"Automatic Railway Gate Control & Hydraulic Road System using Arduino UNO"

Comilla University

Supervised By:

Alimul Rajee

Lecturer

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Faculty of Engineering, Department of ICT

Session: 2018-19

Submission Date: 5th June, 2022

Letter of Transmittal

5th June, 2022

To

Alimul Rajee

Lecturer

Dept. of ICT

Comilla University

Subject: Submission of Project Report on **"Automatic Railway Gate Control & Hydraulic Road System Using Arduino UNO".**

Dear Sir,

It's our pleasure to submit our project report on **"Automatic Railway Gate Control & Hydraulic Road System Using Arduino UNO"** which was assigned to us as a project fulfillment of ICT Department of Comilla University.

While making this paper we came across much pleasant experience. Which will undoubtedly benefit of our in the years ahead. This paper attempts to describe our learning's and experienced gained about the use of many Electronics. Despite the several constraints, we gave our all efforts to make this paper meaning one.

We have tried sincerely to comprehend and our knowledge in writing this paper. We will be grateful and oblige if you accept our project report and evaluate it with your sagacious judgment.

Yours Sincerely,

Meheniger Alam, Rakibul Islam Riyad

Tamanna Akter, Arshadul Islam Sourav

Gargi Roy Tushi

Session: 2018-19

Dept. Of ICT, Comilla University.

Declaration

"We Do hereby declare that this submission is our own work conformed to the norms and guidelines given by our Supervisor sir and that, to the best of our knowledge and belief, it contains no material previously written by another neither person 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."

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Date-5th June,2022

Certificate of Acceptance

This is to certify that the project report entitled **"Automatic Railway Gate Control & Hydraulic Road System Using Arduino UNO"** by ID 11909035,11909005,11909016,11909020 & 11909031 has been carried out as a partial fulfillment of requirement for the Microprocesssor and Microcontroller based lab. The dissertation has been carried out under my guidance and is a record of the authentic work carried out successfully. Their performance has been satisfactory during this project period.

I wish their every success in life.

Supervisor:

……

Alimul Rajee

Lecturer

Dept. of Information and Communication Technology

Comilla University, Cumilla.

Acknowledgement

This project report is the outcome of the contributions and sincere co-operation of different persons. For the fear of sounding like a vote of thanks speech, we could not possibly thank all of those marvelous people who have contributed something of them directly or indirectly in preparing this project report successfully. They are of course some very special people who cannot go without mention. It gives us immense thank them for their cordial cooperation and encouragement.

First of all, we would like to thanks Almighty Allah and we express heartfelt gratitude to our respected supervisor sir Alimul Rajee (Lecturer, Dept. of ICT, Comilla University)

Specially, we are very much grateful to our teammates and classmates of ICT 10th batch for co-operating and helping us in collection of necessary data and in the preparation of this project report.

In spite of sincere and denoted efforts, there might be some mistakes in the report. We take the entire responsibility for such unintended errors and omissions.

Thanking you,

Meheniger Alam, Rakibul Islam Riyad

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Abstract

Transport is exceptionally vital to carry the loads and products from one corner of the country and abroad to the other and for this reason Bangladeshi Railway play exceptionally vital part. Bangladesh's railway framework generally employments normal manual railway crossing method or boom entryways through its 2,955.53 km rail course all over the nation. The accidents are regularly happening within the railway intersections due to not having implement perceptible and quickly operating gate framework, additionally for less security measures within the railroad crossing. Right now, there are exceptionally few programmed railway crossing frameworks (without obstacle detector) accessible, be that as it may all of them are without a reinforcement arrange for any emergency cases. Intelligent traffic systems for railway object detection have become the focus of research in recent years.

This paper suggests an approach towards an intelligent and automatic management of a railway transportation system in order to prevent hazards like collisions. The system is designed as such that it is most viable for Bangladesh, however, it can also be easily implemented at any other railway infrastructure. The system features active train detection using IR sensor coordinates and obstacle detection at level crossings using Hydraulic road; automatic signaling and gate control at level crossings using light emitting diodes (LEDs) and servo motors; automatic and manual communication between trains and level crossings .Our design includes the integration and interaction of four separate sub-systems: central control system(based on Arduino UNO) , hydraulic road control system, automatic gate control system and train system. We design to use infrared (IR) sensors to operate the railway crossing systems which will be controlled by the Arduino Uno. Implementation of such a system in Bangladesh Railway will not only provide a comprehensive level of safety in railway transportation but also take Bangladesh a step forward towards the much-anticipated dream by Bangladesh government of creating a 'Digital Bangladesh'.

The main aim of this project is to reduce train accidents at railway level crossings to the minimum. Experimental studies show that the proposed methodology provides a more cost effective, reliable and simpler railway gate controller than existing dominant work.

List of Contents

Abbreviation

IR	Infrared
LED	Light Emitting Diode
GNSS	Global Navigation Satellite System
GSM	Global System for Mobile Communication
DC	Direct Circuit
LDR	Light Dependent Resistor
I/O	Input/output
PWM	Pulse Width Modulation
IDE	Integrated Development Environment
USB	Universal Serial Bus
MHz	Megahertz
IC	Integrated Circuit
GND	Ground
Op-amp	Operational Amplifier
MAC Address	Addresses of Medium Access Control Sublayer
SNMP	Simple Network Management Protocol
LAN	Local Area Network
QoS	Quality of Service
PoE	Power over Ethernet
GPS	Global Positioning System

List of Figures

Chapter -1
Introduction of the Report

1.1 Background of Study and Motivation

Railway being one of the safest and cheapest modes of transportation are preferred over all the other means of transport. So, it is essential to maintain and improve the current level of safety.

An automatic railway gate control system is an arrangement of physical components which sense the arrival of the train and make the gate pull up and pull down automatically. As a train approaches at the railway crossing from either side, the sensors placed at a certain distance from the gate detect the approaching train and accordingly controls the operation of the gate. Also, an indicator light has been provided to alert the driver of the train if any vehicle or living object gets stuck at the level crossing of the rail-line.

By employing the automatic gate control at the railway level crossing the arrival of the trains are detected by the IR sensors placed on either side of the gate. Once the arrival is sensed, the sensed signal is sent to the Arduino via IR sensor and it checks the possible presence of any vehicle between the gates, again using sensor. Then the yellow LED will be active and the both side gates will be closed and with it the hydraulic roads of both sides will start to rise. The red LED will active as soon as the hydraulic process starts. Once no vehicle is sensed in between the railway gate then the motor is activated and the gates are opened and the hydraulic process will continue to stops with yellow LED. When the process is done the gate is opened. However, if calibrated accurately, the system has a possibility to overcome the accidents.

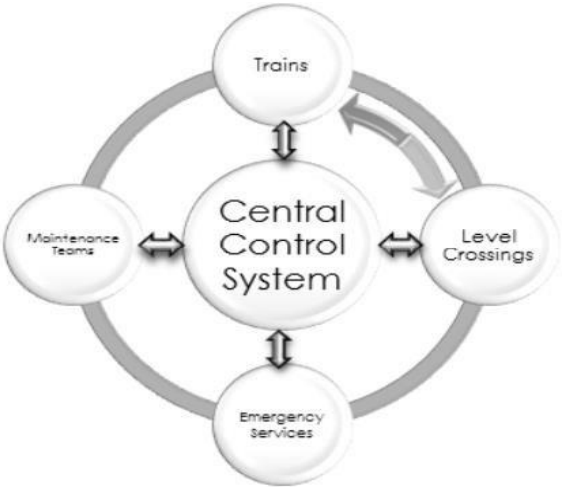

Figure-1: Communication flow diagram of our system

Source: Development of a smart railway system for Bangladesh

1.2 Objective of the Study

1.2.1 Broad Objective

The aim of this report is to study and identify the ensure the safety of railway signaling and prevent accident.

