Automatic Railway Gate Control using Audrino

by

Name	Roll No.	Registration No:
Bikram Das	**11700314030**	**141170110212** *of 2014-2015*
Chaity Roy	**11700314031**	***141170110213*** *of 2014-2015*
Tanuj Kumar Majumdar	**11700315145**	***151170120046*** *of 2015-2016*
Madhurima Das	***11700315130***	**151170120031** *of 2015-2016*

A comprehensive project report has been submitted in partial fulfillment of the requirements for the degree of

Bachelor of Technology

in

ELECTRONICS & COMMUNICATION ENGINEERING

Under the supervision of

Dr. Soham Sarkar

Assistant Professor

Department of Electronics & Communication Engineering
RCC INSTITUTE OF INFORMATION TECHNOLOGY
Affiliated to Maulana Abul Kalam Azad University of Technology, WestBengal
CANAL SOUTH ROAD, BELIAGHATA, KOLKATA – 700015

May,2018

CERTIFICATE OF APPROVAL

This is to certify that the project titled "**Automatic Railway Gate Control using Audrino**" carried out by

Name	Roll No.	Registration No:
Bikram Das	**11700314030**	**141170110212** *of 2014-2015*
Chaity Roy	**11700314031**	***141170110213*** *of 2014-2015*
Tanuj Kumar Majumdar	**11700315145**	***151170120046*** *of 2015-2016*
Madhurima Das	***11700315130***	**151170120031** *of 2015-2016*

for the partial fulfillment of the requirements for B.Tech degree in **Electronics and Communication Engineering** from **Maulana Abul Kalam Azad University of Technology, West Bengal** is absolutely based on his own work under the supervision of Dr. Soham sarkar The contents of this thesis, in full or in parts, have not been submitted to any other Institute or University for the award of any degree or diploma.

Optional in case of External Supervisor

.....
NA

.....
Dr. Soham Sarkar
Professor , Dept. of ECE
RCC Institute of Information Technology

.....
Dr. Abhishek Basu
Head of the Department (ECE)
RCC Institute of Information Technology

DECLARATION

"We Do hereby declare that this submission is our own work conformed to the norms and guidelines given in the Ethical Code of Conduct of the Institute and that, to the best of our knowledge and belief, it contains no material previously written by another neither person nor material (data, theoretical analysis, figures, and text) which has been accepted for the award of any other degree or diploma of the university or other institute of higher learning, except where due acknowledgement has been made in the text."

.....

Bikram Das
Registration No141170110212 OF 2014-2015
Roll No: 11700314030

.....

Chaity Roy
Registration No:141170110213 OF 2014-2015
Roll No: 11700314031

.....

Tanuj Kumar Majumdar
Registration No:151170120046 OF 2015-2016
Roll No: 11700315145

.....

Madhurima Das
Registration No:151170120031 OF 2015-2016
Roll No: 11700315130

Date:

Place:

CERTIFICATE of ACCEPTANCE

This is to certify that the project titled "**Automatic Railway Gate Control using Audrino**" carried out by

Name	Roll No.	Registration No:
Bikram Das	**11700314030**	**141170110212** ***of*** *2014-2015*
Chaity Roy	**11700314031**	***141170110213*** *of 2014-2015*
Tanuj Kumar Majumdar	**11700315145**	***151170120046*** *of 2015-2016*
Madhurima Das	***11700315130***	**151170120031** *of 2015-2016*

is hereby recommended to be accepted for the partial fulfillment of the requirements for B.Tech degree in **Electronics and Communication Engineering** from **Maulana Abul Kalam Azad University of Technology, West Bengal**

Name of the Examiner Signature with Date

1. ……

2.…… ..……..

3.…… ……

4. …… ……

ABSTRACT

From this project we'll know how to implement the automation in railway gate control using Audrino. Application of this project is the direct implementation in real world. Some components will be required more but the main working principle will be same.

Now, other alerting systems can also be developed by using Audrino. The main aim of this project is to reduce train accidents at railway level crossings to the minimum.

CONTENTS

- VicRoads (2014-08-26). "Trains & level crossings". *VicRoads*. Retrieved 2017-11-12.
- Rivanna Chapter, National Railway Historical Society (2005). "This Month in Railroad History: August". Retrieved 25 August 2006.
- *"Railways to eliminate over 6,000 unmanned level crossings". The Indian Express. 30 July 2016.*
- Lloyd's Register Rail (2007). "Study of pedestrian behaviour at public railway crossings". *Public Transport Safety Victoria*. Victoria, Australia.
- Mok, Shannon C; Savage, Ian (1 August 2005). "Why Has Safety Improved at Rail-Highway Grade Crossings?". *Risk Analysis*. **25** (4): 867–881.

LIST OF FIGURES

LIST OF TABLES

Contents

Introduction

1.1. Auromatic Railway Gate Control using Audrino

Level crossing is that area where the rail line intersects with the road which is used by transportation or other vehicles.To prevent accidents a system named “Level Crossing” has been developed.But in early days all the level crossings are operated by humans.So human interference was mandatory.But,manual control is not erros free.The railway gate or level crossing is opened or closed by a gateman who was informed from the nearest railway station about the arrival of a train.

There’re also many level crossings in India which are unmanned.So they are potentially dangerous for road users.

