SONARGAON UNIVERSITY (SU)

Automatic Motion Sensing Barrier Gate Control System with Automated Sirens and Signal System

A Project
By

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24 January 2023

1

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Submitted to the:

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In partial fulfillment of the requirement for the award of the degree Of Bachelor of Science in Mechanical Engineering

24 January 2023

LETTER OF TRANSMITTAL

24 January 2023

To
Md. Sharful Insan
Lecturer
Department of Mechanical Engineering.
Sonargaon University, Dhaka-1215

Subject: Submission of Project Report**.**

Dear Sir,

We are pleased to submit the project report on "**Automatic Motion Sensing Barrier Gate Control System with Automated Sirens and Signal System".** It was a great pleasure to work on such an important topic. This project has been done per the instruction of your supervision and according to the requirements of Sonargaon University.

We expect that the concerned authority will accept the project. We are happy to explain anything further as you may feel necessary.

Thank You
Sincerely yours,

Md. Naimul Islam   Nuhan Amin Khan
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STUDENT'S DECLARATION

We do hereby solemnly declare that, the work presented here in this project report has been carried out by us and has not been previously submitted to any University/ Organization for the award of any degree or certificate.

We hereby ensure that the works that have been prevented here do not breach any existing copyright.

We further undertake to indemnify the university against any loss or damage arising from a breach of the foregoing obligation.

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this project. In my opinion, this project is satisfactory in terms of scope and quality for the award of the degree of Bachelor of Science in Mechanical Engineering.

Md. Sharful Insan

Lecturer

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ACKNOWLEDGEMENT

First, we started in the name of Almighty Allah. This thesis is accomplished under the supervision of Md. Sharful Insan, Lecturer, Department of Mechanical Engineering, Sonargaon University. It is a great pleasure to acknowledge our profound gratitude and respect to our supervisor for this consistent guidance, encouragement, helpful suggestion, constructive criticism, and endless patience through the progress of this work. The successful completion of this thesis would not have been possible without his persistent motivation and continuous guidance.

The authors are also grateful to Md. Mostofa Hossain, Head of the Department of Mechanical Engineering, and all respectful teachers of the Mechanical Engineering Department for their cooperation and significant help in completing this project work successfully.

ABSTRACT

The aim of this project is to design an Automatic Motion Sensing Barrier Gate Control System with Automated Sirens and Signal System using an Arduino nano microcontroller. This mainly aims at preventing accidents at some level crossing where many accidents take place every day. This automatic railway gate controller makes use of one IR sensor placed at the gate placed at a particular distance. The sensor detects the arrival of the train and sends the signal to the micro-controller to close the gate, sirens automatically and after the train left gate will open automatically. When a train detects an IR sensor then a text will send to the gate-man's mobile phone by the use of a GSM module. If some obstacle comes in front of the train, then the train will be automatically slow. The usage of this automatic railway gate controller using a micro controller will largely reduce accidents at the unnamed level crossings and provide immense safety.

TABLE OF CONTENTS

9

LIST OF FIGURES

INTRODUCTION

1.1 Introduction

A level crossing occurs when a railway line is intersected by a road or path on one level, without recourse to a bridge or tunnel. It is a type of at-grade intersection. The term also applies when a light rail line with separate right-of-way in reserved track crosses a road similarly. Other names include railway crossing, railroad crossing, the road through railroad, train crossing, or grade crossing. 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 allaric and clear the tracks.

Manual or electrical closable gates that barricaded the roadway were later introduced. The gates were intended to be a complete barrier against the instruction of any road traffic onto the railway. In the early days of the railways, much road traffic was horse-drawn or included livestock. It was thus necessary to provide a real barrier. Thus, crossing gates, when closed to road traffic, crossed the entire width of the road. When opened to allow road users to cross the line, the gates were swung across the width of the railway, preventing pedestrians or animals from getting onto the line. With the appearance of motor vehicles, this barrier became less effective and the need for a barrier to livestock diminished dramatically.

Many countries, therefore, substituted the gated crossings with weaker but more obvious barriers and relied upon road users following the associated warning signals to stop. The present work is designed using 8051 microcontrollers to avoid railway accidents happening at unattended railway gates if implemented in spirit. We have Automatic Railway Gate Control System considered 5 seconds for this paper. Sensors are fixed at 1km on both sides of the gate. We call the sensor along the train direction as 'foreside sensor' and the other as 'after side sensor'. When the foreside receiver gets activated, the gate motor is turned on in one direction and the gate is closed and stays closed until the train crosses the gate and reaches aft side sensors. When the aft side receiver gets activated motor turns in the opposite direction and the gate opens and the motor stops. A buzzer will immediately sound at the fore side receiver activation and the gate will close after 5 seconds, so giving time to drivers

to clear the gate area to avoid trapping between the gates and stop sound after the train has crossed.