1.2.1 Specific Objectives

The report also seeks to recommend some specific objectives as follows:

I. To prevent human intervention at level crossing completely
II. Automatically opening and closing the railway gate upon detecting arrival or departure of the train
III. Hydraulic road for easy and efficient movement of vehicle

1.3 Findings

It is found that the time for which the gate is closed is less compared to the manually operated gates since the gate is closed depending upon the telephone call from the previous station. In case of train arrival, rail line side roads can be used a hydraulic road for just temporary time and when the train passed out easily from the line then with the help of servo motor, roads will get at its original position. This method can be used as a solution to prevent unwanted accidents.

1.4 Significant of the Study

- Automatic Railway Gate and Hydraulic Road Control System is a simple but very useful project, which help in automatically opening and closing the railway gate as well as root out and down the road upon detecting arrival or departure of the train.

- In general, Railway gates are opened or closed manually by a gate keeper. The information about arrival of train for opening or closing of door is received from nearby station. But some railway crossings are totally unmanned and many railway accidents occur at these unmanned level crossings.

- To avoid the human intervention at level crossings completely, we need to automate the process of railway gate control. [R1]

Figure-2: A glimpse of different types of level crossings is available in Bangladesh and the results of very common casualties that cause lives

Source: Visualization of Renewable Energy Powered Automatic Railway Crossing Systems in Bangladesh

1.5 Keywords

Central control system, Hydraulic road, Automatic gate control system, much-anticipated dream, Arduino UNO, IR sensor.

1.6 Paper Type

Project Report

Chapter -2

Literature Survey

2.1 Theoretical Background

The first survey on automatic gate control system was done by Karthik Krishnamurthi, Monica Bobby, Vidya V, Edwin Baby in 2015 and they suggested that the existing work attempts to automate the opening and closing of gates at a railway level crossing. The proposed system uses infra-red sensors to detect the arrival and departure of trains at the railway level crossing and Arduino to control the opening/closing of gates. The system uses two IR sensors to detect the arrival of the train and a third IR sensor to detect the departure of the train. When the arrival of the train is sensed, signals are provided to the traffic indicating the arrival of the train on the track. When the second sensor detects the train then the signal turns red and the motor operates to close the gate. The gate remains closed until the train completely moves away from the level cross. When the departure of the train is detected by the third sensor, the traffic signal turns green and the motor operates to open the gate. Thus, automation of the gate operations at the railway level cross is achieved using sensors. [R2]

According to Saifuddin Mahmud, Ishtiaq Reza Emon, Md. Mohaimin Billah in 2015 an automatic railway gate at the level crossing replacing the gates operated by the gate keeper by detecting train and stuck on the level crossing, generating corresponding alert signal and controlling the gate. The solution is provided by developing a train detection module, stuck detection module, signal light module, alarm module, railway gate controller and a controller module. There are only four ultrasonic sensors in the train detection module and one ultrasonic sensor in stuck detection module. Both, train detection and stuck detection module generate high frequency signal through the ultrasonic sensors and detect the presence of object if the echo is received back by the sensors. Then the controller unit determines whether the obstacle is train or stuck and takes necessary steps by controlling the gate, alarm generator and signal lights. Experimental studies show that the proposed methodology provides a more cost effective, reliable and simpler railway gate controller than existing dominant work. [R3]

In 2017, Masharul Bin Mahfuz, Zohair Mehtab Ali, Md. Shakhawat Hossain, Avijit Das suggests an approach towards an intelligent and automatic management of a railway transportation system in order to prevent hazards like collisions and derailments. The system is designed as such that it is most viable for Bangladesh, however, it can also be easily implemented at any other railway infrastructure. The system features active train detection using Global Navigation Satellite System (GNSS) coordinates and obstacle detection at level crossings using long range infrared; automatic signaling and gate control at level crossings using light emitting diodes (LEDs) and servo motors; automatic and manual communication between trains and level crossings using Global System for Mobile Communication (GSM) Technology and lastly development of a web-based central control system to monitor locations and activities of trains using navigation technology and to communicate with the entire railway community as well as the country's emergency services. The design includes the integration and interaction of three separate sub-systems: central control system, level crossing system and train system. [R4]

In 2019, G.Madhu, M.Yohan developed the vehicle to minimize the time for detecting the cracks and notifying the exact position of the defect on railway tracks by utilizing solar energy. In this vehicle solar panel is used to capture solar energy and then it is converted into electrical energy which in turn is used to charge lead acid battery, which then gives the necessary power to a DC motor. This power is then transmitted to the DC motor to drive the wheels. Here sensors are used to detect the cracks when the system detect crack it will stop and rings the alarm. [R5]

According to Ms. Nida Aafreen Aslam Khan, Ms. Komal Sunil Pise in 2020 proposed that hydraulic jack system installed in footpath for reducing traffic in case of emergency, Automatic street light control system based on LDR (Light Dependent Resistor) for mnimize the electricity consumption. This is the one of best solution to control the traffic. Highway paving materials, under normal operating conditions, are subjected to various forces. Motor vehicles, of necessity, have at least one set of driving wheels which exert tractive forces on the surface of the paving. The remaining wheels do not exert this tractive force but merely roll on the surface of the paving. [R6]

In 2020, Prof. Chetan N. Gawali , Amit R. Bhongade , Amit M. Ramteke , Nilesh G. Landge, Prafull P. Shende , Sagar S. Modak have shown that vehicular traffic is the major problem in metropolitan cities because traffic congestion is increasing rapidly at signalized intersections; it results in chronic situation in dense downtown areas. The purpose is to create a mechanism which lifts the footpath at signalized intersection up and down when there is more traffic at signalized intersection. Various congested signalized intersection areas and Bhim Square were studied. Comparing the reduction of queue length percentage, the researchers observed that hydraulic footpath is more preferable than the normal footpath for congested traffic at signalized intersection, because it reduce approximate 60% queue length. Also, hydraulic footpath gives extra space at signalized intersection and it helps to increase service volume. [R7]

Deva Rajan in 2021 proposed a system using infrared sensors to detect the arrival and departure of trains at the railway level crossing and Arduino to control the opening/closing of gates. The system uses two IR sensors to detect the arrival of the train and a third IR sensor to detect the departure of the train. When the arrival of the train is sensed, signals are provided to the traffic indicating the arrival of the train on the track. When the second sensor detects the train then the signal turns red and the motor operates to close the gate. The gate remains closed until the train completely moves away from the level cross. When the departure of the train is detected by the third sensor, the traffic signal turns green and the motor operates to open the gate. Thus, automation of the gate operations at the railway level cross is achieved using sensors. [R8]

Finally, in 2022, Ranu Rawat, Roshni Ambulkar, Reena Chilhate, Ashish Chokikar, Nilesh Mishra found that around 1,000,000 individuals have kicked the bucket throughout the course of recent years in automated rail route intersections everywhere. Somewhere around 1/third of the rail line intersections are automated because of their distant position and less traffic. The Programmed Railroad Entryway Control Framework utilizing IR Sensor and Arduino centers around orderly traffic signal of railroad entryways that are both monitored and automated. [R9]

Chapter-3

Methodology and Modeling

3.1 Introduction

This chapter will cover the details explanation of methodology that is being used to make this project complete and working well. Many methodology or findings from this field mainly generated into journal for others to take advantages and improve as upcoming research on projects. The methodology refers to the overall approach that our project requires. We need to explain our project briefly, demonstrating that we comprehend the meaning of our approaches. The methods are the tools of data collection, the procedure of our project. The procedures or strategies used to find, select, process, and analyze information about a topic are referred to as methodology. A particular procedure or set of procedures demonstrating the issue is massive revision of teaching methodology. In a report or article, the methodology section allows the reader to critically evaluate a study's overall validity and reliability. So, this methodology chapter explains what we did and how we did it.