In India we must develop a prototype to be implemented to automatically control railway gate upon arrival as well as departure of train.The project should not be too much expensive but must be reliable.So we used Audrino uno R3 which is quite reliable as well as affordable.

We started to develop our project based upon 8051 microcontroller which is also cheaper than Audrino.But in terms of of reliability and implementation of future featured we upgraded to audrino uno.

1.2 what is a level crossing?

A level crossing is an intersection where a railway line crosses a road or path at the same level, as opposed to the railway line crossing over or under using a bridge or tunnel. The term also applies when a light rail line with separate right-of-way or reserved track crosses a road in the same fashion. Other names include railway level crossing, grade crossing, road through railroad, railroad crossing, train crossing, and RXR.

1.3History of level crossing

The history of level crossings depends on the location, but often early level crossings had a flagman in a nearby booth who would, on the approach of a train, wave a red flag or lantern to stop all traffic and clear the tracks. Gated crossings became commonplace in many areas, as they protected the railway from people trespassing and livestock, and they protected the users of the crossing when closed by the signalman/gateman. In the second quarter of the 20th century, manual or electrical closable gates that barricaded the roadway started to be introduced, intended to be a complete barrier against intrusion of any road traffic onto the railway. Automatic crossings are now commonplace in some countries as motor vehicles replaced horse-drawn vehicles and the need for animal protection diminished with time. Full, half or no barrier crossings superseded gated crossings, although crossings of older types can still be found in places. New technology is advancing to create new ways of protecting the railway from users of a level crossing, with one of the most recent being obstacle detection scanners fitted to some crossings in Europe.

In rural regions with sparse traffic, the least expensive type of level crossing to operate is one without flagmen or gates, with only a warning sign posted. This type has been common across North America and in many developing countries.

Some international rules have helped to harmonize level crossing. For instance, the 1968 Vienne convention about *signalisation routière*:

- in its *Chapitre III Signaux lumineux de circulation*: Article 23b stand that one or two blinking red fire indicates a car should stop, when if they are yellow the car can pass with caution.

This has been implemented in many countries, including countries not being part of the Vienna Convention.

- in its article 27, a stop line is suggested at grade crossing
- article 33, 34, 35 and 36 are specific to level crossing, because level crossing are recognized as dangerous
- article 35 indicates a cross should exist when there is no barrier

A majority of the level crossings in India were manually regulated. Signals and barriers are installed at all crossings while manual crossings are additionally required to have the hand red and green signal flags. But Indian Railways aims at elimination of all unmanned crossings and replacing it with manned crossings.

2.Required Components

1. Audrino Uno R3
2. L293D motor drvier
3. Lm 358 IC
4. IR sensor Pairs
5. Stepper Motor
6. Buzzer
7. LEDs
8. Jumper Wires

3.Description of components

3.1.1.Audrino Uno R3

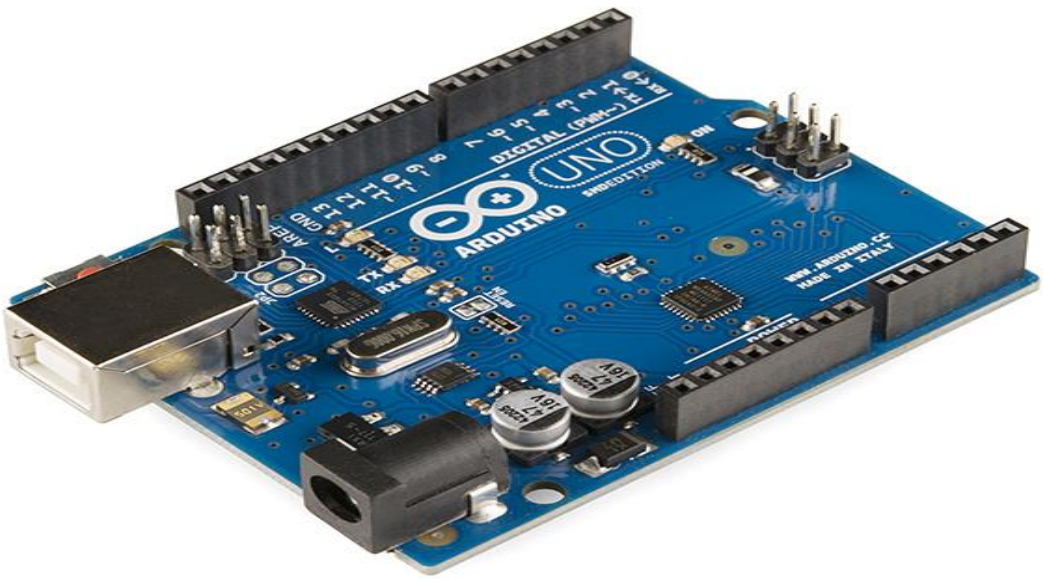

Fig 1. Audrino UNO R3

The Arduino UNO is a widely used open-source microcontroller board based on the ATmega328P microcontroller and developed by Arduino.cc.The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards (shields) and other circuits.[1] The board features 14 Digital pins and 6 Analog pins. It is programmable with the Arduino IDE(Integrated Development Environment) via a type B USB cable. It can be powered by a USB cable or by an external 9 volt battery, though it accepts voltages between 7 and 20 volts. It is also similar to the Arduino Nano and Leonardo. The hardware reference design is distributed under a Creative Commons Attribution Share-Alike 2.5 license and is available on the Arduino website. Layout and production files for some versions of the hardware are also available. "Uno" means one in Italian and was chosen to mark the release of Arduino Software (IDE) 1.0.The Uno board and version 1.0 of Arduino Software (IDE) were the reference versions of Arduino, now evolved to newer releases. The Uno board is the first in a series of USB Arduino boards, and the reference model for the Arduino platform.[3] The ATmega328 on the Arduino Uno comes preprogrammed with a bootloader that allows to upload new code to it without the use of an external hardware programmer. It communicates using the original STK500 protocol. The Uno also differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB-to-serial converter.

