you sample

2.Pulse width modulation (PWM)

The Arduino has 8bit of resolution, when outputting a signal using PWM. The range of output voltage is from 0 to 5 Volts 2power 8=255 Increments average of on/off (digital signals to make an average voltage),Duty cycle in 100% of 5Volts.

Arduino development environment(based on processing)

Processing

Processing is an open source programming language and environment for people who want to create images, animations, and interactions. Initially developed to serve as a software sketchbookevolved into a tool for generating finished professional work.

Today, there are tens of thousands of students, artists, designers, researchers, and hobbyists who use Processing for learning, prototyping, and production.

Software

The software used by the arduino is Arduino IDE.

The Arduino IDE is a cross-platform application written in Java, and is derived from the IDE for the Processing programming language and the Wiringproject. It is designed to introduce programming to artists and other newcomers unfamiliar with software development. It includes a code editor with features such as syntax highlighting, brace matching, and automatic indentation, and is also capable of compiling and uploading programs to the board with a single click. There is typically no need to edit make files or run programs on acommand-line interface. Although building on command-line is possible if required with some third-party tools such as Ino.

The Arduino IDE comes with a C/C++ library called "Wiring" (from the project of the same name), which makes many common input/output operations much easier. Arduino programs are written in C/C++, although users only need define two functions to make a runnable program:

- `setup()` – a function run once at the start of a program that can initialize settings
- `loop()` – a function called repeatedly until the board powers off

LCD:

Liquid Crystal Display (LCD) consists of rod-shaped tiny molecules sandwiched between a flat piece of glass and an opaque substrate. These rod-shaped molecules in between the plates align into two different physical positions based on the electric charge applied to them.



When electric charge is applied they align to block the light entering through them, where as when no-charge is applied they become transparent.

Light passing through makes the desired images appear. This is the basic concept behind LCD displays. LCDs are most commonly used because of their advantages over other display technologies. They are thin and flat and consume very small amount of power compared to LED displays and cathode ray tubes (CRTs).

LCD Technologies and types:

Some of the LCD technologies are,

Blue Mode STN - This is the basic LCD, which needs lot of improvement on contrast ratio and viewing angle.

FSTN (Film STN) - Comes with an additional linearization film to offer better contrast.

CSTN (colour STN) - Layers of color filters are added to create up to 65,000 colors.

DSTN (Double STN) - Improves contrast and eliminates any other colors appearing on the screen.

Types based on displayed data:

1. Segment LCD: Displays numbers, letters and fixed symbols and were used in old style industrial panel display and such standard where we need to display fixed number of characters.

2. Graphical LCD: Instead of segments it has pixels in rows and columns. By energizing set of pixels any character can be displayed.

3. Color LCD displays: Are of type passive matrix and Thin film transistor/ active matrix.

Two types of color displays:

Passive Matrix:

• Row & Column approach

Apply small bias to perpendicular lines of electrodes
Bias strong enough to darken bit at line intersection •
Multiplexed addressing scheme

Advantages: Simple to implement

Disadvantages: Can cause distortion

Active Matrix

- Each cell has its own thin-film transistor (TFT).
- Addressed independently from behind LCD.
- Direct addressing scheme

Advantages:

Sharp display, better viewing angle, 40:1 contrast

Disadvantages:

Need better backlight, complex hardware

LCD Module Backlighting:

LCDs unlike LEDs do not produce light, they need some external light source to view. So most the latest LCD screens used in notebook computers use a light source. They use CFT or EL Panel or in recent times white LED as source of light fixed in the background of LCD.

LED lamp is a better choice over CFT and EL due to its ability to offer variety of colors, intensity, long life (>100K Hrs), wide temperature range, and low voltage operation.

VIII. PIN DETAILS OF LCD

Pin-1 Vss- Ground

Pin-2 VDD- Power 5V

pin-3 VEE- LCD Contrast Adjustment

Control Signals

RS- Register Select

There are 2 very important registers in LCD

Command Code register

Data Register

If

RS=0 □ Instruction command Code register is selected, allowing user to send command

RS=1 □ Data register is selected allowing to send data that has to be displayed.

R\W- Read\Write

R\W input allows the user to write information to LCD or read information from it. How do we read data from LCD The data that is being currently displayed will be stored in a buffer memory DDRAM. This data could be read if necessary.