3.2 Block Diagram

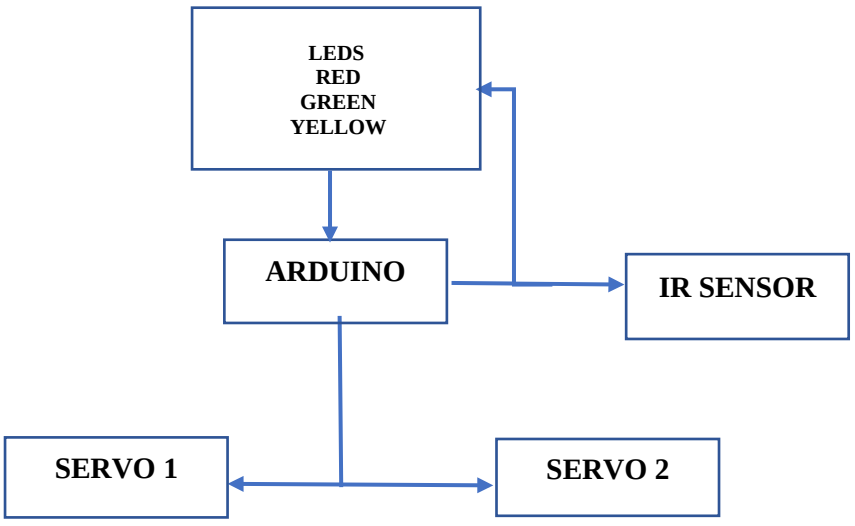

Figure-3: Block Diagram using chart

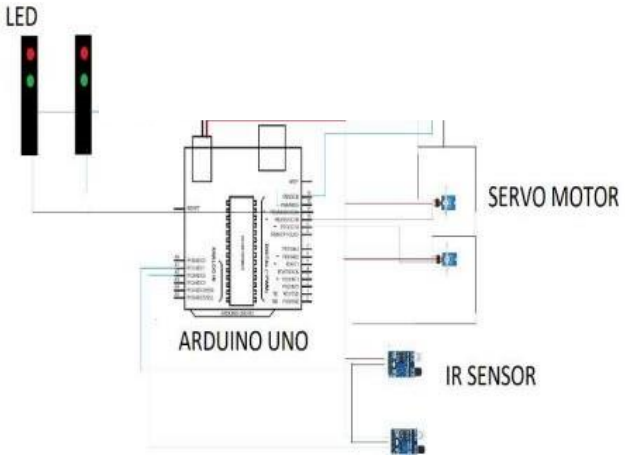

Figure-4: Block Diagram

3.3 System Architecture

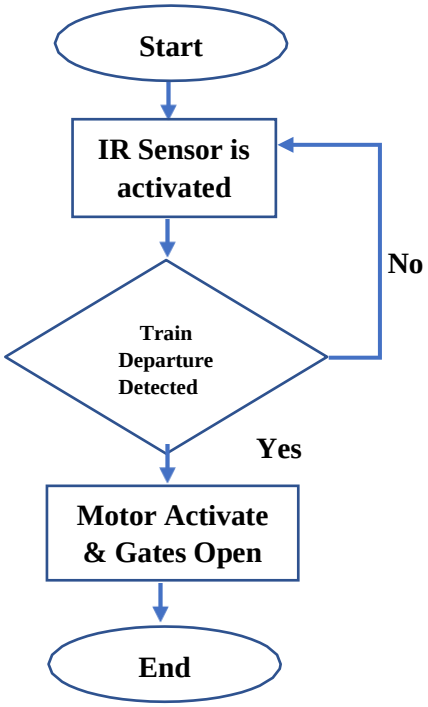

Figure- 6: Flowchart of opening the gate

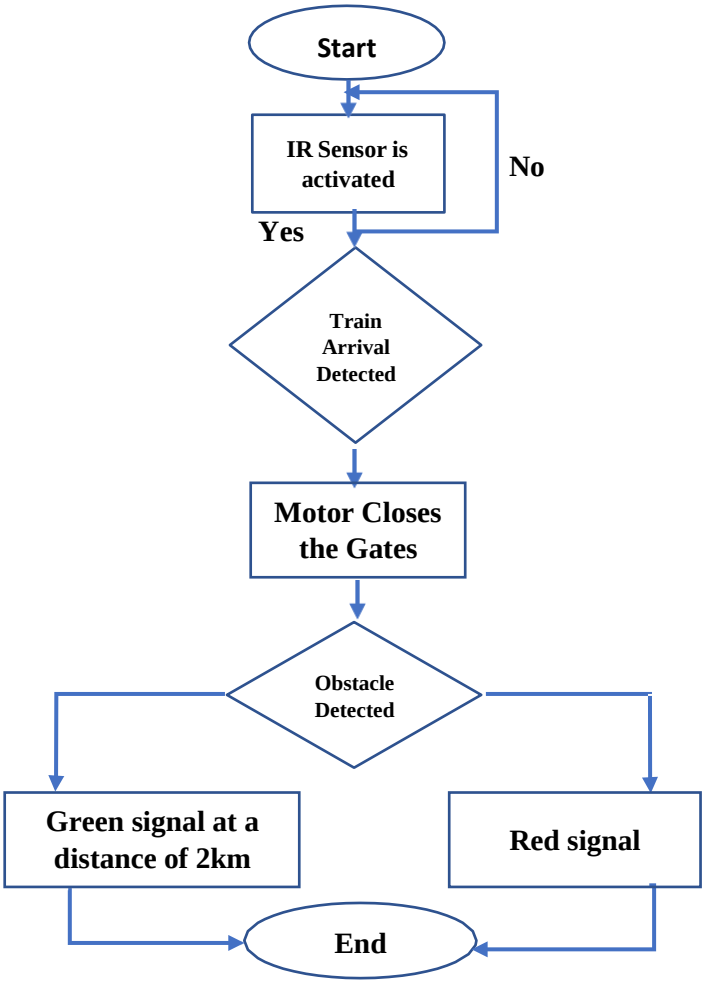

Figure-5: Flowchart of closing of gate

3.4 Components and Description

The main components of the automatic railway gate control and hydraulic road system for track crack detecting vehicle are given bellow-

i. Arduino Uno
ii. IR Sensor
iii. Servo Motor
iv. Switch
v. LED's
vi. Connecting Wires
vii. Bread Board

3.4.1 Arduino UNO

The **Arduino Uno** is an open- source microcontroller board. 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. The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable. [R10]