3.1.2 Technical Specifications

- Microcontroller: ATmega328P
- Operating Voltage: 5v
- Input Voltage: 7-20v
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 6
- DC Current per I/O Pin: 20 mA
- DC Current for 3.3V Pin: 50 mA
- Flash Memory: 32 KB of which 0.5 KB used by bootloader
- SRAM: 2 KB
- EEPROM: 1 KB
- Clock Speed: 16 MHz
- Length: 68.6 mm

- Width: 53.4 mm
- Weight: 25 g

3.1.3 PINS

General Pin functions

- **LED**: There is a built-in LED driven by digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.
- **VIN**: The input voltage to the Arduino/Genuino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.
- **5V**: This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 20V), the USB connector (5V), or the VIN pin of the board (7-20V). Supplying voltage via the 5V or 3.3V pins bypasses the regulator, and can damage the board.
- **3V3**: A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.
- **GND**: Ground pins.
- **IOREF**: This pin on the Arduino/Genuino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs to work with the 5V or 3.3V.
- **Reset**: Typically used to add a reset button to shields which block the one on the board.

3.1.4Special Pin Functions

Each of the 14 digital pins and 6 Analog pins on the Uno can be used as an input or output, using pinMode(),digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive 20 mA as recommended operating condition and has an internal pull-up resistor (disconnected by default) of 20-50k ohm. A maximum of 40mA is the value that must not be exceeded on any I/O pin to avoid permanent damage to the microcontroller.The Uno has 6 analog inputs, labeled A0 through A5, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analogReference() function.

In addition, some pins have specialized functions:

- **Serial**: pins 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.
- **External Interrupts**: pins 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.
- **PWM**(**P**ulse **W**idth **M**odulation) 3, 5, 6, 9, 10, and 11 Can provide 8-bit PWM output with the analogWrite() function.
- **SPI**(**S**erial **P**eripheral **I**nterface): 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication using the SPI library.
- **TWI**(**T**wo **W**ire **I**nterface): A4 or SDA pin and A5 or SCL pin. Support TWI communication using the Wire library.
- **AREF**(**A**nalog **REF**erence: Reference voltage for the analog inputs.

3.1.5. Communication

The Arduino/Genuino Uno has a number of facilities for communicating with a computer, another Arduino/Genuino board, or other microcontrollers. The ATmega328 provides UART TTL (5V) serial communication, which is available on digital pins 0 (RX) and 1 (TX). An ATmega16U2 on the board channels this serial communication over USB and appears as a virtual com port to software on the computer. The 16U2 firmware uses the standard USB COM drivers, and no external driver is needed. However, on Windows, a .inf file is required. The Arduino Software (IDE) includes a serial monitor which allows simple textual data to be sent to and from the board. The RX and TX LEDs on the board will flash when data is being transmitted via the USB-to-serial chip and USB connection to the computer (but not for serial communication on pins 0 and 1). A SoftwareSerial library allows serial communication on any of the Uno's digital pins.

3.1.5.Automatic (Software) Reset

Rather than requiring a physical press of the reset button before an upload, the Arduino/Genuino Uno board is designed in a way that allows it to be reset by software running on a connected computer. One of the hardware flow control lines (DTR) of the ATmega8U2/16U2 is connected to the reset line of the ATmega328 via a 100 nanofarad capacitor. When this line is asserted (taken low), the reset line drops long enough to reset the chip.[7]

This setup has other implications. When the Uno is connected to either a computer running Mac OS X or Linux, it resets each time a connection is made to it from software (via USB). For the following half-second or so, the bootloader is running on the Uno. While it is programmed to ignore malformed data (i.e. anything besides an upload of new code), it will intercept the first few bytes of data sent to the board after a connection is opened.

3.2 Atmel ATmega 328P

The Atmel 8-bit AVR RISC-based microcontroller combines 32 kB ISP flash memory with read-while-write capabilities, 1 kB EEPROM, 2 kB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts. The device achieves throughput approaching 1 MIPS per MHz.

Table 1.