1.2 Rail Accident in BD:

[Rff: Accident where at least 12 people were killed when a bus collided with a train at Puranapoil area in Joypurhat town on Saturday, December 19, 2020.]

Bangladesh on Saturday witnessed a tragic train accident in the Puranapoil area of Joypurhat Sadar upazila, where a collision between a train and a bus left at least 12 people dead and three others injured. Police say the accident is a result of negligence by the level-crossing gateman. According to Bangladesh Railway, human errors are accountable for 72% of rail accidents in Bangladesh, with 23% of the accidents being results of mechanical failure. Human error includes negligence or mistake by the driver, stationmaster, and guard, reckless driving, and mechanical failure due to the malfunctioning of locomotives, defective tracks, and the signal system. Unprotected railroad crossings and careless crossing of rail tracks by vehicle drivers and pedestrians account for 5% of accidents.

Figure 1.1: Rail Accident in BD of negligence by the level-crossing gate man

Train accident graph

Here is shown the graph of human death in rail collision:
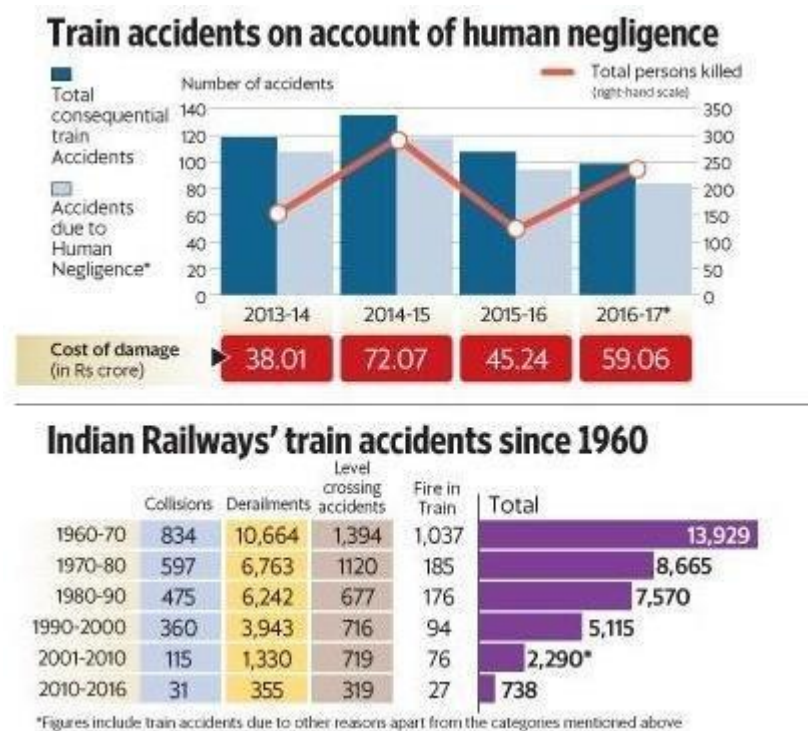
Figure 1.2: Graph of human death in rail collision.

1.3 Objectives

The objectives of this project are

1. To study **Automatic Motion Sensing Barrier Gate Control System with Automated Sirens and Signal System**.
2. To implement a railway gate control.
3. To send an alert to the gateman's phone by the use of the GSM Module.
4. To alert train driver to stop ahead by automatic signal light.
5. To test the performance of the system.
6. To test the siren system.
7. To test the whole project.

1.4 Methodology

Our used methodology for the project:

1. Creating an idea for the design and construction of an "**Automatic Motion Sensing Barrier Gate Control System with Automated Sirens and Signal System".** And designing a block diagram & circuit diagram to know which components we need to construct it.

2. Collecting all the components and programming the microcontroller to control our desired system.

3. Setting up all the components in a PCB board & soldering. Then assemble all the blocks in a board and finally run the system to check if it actually works or not.

1.5 Structure of the Project

This Project is organized as follows:

Chapter 1 Introduction**:** The first chapter contains the statement of the introduction, our background study for the project, the problem statement, the objectives of the study, and the project outline.

Chapter 2 Literature Review**:** Chapter two contains our introduction and literature review part.

Chapter 3 Hardware and Software Analysis**:** Chapter three describes the theoretical model. Here we mainly discuss the proposed system Hardware and software development of our project etc.

Chapter 3 Methodology**:** Chapter three describes the theoretical model. Here we mainly discuss the proposed system architecture in detail with having a block diagram, circuit diagram, structural diagram, project working principle, complete project image, etc.

Chapter 4 Result and Discussion**:** Chapter four deals with the result and discussion and discuss our project's advantages and application.

Chapter 5 Conclusion**:** Chapter five is all about our project conclusion and future scope.