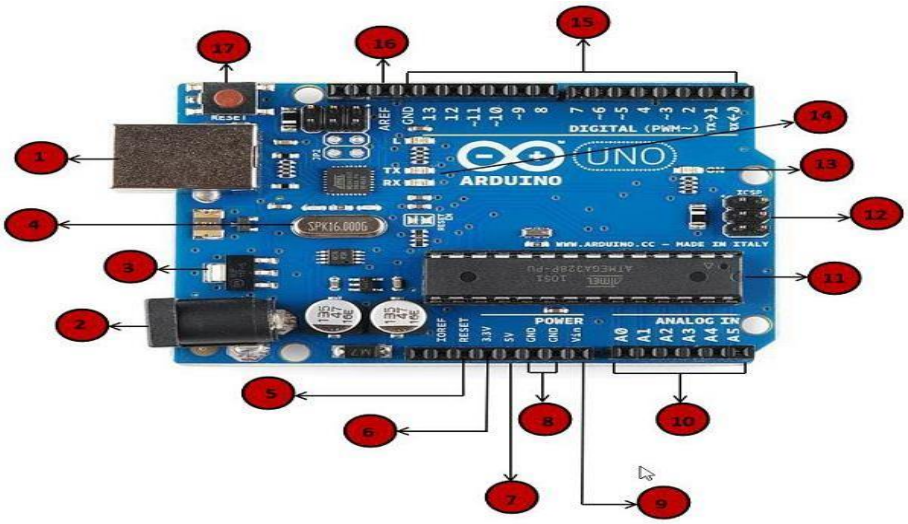

Figure -7: Arduino UNO

Source: tutorialspoint

1	**Power USB** Arduino board can be powered by using the USB cable from your computer. All you need to do is connect the USB cable to the USB connection.
2	**Power (Barrel Jack)** Arduino boards can be powered directly from the AC mains power supply by connecting it to the Barrel Jack
3	**Voltage Regulator** The function of the voltage regulator is to control the voltage given to the Arduino board and stabilize the DC voltages used by the processor and other elements.
4	**Crystal Oscillator** The crystal oscillator helps Arduino in dealing with time issues. Arduino calculate time by using the crystal oscillator. The number printed on top of the Arduino crystal is 16.000H9H. It tells us that the frequency is 16,000,000 Hertz or 16 MHz
5,17	**Arduino Reset** You can reset your Arduino board, i.e., start your program from the beginning. You can reset the UNO board in two ways. First, by using the reset button on the board. Second, you can connect an external reset button to the Arduino pin labelled RESET.
6,7 8,9	**Pins (3.3, 5, GND, Vin)** • 3.3V (6) − Supply 3.3 output volt • 5V (7) − Supply 5 output volt • Most of the components used with Arduino board works fine with 3.3 volt and 5 volt.

	• GND (Ground) − There are several GND pins on the Arduino, any of which can be used to ground your circuit. • Vin − This pin also can be used to power the Arduino board from an external power source, like AC mains power supply.
10	**Analog pins** The Arduino UNO board has six analog input pins A0 through A5. These pins can read the signal from an analog sensor like the humidity sensor or temperature sensor and convert it into a digital value that can be read by the microprocessor.
11	**Main microcontroller** Each Arduino board has its own microcontroller. You can assume it as the brain of your board. The main IC (integrated circuit) on the Arduino is slightly different from board to board. The microcontrollers are usually of the ATMEL Company. You must know what IC your board has before loading up a new program from the Arduino IDE. This information is available on the top of the IC. For more details about the IC construction and functions, you can refer to the data sheet.
12	**ICSP pin** Mostly, ICSP (12) is an AVR, a tiny programming header for the Arduino consisting of MOSI, MISO, SCK, RESET, VCC, and GND. It is often referred to as an SPI (Serial Peripheral Interface), which could be considered as an "expansion" of the output. Actually, you are slaving the output device to the master of the SPI bus.
13	**Power LED indicator** This LED should light up when you plug your Arduino into a power source to indicate that your board is powered up correctly. If this light does not turn on, then there is something wrong with the connection.

	**TX and RX LEDs** On your board, you will find two labels: TX (transmit) and RX (receive). They appear in two places on the Arduino UNO board. First, at the digital pins 0 and 1, to indicate the pins responsible for serial communication. Second, the TX and RX led. The TX led flashes with different speed while sending the serial data. The speed of flashing depends on the baud rate used by the board. RX flashes during the receiving process.
	**Digital I/O** The Arduino UNO board has 14 digital I/O pins (of which 6 provide PWM (Pulse Width Modulation) output. These pins can be configured to work as input digital pins to read logic values (0 or 1) or as digital output pins to drive different modules like LEDs, relays, etc. The pins labeled "~" can be used to generate PWM.
	**AREF** AREF stands for Analog Reference. It is sometimes, used to set an external reference voltage (between 0 and 5 Volts) as the upper limit for the analog input pins.

3.4.2 Infrared Sensor or IR Sensor

An infrared sensor is an electronic device that emits in order to sense some aspects of the surroundings. An IR sensor can measure the heat of an object as well as detects the motion. These types of sensors measure only infrared radiation, rather than emitting it that is called a passive IR sensor. Usually, in the infrared spectrum, all the objects radiate some form of thermal radiation. [R11]

Figure -8: Infrared Sensor

Source: EL-PRO-CUS

These types of radiations are invisible to our eyes, which can be detected by an infrared sensor. The emitter is simply an IR LED (Light Emitting Diode) and the detector is simply an IR photodiode that is sensitive to IR light of the same wavelength as that emitted by the IR LED. When IR light falls on the photodiode, the resistances and the output voltages will change in proportion to the magnitude of the IR light received.

IR Sensor Circuit Diagram

An infrared sensor circuit is one of the basic and popular sensor modules in an electronic device. This sensor is analogous to human's visionary senses, which can be used to detect obstacles and it is one of the common applications in real-time. This circuit comprises the following components

- LM358 IC 2 IR transmitter and receiver pair
- Resistors of the range of kilo-ohms.
- Variable resistors.
- LED (Light Emitting Diode).

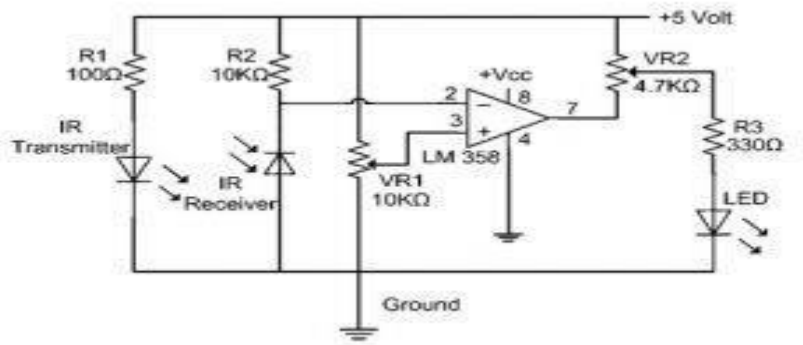

Figure -9: IR Sensor Circuit Diagram

Source: EL-PRO-CUS

In this project, the transmitter section includes an IR sensor, which transmits continuous IR rays to be received by an IR receiver module. An IR output terminal of the receiver varies depending upon its receiving of IR rays. Since this variation cannot be analyzed as such, therefore this output can be fed to a comparator circuit. Here an operational amplifier (op-amp) of LM 339 is used as a comparator circuit.

When the IR receiver does not receive a signal, the potential at the inverting input goes higher than that non-inverting input of the comparator IC (LM339). Thus, the output of the comparator goes low, but the LED does not glow. When the IR receiver module receives a signal to the potential at the inverting input goes low. Thus, the output of the comparator (LM 339) goes high and the LED starts glowing.

Resistor R1 (100), R2 (10k), and R3 (330) are used to ensure that a minimum of 10 mA current passes through the IR LED Devices like Photodiode and normal LEDs respectively. Resistor VR2 (preset=5k) is used to adjust the output terminals. Resistor VR1 (preset=10k) is used to set the sensitivity of the circuit Diagram. Read more about IR sensors. [R11]

3.4.3 Servo Motor

A servomotor (or servo motor) is **a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity, and acceleration**. It consists of a suitable motor coupled to a sensor for position feedback. Servomotors are used in applications such as robotics, CNC machinery, or automated

manufacturing. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors. Servomotors are not a specific class of motor, although the term servomotor is often used to refer to a motor suitable for use in a closed-loop control system. Servo motors are part of a closed-loop control system and consist of several parts namely a control circuit, a servo motor, a shaft, a potentiometer, a drive gear, an amplifier, and either an encoder or a resolver. A servomotor is a self-contained electrical device that rotates parts of a machine with high efficiency and great precision. [R12]

Figure-10: Servo Motor

Source: CIRCUIT DIGEST

Types of Servo Motors

Servomotors come in many sizes and in three basic types. The three types include positional rotation, continuous rotation, and linear.