Parameter	Value
CPU type	8-bit AVR
Performance	20 MIPS at 20 MHz[2]
Flash memory	32 kB
SRAM	2 kB
EEPROM	1 kB
Pin count	28-pin PDIP, MLF, 32-pin TQFP, MLF[2]
Maximum operating frequency	20 MHz
Number of touch channels	16
Hardware QTouch Acquisition	No
Maximum I/O pins	23

External interrupts	2
USB Interface	No
USB Speed	–

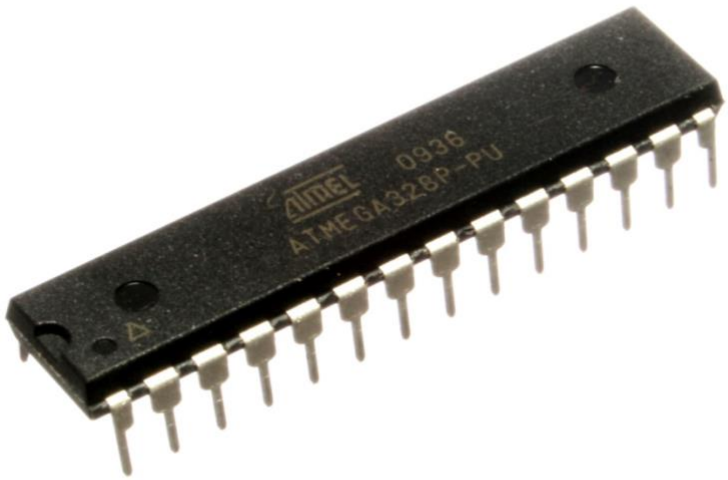

Fig 2. Atmel mega 328p

3.3. L293D Motor Driver

L293D is a dual H-bridge motor driver integrated circuit (IC). Motor drivers act as current amplifiers since they take a low-current control signal and provide a higher-current signal. This higher current signal is used to drive the motors.

L293D contains two inbuilt H-bridge driver circuits. In its common mode of operation, two DC motors can be driven simultaneously, both in forward and reverse direction. The motor operations of two motors can be controlled by input logic at pins 2 & 7 and 10 & 15. Input logic 00 or 11 will stop the corresponding motor. Logic 01 and 10 will rotate it in clockwise and anticlockwise directions, respectively.

Enable pins 1 and 9 (corresponding to the two motors) must be high for motors to start operating. When an enable input is high, the associated driver gets enabled. As a result, the outputs become active and work in phase with their inputs. Similarly, when the enable input is low, that driver is disabled, and their outputs are off and in the high-impedance state.