2.1 Introduction

In this section topics related to **Automatic Motion Sensing Barrier Gate Control System with Automated Sirens and Signal System** are included. These provide a sampling of problems appropriate for the application of Automatic railway gate control, send text, and auto braking systems. The references are summarized below.

2.2 Literature Review

Recently, many automatic railways gate controllers with advanced technology are introduced to make level crossing risk-free. Al-Zuhairi et.al concentrated on unmanned level crossing which caused frequent accidents [2]. For this, they proposed a Microcontroller based Railway Gate and Crossing Control system. In their system, they used an IR sensor and Microcontroller.

In their system, IR sensors sense the presence of a train and send the signal to Microcontroller. Based on the signal Microcontroller controls the gate of the crossing. The main limitation of this system is low accuracy. The performance of the IR sensor is not adequate in open places and in light. Subrata Biswas et.al proposed a pressure sensor-based swift response anticollision system for an automatic railway gate control system [3].

The pressure switches which have been integrated into this system detect the condition of whether any vehicle gets stuck at the level crossing or not. IR sensors have been used to detect the arrival and departure of the train.

The system is a little bit complex and due to the use of IR sensors performance is not satisfactory. Sandya Goutam et.al concentrated on predicting the major cause of railway accidents which is a collision on the same track [4]. For this purpose, a technology used to identify train positions, collision detection, as well as the points where collisions may occur, has been used. The primary goal of this paper is the anti-collision system to identify such

collision points and to report the error cases to the main control room, nearby stations as well as grid control stations.

To build this system, advanced sensing technology, a long-distance communication system (RS 485protocol), a microcontroller (8051), and a wireless communication protocol has been used. But this system is not concerned with the collision between the train and vehicles on the road.

J. Banuchandar et.al proposed an automated unmanned railway level crossing system [5]. In this system when the train arrives in a particular direction the transmitter IR senses and generates the appropriate signal, then at the same time the receiver IR receives the signal and generates an interrupt. The main problem of this model is low accuracy because the interrupt signal can be generated even if a small object crosses the IR Sensor. Krishna et.al proposed a model to control railway tracks by using anti-collision techniques [6].

The model of the railway track controller is designed by using 8952 microcontrollers to avoid railway accidents. When we go through the daily newspapers, we come across many railway accidents occurring at unmanned railway crossings. This model is implemented using the sensor technique. They placed the sensors at a certain distance from the gate to detect the approaching train and accordingly control the operation of the gate.

Also, an indicator light has been provided to alert motorists about the approaching train. In their system, they have used an anti-collision device that uses GPS for preventing collision between two trains and an IR sensor for gate controlling at the level crossing. Sheikh Shanawaz Mostafa et.al proposed "A Radio-Based Intelligent Railway Grade Crossing System to Avoid Collision" [7].

Their system offers an intelligent railway crossing control system for multiple tracks that features a controller which receives messages from incoming and outgoing trains by sensors. These messages contain detailed information including the direction and identity of a train. Depending on those messages the controller device decides whether the railroad crossing gate will close or open. This system is also complex and costly. Upon realizing the

16

importance of automatic railway gate controllers in India Acy M. Kottalil el. al proposed Automatic Railway Gate Control System gate[8].

The objective of their system is to provide an automatic railway gate at a level crossing replacing the gates operated by the gatekeeper. The system reduces the time for which the gate remains closed. The system works on a microcontroller-based control. Their proposed system uses AT mega 16A microcontroller. With the help of IR sensors, the arrival and leaving of the system are monitored and the gate is operated accordingly.

Anti-Collision and Secured Level Crossing Systems were proposed by K. Vidyasagar et. al[9]. Their proposed model presents an automatic rail gate control system at level crossing positions and an accident prevention mechanism. Two vibration sensors are used to control the open and closed state of the gate at the level crossing position. An ultrasonic sensor is positioned to detect an unauthorized object on the track.

The open and closing status of the gate and unauthorized objects on the track will be communicated with the central control room using a wireless communication protocol. This system is complex, costly, and requires a lot of equipment to implement. The complex design, low performance, and cost have raised a question about the effectiveness of the approaches.

2.3 Proposed Railway Gate Controlling System

The proposed system uses ultrasonic sensors which have very high efficiency. These ultrasonic sensors are placed near the rail line at both sides of the level crossing. These sensors which are placed at a certain distance from the level crossing detect the train coming from either direction to the level crossing. Then the information about the train is transferred to the control unit and the control unit switches on the red light to generate an alarm and pull down the gate immediately.

The sensors on either side determine whether the train passes a certain distance or not from the level crossing. If passes the controller switches on the green light stops the generation of the alarm and pulls the gate up. If any vehicle gets stuck at the level crossing of the rail line is detected by the sensor placed at the level crossing. Our proposed system is very simple

17

and inexpensive with respect to other systems but its performance is very laudable and excellent.