- **Positional Rotation** Servos rotate 180 degrees. They also have stops in the gearbox to protect the output shaft from over-rotating.
- A **continuous rotation** servo motor is a servo whose range of motion is not limited. Instead of letting the input signal determine which position the servo should turn. The continuous rotation of the servo relates the input to the speed of the output and the direction. The limitless movement of these motors allows them to move in both CW and CCW directions.

- **Linear servos** use a rack and pinion mechanism to change their performance. The rack and pinion convert rotary motion into linear motion.

How Does A Servo Motor Work

A servo motor is an electromechanical device that generates torque and velocity based on the supplied current and voltage. A servo motor operates as part of closed-loop control, providing torque and velocity as commanded by a servo controller which uses a feedback device to close the loop.

The feedback device provides information such as current, velocity, or position to the servo controller, which adjusts the motor action depending on the commanded parameters.

Servos are controlled by sending a variable width electrical pulse or pulse width modulation (PWM) over the control cable. There is a minimum heart rate, a maximum heart rate, and a repetition rate. A servo motor can normally only rotate 90 ° in each direction. Which adds up to a total of 180 ° of movement.

The neutral position of the motor is defined as the position where the servo has the same potential rotation in both clockwise and counterclockwise directions. The PWM sent to the motor determines the position of the shaft and is based on the duration of the pulse sent over the control cable; the rotor turns into the desired position.

The servo motor expects a pulse every 20 milliseconds and the length of the pulse determines how far the motor turns. A pulse of 1.5ms, for example, causes the motor to turn to the 90 ° position.

For less than 1.5ms it moves counterclockwise towards the 0 ° position, and longer than 1.5ms rotates the servo clockwise towards the 180 ° position.

Figure-11: Working Principle of Servo Motor

Source: ENGINEERING CHOICE

When a move command is given to these servos, they will move into position and hold that position. If an external force is pressing against the servo while the servo is holding a position, the servo will resist moving from that position.

The maximum force the servo can exert is called the servo's torque. Servos won't hold their position forever, however; the position pulse must be repeated to tell the servo to stay in position. [R12]

3.4.4 Connecting Wire or Jumper

A jumper is a short length of conductor used to close, open or bypass part of an electric circuit. There are 3 types of jumper. Male to male, Male to female, female to female.

Connecting wires allows an electrical current to travel from one point on a circuit to another, because electricity needs a medium through which to move. In the case of computers, wires are embedded into circuit boards, carrying pulses of electricity that are interpreted as binary signals of zeros and ones.

Most wires in computers and electronic components are made of copper or aluminum. Copper is cheap and electrically conductive. Silver has higher conductivity but is far more expensive.

In a basic circuit, the wire comes from one terminal of a power source, such as a battery. It then connects to a switch that determines whether the circuit is open or closed. The wire then connects to the device that is drawing power, allowing it to draw electricity and perform its task. Finally, the wire connects the load back to the opposite terminal of the power source.

Before a current can travel through the wire, the circuit has to be closed; in other words, there cannot be any breaks in the path. Electricity cannot easily travel through air, and if it does there is a risk of stray current leaking into the surroundings and causing damage or failing to power the appliance. [R13]

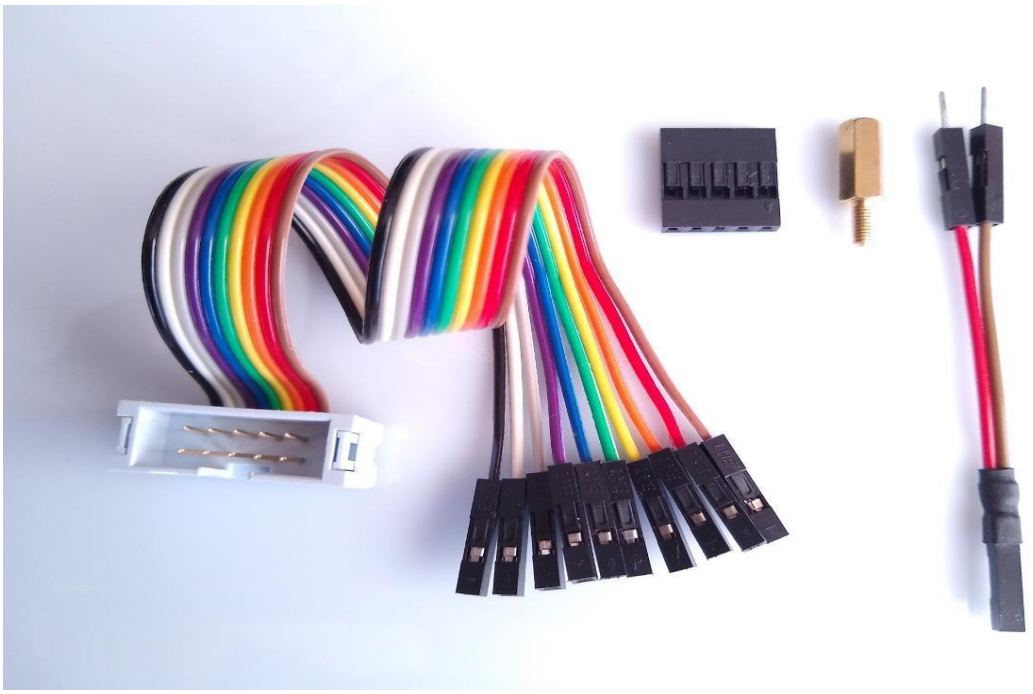

Figure-12: Jumper or Connecting Wire
Source: Electronics Hub

3.4.5 Light Emitting Diode (LED)

Light-emitting diode (LED) is a widely used standard source of light in electrical equipment. It has a wide range of applications ranging from your mobile phone to large advertising billboards. They mostly find applications in devices that show the time and display different types of data.

What is LED?

A light-emitting diode (LED) is a semiconductor device that emits light when an electric current flow through it. When current passes through an LED, the electrons recombine with holes emitting light in the process. LEDs allow the current to flow in the forward direction and blocks the current in the reverse direction.

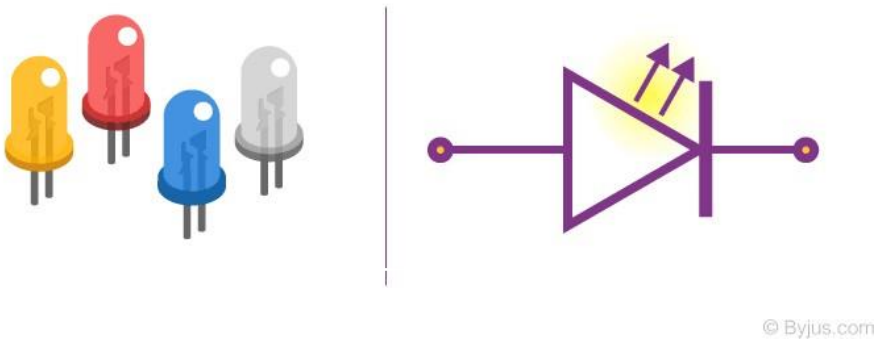

Figure-13: Light Emitting Diode

Source: BYJU'S

Light-emitting diodes are heavily doped p-n junctions. Based on the semiconductor material used and the amount of doping, an LED will emit a colored light at a particular spectral wavelength when forward biased. As shown in the figure, an LED is encapsulated with a transparent cover so that emitted light can come out.

LED Symbol

The LED symbol is the standard symbol for a diode, with the addition of two small arrows denoting the emission of light.

Simple LED Circuit

The figure below shows a simple LED circuit. The circuit consists of an LED, a voltage supply and a resistor to regulate the current and voltage.