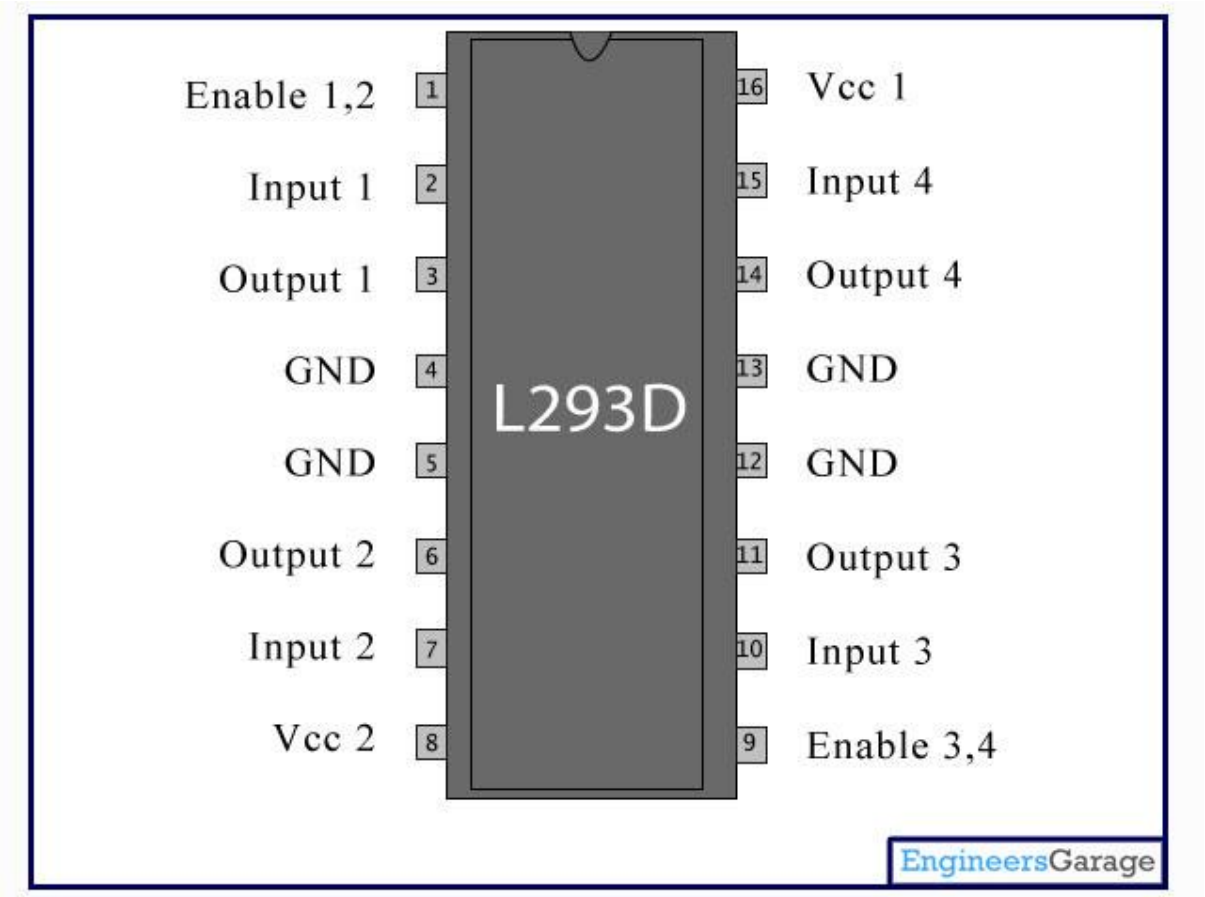

Fig 3. L293D Motor Driver

3.3.2. 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 2

3.4.1. LM 358 IC

The LM358 IC is a great, low power and easy to use dual channel op-amp IC. It is designed and introduced by national semiconductor. It consists of two internally frequency compensated, high gain, independent op-amps. This IC is designed for specially to operate from a single power supply over a wide range of voltages. The LM358 IC is available in a chip sized package and applications of this op amp include conventional op-amp circuits,

DC gain blocks and transducer amplifiers. LM358 IC is a good, standard operational amplifier and it is suitable for your needs. It can handle 3-32V DC supply & source up to 20mA per channel. This op-amp is apt, if you want to operate two separate op-amps for a single power supply. It's available in an 8-pin DIP package.

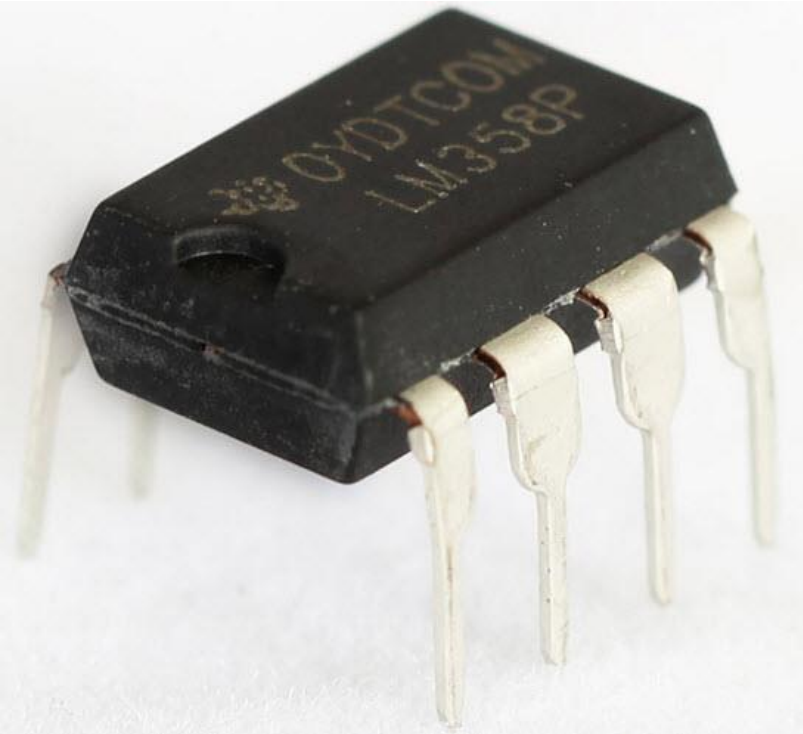

Fig 4 . LM358 IC

3.4.2 PIN configuration

The pin diagram of LM358 IC comprises of 8 pins, where

- Pin-1 and pin-8 are o/p of the comparator
- Pin-2 and pin-6 are inverting i/ps
- Pin-3 and pin-5 are non inverting i/ps
- Pin-4 is GND terminal
- Pin-8 is VCC+

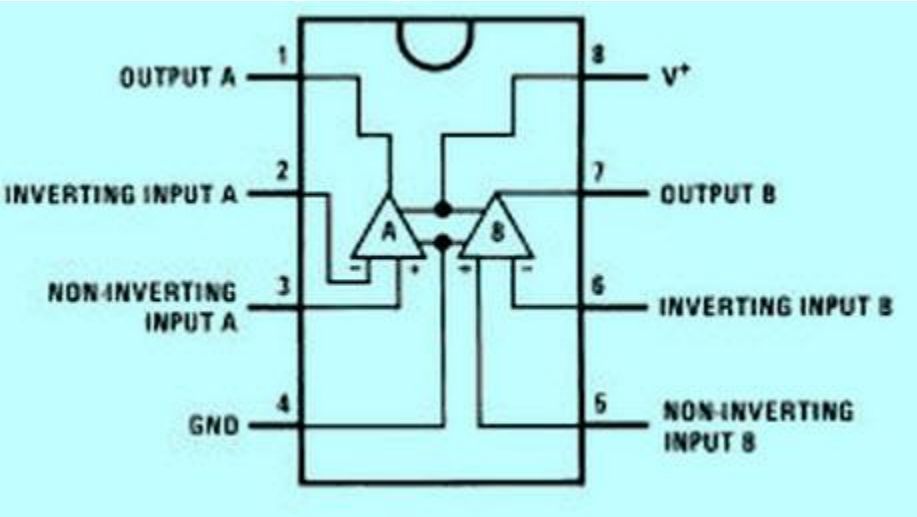

Fig 5. Internal circuitry config. Of LM 358 IC.