If

R\W=0 □ Reading

R\W=1 □ Writing

E- Enable

The enable Pin is used by the LCD to latch information at its data pins. When data is supplied to data pins, a high to low pulse must be applied to this pin in order for the LCD to latch the data present in the data pins.

E□ Toggle

Data Bus- D0-D7

Power for Backlighting LEDs

VDD-Power 5V

Vss- GND

Advantages:

- Consumes less power and generates less heat.
- Saves lot of space compared picture tubes due to LCD's flatness.
- Due to less weight and flatness LCDs are highly portable.
- No flicker and less screen glare in LCDs to reduce eyestrain.
- Drawbacks:
- LCDs cannot form multiple resolution images.

- The contrast ratio for LCD images is lesser than CRT and plasma displays.
- Due to their longer response time, LCDs show ghost images and mixing when images change rapidly.
- The narrow viewing angle of an LCD weakens the image quality in wider viewing angles.

IX. GSM MODEM

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves. The working of GSM modem is based on commands, the commands always start with AT (which means Attention) and finish with a <CR> character. For example, the dialing command is ATD<number>; ATD3314629080; here the dialing command ends with semicolon



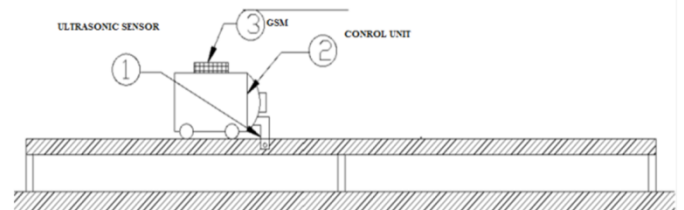
The AT commands are given to the GSM modem with the help of PC or controller. The GSM modem is serially interfaced with the controller with the help of MAX 232. Here max 232 acts as driver which converts TTL levels to the RS 232 levels. For serial interface GSM modem requires the signal based on RS 232 levels. The T1_OUT and R1_IN pin of MAX 232 is connected to the TX and RX pin of GSM modem

X. WORKING PRINCIPLE

In our project, there are two set of ultrasonic sensor units are used to fit the two sides of the vehicle. This unit is used to activate/deactivate FM transmitter unit when there is any cracks in their path.

At crack detection conditions the transmitter and receiver, the resistance across the Transmitter and receiver is high due to the non-conductivity of the waves. So the output of transistor T5 goes from OFF condition to ON stage. In that time the relay is ON position. In that time, the motor power supply is disconnected and switch on to the GSM unit send alert message to railway station

AUTOMATIC RAILWAY TRACK CRACK DETECTION USING



XI. ADVANTAGES

- The auto crack detection method is more efficient in the technical field
- Quick response is achieved
- Simple in construction
- Easy to maintain and repair
- Cost of the unit is less when compared to other
- No fire hazard problem due to over loading
- Comparatively the operation cost is less
- Continuous operation is possible without stopping
- Automatic alert system to the station master
- The signal transmission is wireless transmission.

XII. DISADVANTAGES

- The signal transmission is below 50 feet
- The vehicle operated in battery power, so rechargeable battery is used to drive the vehicle

XIII. APPLICATIONS

❖ **Automatic crack checking:-**

The vehicle draws power from the battery. The optical sensor is used to detect the crack in the railway track. Suppose any crack in the track, the vehicle automatically stop and activates the FM transmitter circuit.

❖ **Cordless identification to the station master:**

This unit can also be used to intimate the nearest railway station. The FM receiver circuit is fixed in the room of the station master.

XIV. CONCLUSION

A strong multidiscipline team with a good engineering base is necessary for the Development and refinement of advanced computer programming, editing techniques, diagnostic Software, algorithms for the dynamic exchange of informational different levels of hierarchy.

This project work has provided us an excellent opportunity and experience, to use our limited knowledge. We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work.

We are proud that we have completed the work with the limited time successfully. The "AUTOMATIC RAILWAY TRACK CRACK DETECTION USING ULTRASONIC SENSOR AND GSM MODEM" is working with satisfactory conditions. We are able to understand the difficulties in maintaining the tolerances and also quality.

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