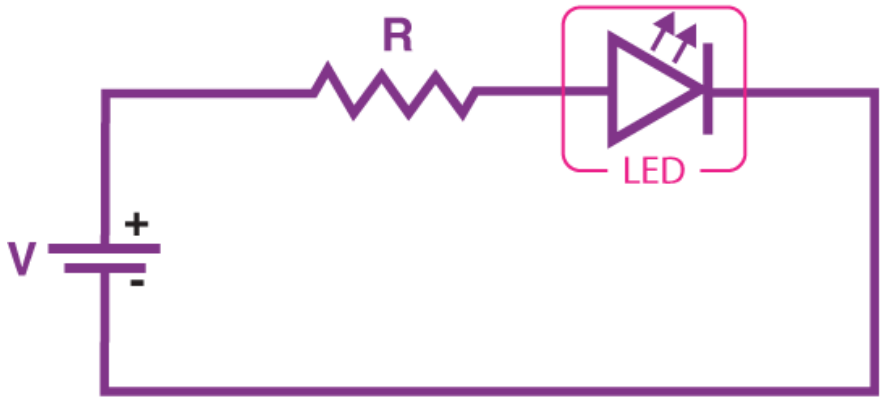

Figure-14: LED Circuit
Source: BYJU'S

How does an LED work?

When the diode is forward biased, the minority electrons are sent from p → n while the minority holes are sent from n → p. At the junction boundary, the concentration of minority carriers increases. The excess minority carriers at the junction recombine with the majority charges carriers.

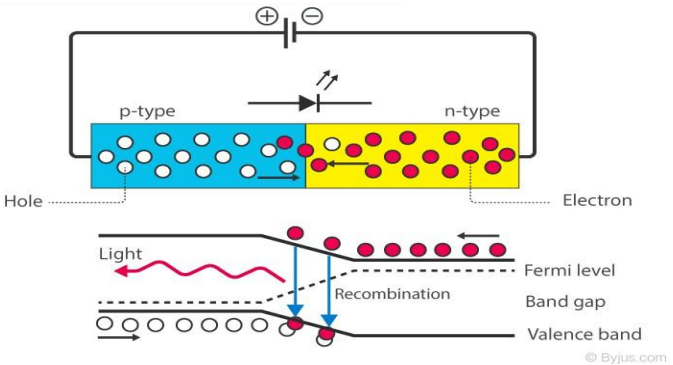

Figure-15: Working Principle of LED
Source: BYJU'S

The energy is released in the form of photons on recombination. In standard diodes, the energy is released in the form of heat. But in light-emitting diodes, the energy is released in the form of photons. We call this phenomenon electroluminescence. Electroluminescence is an optical phenomenon, and electrical phenomenon where a material emits light in response to an electric

current passed through it. As the forward voltage increases, the intensity of the light increases and reaches a maximum. [R14]

Uses of LED

LEDs find applications in various fields, including optical communication, alarm and security systems, remote-controlled operations, robotics, etc. It finds usage in many areas because of its long-lasting capability, low power requirements, swift response time, and fast switching capabilities. Below are a few standards LED uses:

- Used for TV back-lighting
- Used in displays
- Used in Automotive
- LEDs used in the dimming of lights

Types of LED

Below is the list of different types of LED that are designed using semiconductors:

- Miniature LEDs
- High-Power LEDs
- Flash LED
- Bi and Tri-Color
- Red Green Blue LEDs
- Alphanumeric LED
- Lighting LED

3.4.6 Bread Board

As the name suggests, the term breadboard can be derived from two terms namely bread & board. Initially, this was used to cut the bread into pieces. Further, it was called a breadboard & it was used in electronics projects and electronic devices in the year 1970. A breadboard is also known as a solderless board because the component used on the breadboard does not need any soldering to connect to the board, so it can be reused.

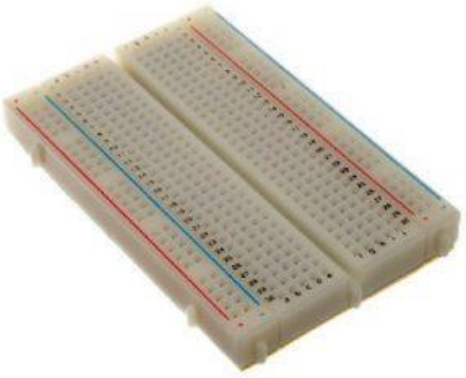

Figure-16: Breadboard

Source: Wikipidia

The arrangement of different components on a breadboard can be done by inserting their terminals into the breadboard, so it is frequently known as a plugboard. Breadboard definition is a plastic board in rectangular shape that includes a lot of small holes in it to allow you to place different components to build an electronic circuit is known as a breadboard. The connection on the breadboard is not permanent but they can be connected without soldering the components.

What is a breadboard diagram?

A **breadboard diagram** is a computer-generated drawing of a circuit on a breadboard. Unlike a **circuit diagram** or a **schematic.** For example, this diagram shows a basic circuit with a battery pack, an LED, a resistor, and a pushbutton, which looks very similar to the physical circuit:

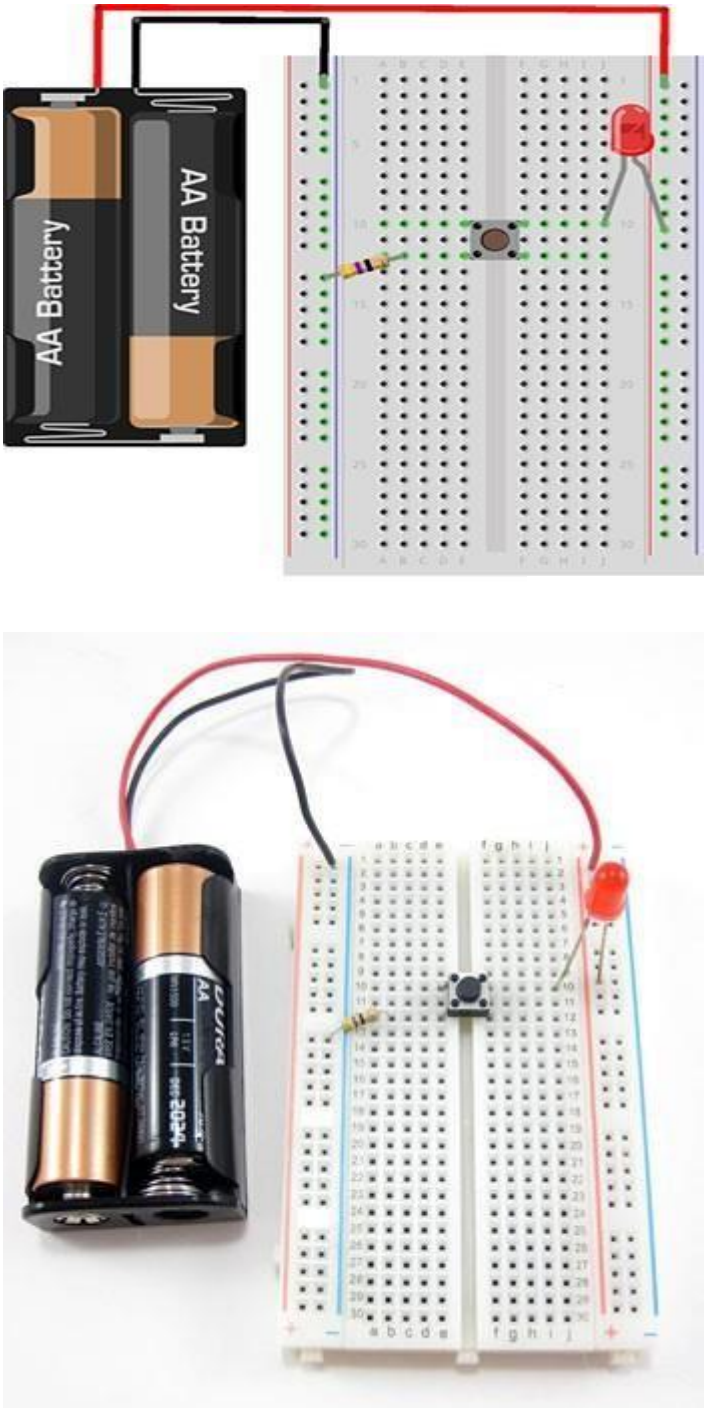

Figure-17: Block Diagram of Bread Board

Source: Science Buddies

Sometimes, breadboard diagrams might be accompanied by (or replaced with) written directions that tell you where to put each component on the breadboard. For example, the directions for this circuit might say:

1. Connect the battery pack's red lead to the power bus.
2. Connect the battery pack's black lead to the ground bus.
3. Connect the resistor from hole B12 to the ground bus.
4. Insert the pushbutton's four pins into holes E10, F10, E12, and F12.
5. Insert the LED's long lead into the power bus, and the short lead into hole J10. [R15]

3.4.7 Switch

Switches are networking devices operating at layer 2 or a data link layer of the OSI model. They connect devices in a network and use packet switching to send, receive or forward data packets or data frames over the network. A switch has many ports, to which computers are plugged in. When a data frame arrives at any port of a network switch, it examines the destination address, performs necessary checks and sends the frame to the corresponding device(s). It supports unicast, multicast as well as broadcast communications.