3.4.3. Features of LM 358 IC

The features of the LM358 IC are

- It consists of two op-amps internally and frequency compensated for unity gain
- The large voltage gain is 100 dB
- Wide bandwidth is 1MHz
- Range of wide power supplies includes single and dual power supplies
- Range of Single power supply is from 3V to 32V
- Range of dual power supplies is from + or -1.5V to + or -16V
- The supply current drain is very low, i.e., 500 μA
- 2mV low i/p offset voltage
- Common mode i/p voltage range comprises ground
- The power supply voltage and differential i/p voltages are similar
- o/p voltage swing is large.
-

3.5. IR sensor kit using LM 358 IC

3.5.1 IR LED

IR LED emits light, in the range of Infrared frequency. IR light is invisible to us as its wavelength (700nm – 1mm) is much higher than the visible light range. Everything which produce heat, emits infrared like for example our human body. Infrared have the same properties as visible light, like it can be focused, reflected and polarised like visible light.

Fig 6. IR LED

3.5.2 Photodiode

Photodiode is considered as Light dependent Resistor (LDR), means it has very High resistance in absence of light and become low when light falls on it. Photodiode is a semiconductor which has a P-N junction, **operated in Reverse Bias**, means it start conducting the current in reverse direction when Light falls on it, and the amount of current flow is proportional to the amount of Light. This property makes it useful for IR detection.

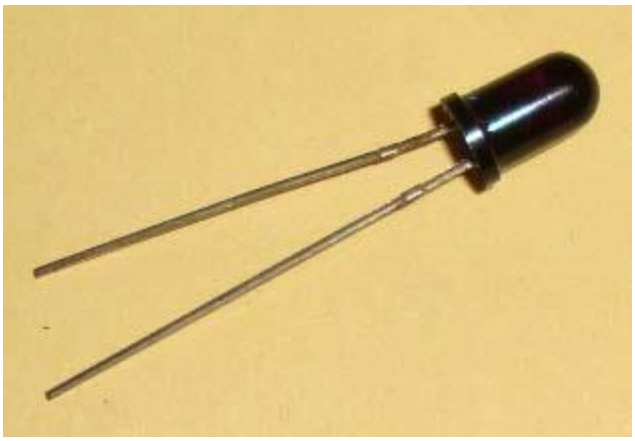

Fig 7. Photodiode

3.5.3 IR sensor Module

Components

- IR pair (IR LED and Photodiode)
- IC LM358
- Resistor 100, 10k, 330 ohm

- Variable resistor – 10k
- LED

3.5.4 Circuit Diagram of IR Sensor module

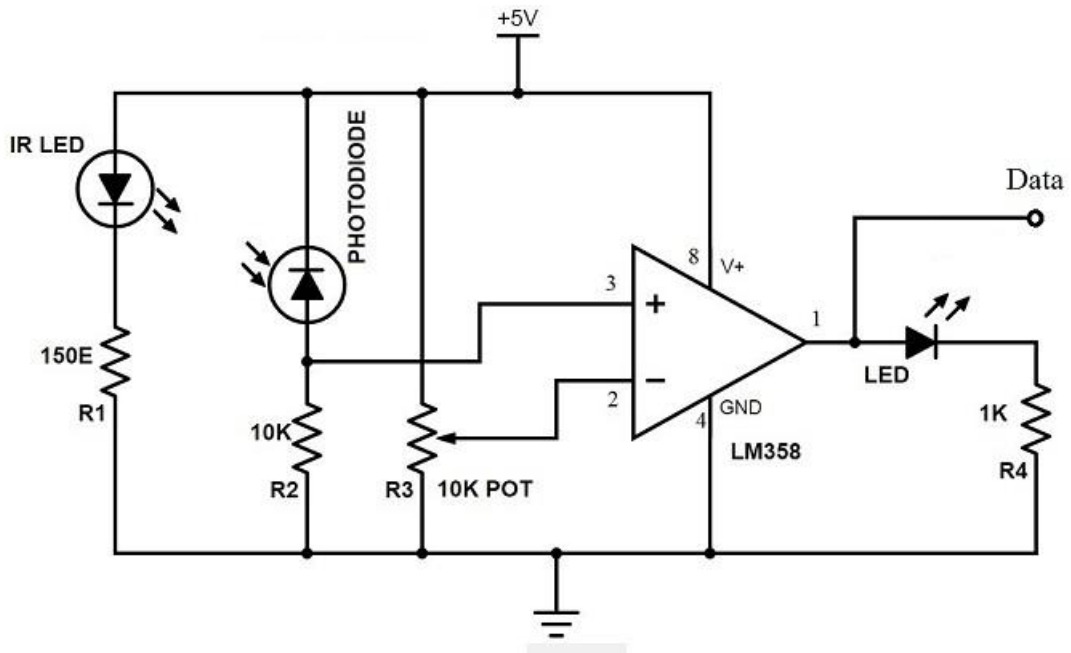

Fig 8. Circuit diagram of IR sensor module

IR sensor module used in prototype

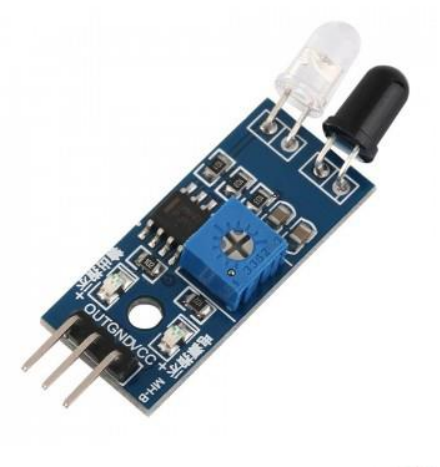

Fig 9. IR sensor module

3.5.5 Working method

When we turn ON the circuit there is no IR radiation towards photodiode and the Output of the comparator is LOW. When we take some object (not black) in front of IR pair, then IR emitted by IR LED is reflected by the object and absorbed by the photodiode. Now when reflected IR Falls on Photodiode, the voltage across photodiode drops, and the voltage across series resistor R2 increases. When the voltage at Resistor R2 (which is connected to the non-inverting end of comparator) gets higher than the voltage at inverting end, then the output becomes HIGH and LED turns ON.

Voltage at inverting end, which is also called **Threshold Voltage**, can be set by rotating the variable resistor's knob. Higher the voltage at inverting end (-), less sensitive the sensor and Lower the voltage at inverting end (-), more sensitive the sensor.

3.6.1 Stepper Motor

A stepper motor or step motor or stepping motor is a brushless DC electric motor that divides a full rotation into a number of equal steps. The motor's position can then be commanded to move and hold at one of these steps without any position sensor for feedback (an open-loop controller), as long as the motor is carefully sized to the application in respect to torque and speed.

Switched reluctance motors are very large stepping motors with a reduced pole count, and generally are closed-loop commutated.

3.6.2 Fundamentals of Operation

Fig 10. Steeper Motor

Brushed DC motors rotate continuously when DC voltage is applied to their terminals. The stepper motor is known by its property to convert a train of input pulses (typically square wave pulses) into a precisely defined increment in the shaft position. Each pulse moves the shaft through a fixed angle.

Stepper motors effectively have multiple "toothed" electromagnets arranged around a central gear-shaped piece of iron. The electromagnets are energized by an external driver circuit or a micro controller. To make the motor shaft turn, first, one electromagnet is given power, which magnetically attracts the gear's teeth. When the gear's teeth are aligned to the first electromagnet, they are slightly offset from the next electromagnet. This means that when the next electromagnet is turned on and the first is turned off, the gear rotates slightly to align with the next one. From there the process is repeated. Each of those rotations is called a "step", with an integer number of steps making a full rotation. In that way, the motor can be turned by a precise angle.

The circular arrangement of electromagnets is divided into groups, each group called a phase, and there is an equal number of electromagnets per group. The number of groups is chosen by the designer of the stepper motor. The electromagnets of each group are interleaved with the electromagnets of other groups to form a uniform pattern of arrangement. For example, if the stepper motor has two groups identified as A or B, and ten electromagnets in total, then the grouping pattern would be ABABABABAB.

Electromagnets within the same group are all energized together. Because of this, stepper motors with more phases typically have more wires (or leads) to control the motor.

3.7 Battery

A 9V battery is required to supply the dc power to drive the audrino uno and other components connected to the audrino.

3.8 Software

Audrino IDE is used to develop the prototype of the software.Audrino IDE is available at the official website of audrino.This is open source. So any one can develop anything according to their choices.