Figure -18: Switch

Source: Nowwy Jirawat/Shutterstock.com

Features of Switches

- A switch operates in the layer 2, i.e. data link layer of the OSI model.
- It is an intelligent network device that can be conceived as a multiport network bridge.
- It uses MAC addresses (addresses of medium access control sublayer) to send data packets to selected destination ports.
- It uses packet switching technique to receive and forward data packets from the source to the destination device.
- It is supports unicast (one-to-one), multicast (one-to-many) and broadcast (one-to-all) communications.

- Transmission mode is full duplex, i.e. communication in the channel occurs in both the directions at the same time. Due to this, collisions do not occur.
- Switches are active devices, equipped with network software and network management capabilities.
- Switches can perform some error checking before forwarding data to the destined port.
- The number of ports is higher – 24/48. [R16]

Types of Switches

There are variety of switches that can be broadly categorized into 4 types −

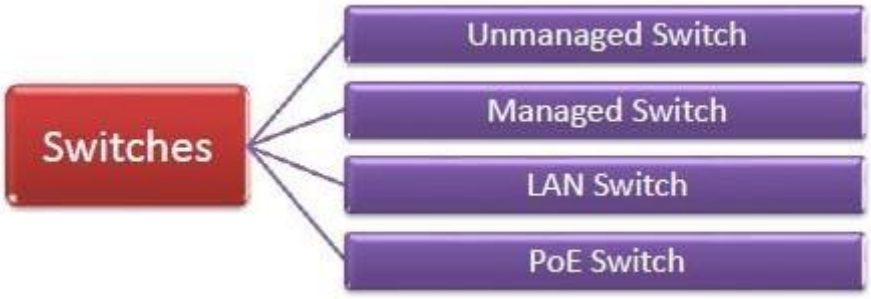

Figure-19: Types of Switches

Source: tutorialspoints

- **Unmanaged Switch** − These are inexpensive switches commonly used in home networks and small businesses. They can be set up by simply plugging in to the network, after which they instantly start operating. When more devices need to be added, more switches are simply added by this plug and play method. They are referred to as u managed since they do not require to be configured or monitored.
- **Managed Switch** − These are costly switches that are used in organizations with large and complex networks, since they can be customized to augment the functionalities of a standard switch. The augmented features may be QoS (Quality of Service) like higher security levels, better precision control and complete network management. Despite their cost, they are preferred in growing organizations due to their scalability and flexibility. Simple Network Management Protocol (SNMP) is used for configuring managed switches.
- **LAN Switch** − Local Area Network (LAN) switches connects devices in the internal LAN of an organization. They are also referred as Ethernet switches or data switches.

These switches are particularly helpful in reducing network congestion or bottlenecks. They allocate bandwidth in a manner so that there is no overlapping of data packets in a network.

- **PoE Switch** − Power over Ethernet (PoE) switches are used in PoE Gigabit Ethernets. PoE technology combine data and power transmission over the same cable so that devices connected to it can receive both electricity as well as data over the same line. PoE switches offer greater flexibility and simplifies the cabling connections. [R16]

3.4.8 Software

Arduino IDE is used to develop the prototype of the software. Arduino IDE is available at the official website of Arduino. This is open source. So, anyone can develop anything according to their choices.

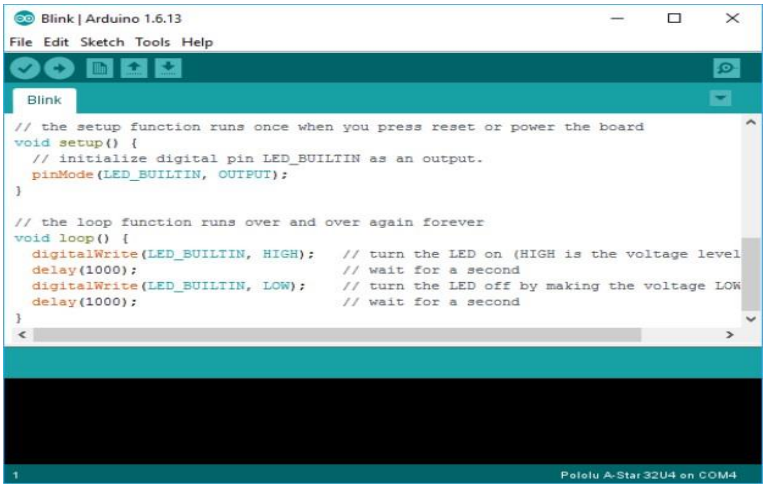

Figure- 20: Arduino IDE interface

3.5 Circuit Diagram of Prototype

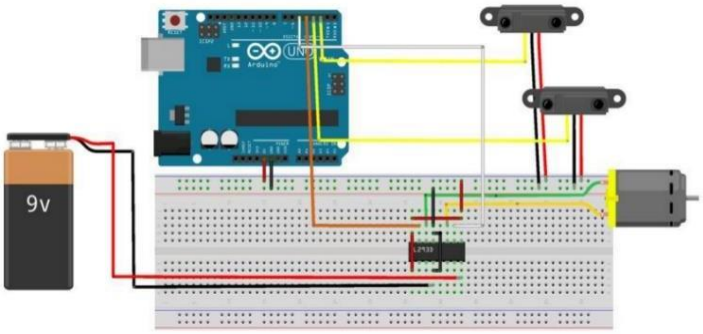

Figure-21: Circuit diagram of prototype

3.6 Working principle of the proposed project

The working principle of the prototype is quite simple. IR sensors are placed at the both sides of railway crossing. They are placed 3Km. apart from level crossing. The arrival and departure of train is sensed by the sensors and transmitted to the Arduino UNO. There's a loop that keeps running in the Arduino that always checks the IR sensor output. If the IR sensor outputs the signal, the Arduino instructs the yellow LED to be active and to close the gate using servo motor and play the buzzers to alert the road users as soon as the hydraulic process will be started using servo motor. The servo motor exactly rotated at 90 degrees and the railway gate gets closed. After fulfilling the process, the Arduino instructs the red LED to be active. After passing the train the departure is sensed by another IR sensor. When the departure is sensed by the IR sensor the Arduino gets the acknowledgement signal to open the gate. Again, the same process occurs. While the Hydraulic process is stopped and the gate is opened then the Arduino instructs the green LED to be active. Same process happens if the train is coming from another side. The delay between sensed signal and closing of gate is kept small here (30 ms & 20 ms). But in real life the delay is kept more.

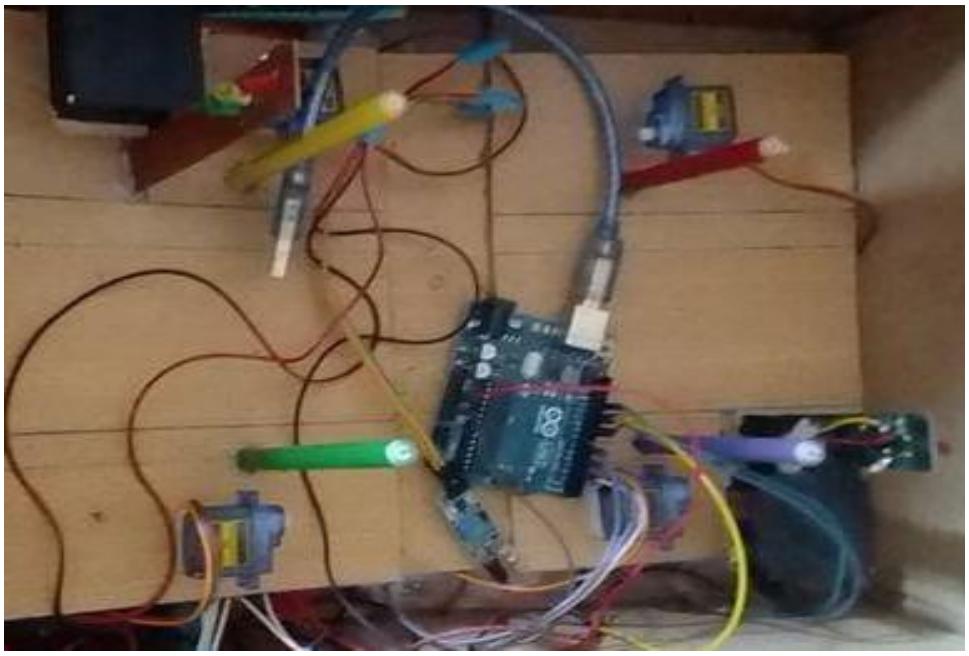

Figure -22: Working Principle

Chapter – 4

Results and Discussion

4.1 Experimental Analysis

The proposed framework is profoundly solid, compelling and affordable at thick traffic region, rural region and the course where recurrence of trains is more. Utilizing programmed rail route crossing framework, we further develop the rail street transportation office by diminishing the possibilities of event of mishaps at automated level intersections and giving. enormous wellbeing giving enormous wellbeing. Additionally, this strategy has quick activity than more seasoned framework, it saves a ton of time as it is computerized while manual frameworks invest in some opportunity for the line man to illuminate the station expert to close and open the entryway which will consume a lot of time. The obstruction recognition unit has been utilized in the proposed framework to decrease the mishaps at level intersections up to greatest sum. Since the plan is totally mechanized it very well may be utilized in distant regions where no station expert or line man is present and it doesn't debase than existing framework. Consequently, this framework tracks down its applications generally speaking. [R9]

Figure-23: Arrival train gate closed

Source: AUTOMATIC RAILWAY GATE CONTROL SYSTEM BY USING ARDUINO

Figure -24: Departure train gate opened

Source: AUTOMATIC RAILWAY GATE CONTROL SYSTEM BY USING ARDUINO

Figure-25: Model of automatic street

Source: Hydraulic Jack System Installed in Footpath for Reducing Traffic in Case of Emergency, Automatic Street Light Control System Based on LDR for Minimize the Electricity Consumption

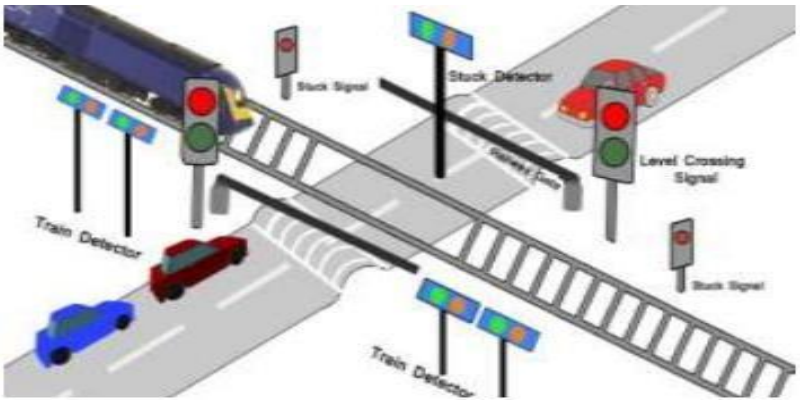

Figure -26: The Prototype of the Proposed Project

Source: Automated Railway Gate Controlling System

Chapter- 5

Conclusion and Recommendations

In a nutshell, this project has given us a unique experience of amalgamating the fields of electronics, communication and computer science, and has brought out a developed system that can be implemented in the real-life scenario. By implementing our system, train collisions can be predicted beforehand and necessary precautions could be taken in order to avoid any accidents. Derailments caused by excessive speeds could also be prevented as speeds of trains are always monitored. Automatic train detection and obstacle detection at level crossings would play a major role and guarantee a comprehensive amount of safety in the level crossings.

5.1 Implications

Automatic railway gate control system is centered on the idea of reducing human involvement for closing and opening the railway gate which allows and prevents cars and humans from crossing railway tracks. The railway gate is a cause of many deaths and accidents. Hence, automating the gate can bring about a ring of surety to controlling the gates. Human may make errors or mistakes so automating this process will reduce the chances of gate failures. Automation of the closing and opening of the railway gate using the switch circuit reduces the accidents to a greater extend. The hydraulic system implemented reduces the accidents which are usually caused when the railway line passes through the roads. Most of the times greater loss has been caused when animals or cars cross the tracks.

5.2 Possible Obstacles

The limitation of this project is the use of IR sensors. Hence, any obstacle in the way of the sensor will be detected. Another important limitation is that this project does indeed close and open the gate but it cannot control the crossing of cars and vehicles. It only controls the gate. To combat this problem pressure sensors can be used as extension to the present work. We are using IR sensors but it is better to use load sensors. We have not used load sensors because it was not economically feasible. Another big limitation is if there stuck any vehicle in the road while the hydraulic process starts then there will cause a big traffic jam.

5.3 Possible Solutions and Future Goals

The accidents due to railway level crossing and the obstacle can be avoided in real time by implementing this system and the whole process is completely automatic. In future the features like wireless system can be implemented in the real time operation. In real time operation vibration sensors can be used in place of IR sensors for the detection of arrival and departure of train. So, the vibration sensor serves better when compared to the IR sensors for the real time. And also, the GPS system can be implemented and interfaced with the circuitry. GPS system ensures that the correct location of the obstacle can be sent to the nearby railway station through GSM modem. This helps to get the exact location of the obstacle so that the work for the clearance of obstacle can be done faster. Our system can be implemented in real time by fixing the current limitations using new technologies.

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Appendix

Arduino IDE

The Arduino IDE is an open-source program for writing and uploading code to Arduino boards. The IDE program is compatible with a variety of operating systems, including Windows, Mac OS X, and Linux. C and C++ are supported programming languages. IDE stands for Integrated Development Environment in this case. Sketching refers to the process of writing a program or code in the Arduino IDE. To upload the sketch written in the Arduino IDE software, we must connect the Genuine and Arduino boards to the IDE. The '. ino' extension is used to save the sketches.

Servo-Motor

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. It consists of a suitable motor coupled to a sensor for position feedback. It also requires a relatively sophisticated controller, often a dedicated module designed specifically for use with servomotors.

Arduino Library

The Library is considered as the advanced feature, which extends the capabilities of the Arduino IDE. It means that the libraries provide extra functionality to the programming platform of Arduino. The libraries in Arduino are written in C or C++ (.cpp). These libraries allow us to manipulate data and work with the hardware. To implement any Library in the Arduino IDE, go to the Sketch -> Import Library. There are several libraries available for download. We can also create our own library.