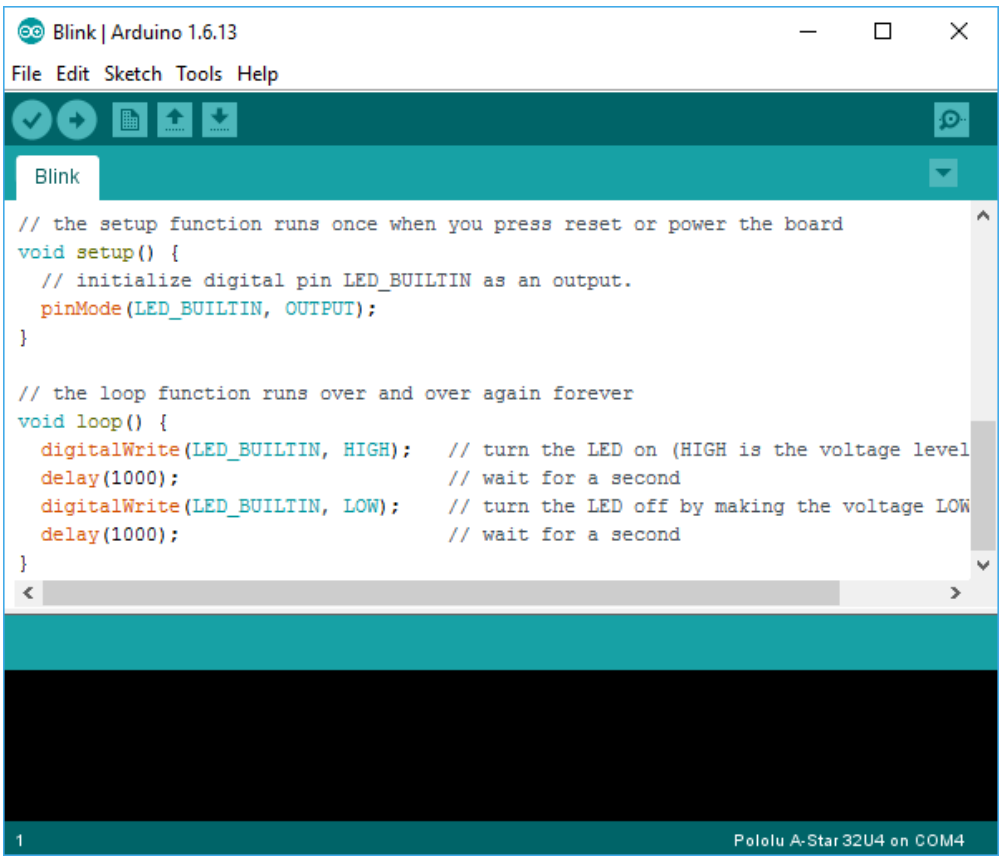

Fig 11. Audrino IDE interface

4.1 Circuit Diagram Of prototype

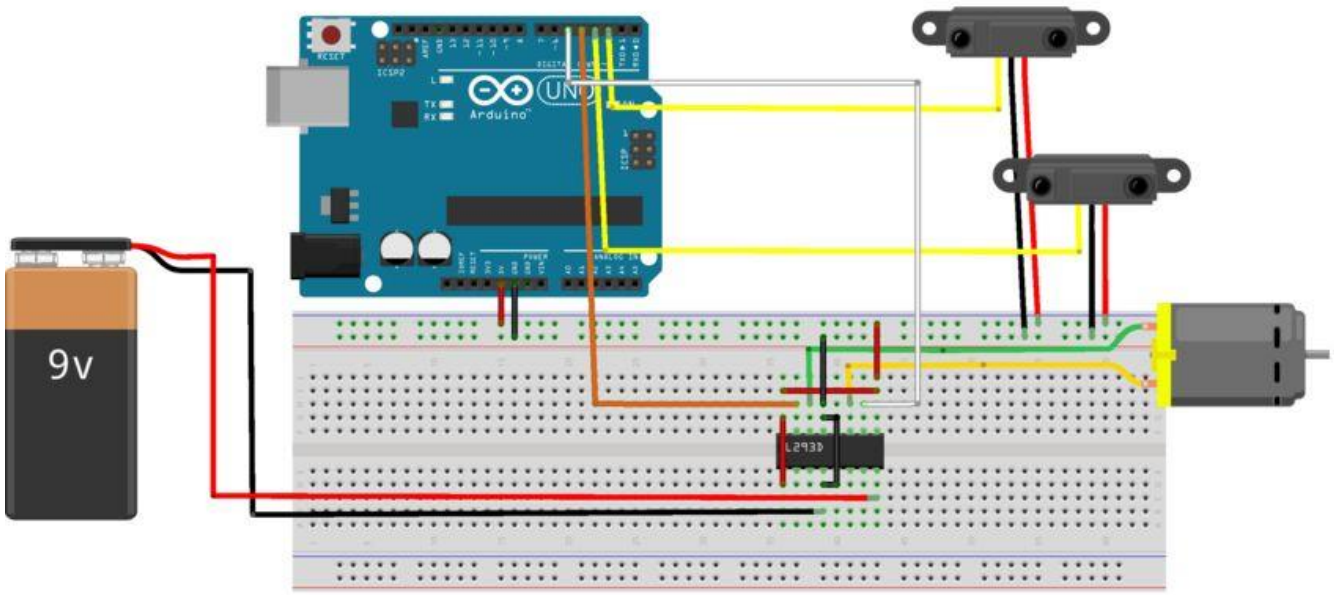

Fig 12. Circuit diagram of prototype

4.2 Working Principle

The working principle of the prototype is quite simple.Two IR sensors are placed at the bpth sides of railway crossing.They are placed 1Km. apart from level crossing.The arrival and departure of train is sensed by the sensors and transmitted to the audrino uno.

There's a loop that keeps running in the audrino that always checks the ir sensor output.If the ir sensor outputs the signal ,the audrino instructs the L293D to close the gate using Stepper motor and play the buzzers to alert the road users.The stepper motor exactly rotated at 90 degrees and the railway gate gets closed.After passing the train the departure is sensed by the another IR sensor which is placed at the opposite side of the other other IR sensor.When the departure is sensed by the another IR sensor the audrino gets the acknowledgement signal to open the gate via L293D module.

Same process happens if the train is coming from another side.The delay between sensed signal and closing of gate is kept small here(500 ms).But in real ife the delay is kept more.

5.1 Possible obstacles

Though this prototype is simple to build and highly reliable but there're some obstacles too.

Rather than a train if an animal or other object is placed in front of the IR sensor the alarm will and the gate will be closed which is not desirable at all.Also other natural obstacles like fog may arise problems.

There're also a scope of alerting the nearest railway station about arrival and departure of the train.

5.2 Possible solutions and future scopes

The problems indicated above can be overcome by adding some extra modules.

Like we left the GSM module for future scope.After addingh this module,upon arrival and departure of train,the GSM module will send an SMS to registered phone number for acknowledgement and safety.

Also adding a pair of pressure sensor increases the chance of fault triggering of gate as well as alarm. After adding the pressure sensor , the audrino closes the gate after reciving both signal from IR sensor as well as pressure sensor.

THE END