2.4 Summary

We try to do this project by reading the above literature, and we have been able to make our project successful by reducing the mistakes of last year's project. And it will be more efficient this year. In future we will add some more features, we will make it fully automatic.

CHAPTER 3
HARDWARE AND SOFTWARE ANALYSIS

3.1 Introduction

This Project has worked on two things, Hardware and Software. Here we will discuss about our project hardware and software details.

Hardware

- ➢ Arduino Nano
- ➢ Servo Motor
- ➢ Buck Converter
- ➢ GSM Module
- ➢ IR Sensor
- ➢ Relay
- ➢ SMPS
- ➢ Buzzer

3.2 Arduino Nano

Arduino is 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. Arduino can sense the environment by receiving input from a variety of sensors and can affect its surroundings by controlling Lights, motors, and other actuators.
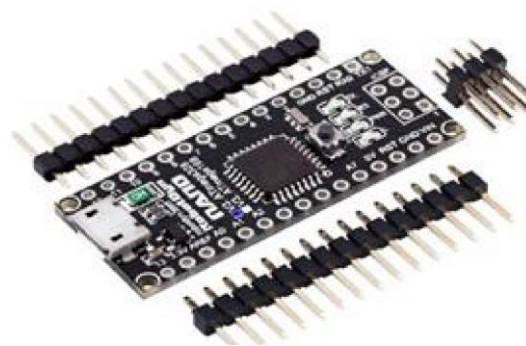

Figure 3.1: Arduino Nano

The microcontroller on the board is programmed using the Arduino programming language (based on Wiring) and the Arduino development environment (based on Processing). Arduino projects can be stand-alone or they can communicate with software running on a computer (e.g. Flash, Processing, Maxims').

Arduino Nano is a surface mount breadboard embedded version with an integrated USB. It is a small, complete, and breadboard-friendly component. It has everything that Decimal/ Duemilanove has (electrically) with more analog input pins and an onboard +5V AREF jumper. Physically, it is missing a power jack. The Nano can automatically sense and switch to the higher potential source of power.
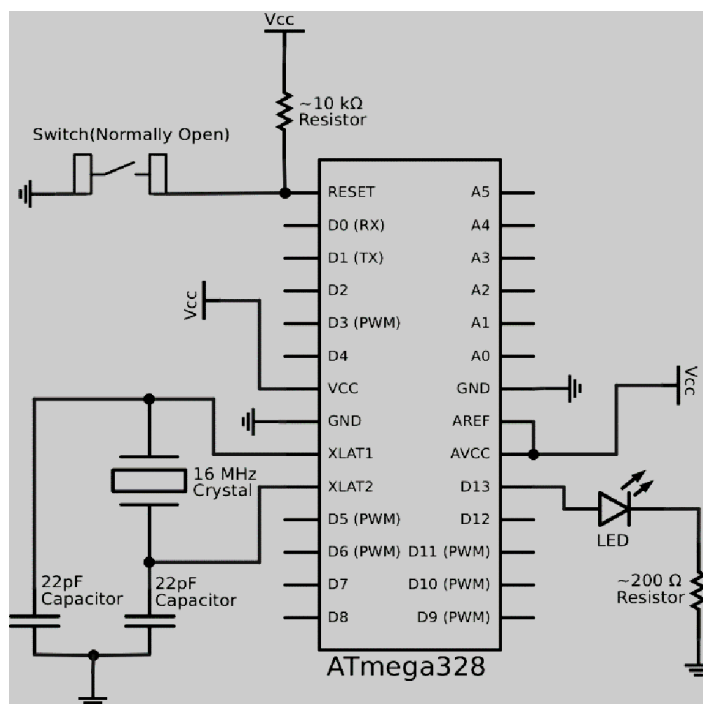

Figure 3.2: Arduino Nano Schematic Diagram

Nano's got the breadboard-ability of the Boarding and the Minibus with a smaller footprint than either, so users have more breadboard space. It's got a pin layout that works well with the Mini or the Basic Stamp (TX, RX, ATN, and GND on one top, power, and ground on the other). This new version 3.0 comes with ATMEGA328 which offers more programming and data memory space. It has two layers. That makes it easier to hack and more affordable. One of the best features of Arduino Nano is, it's easy to use, compact, and also small.

Specifications:

- Microcontroller: Atmel ATmega328
- Operating Voltage (logic level): 5 V
- Input Voltage (recommended): 7-12 V
- Input Voltage (limits): 6-20 V
- Digital I/O Pins: 14 (of which 6 provide PWM output)
- Analog Input Pins: 8
- DC Current per I/O Pin: 40 mA
- Flash Memory: 32 KB (of which 2KB used by the boot loader)
- SRAM: 2 KB
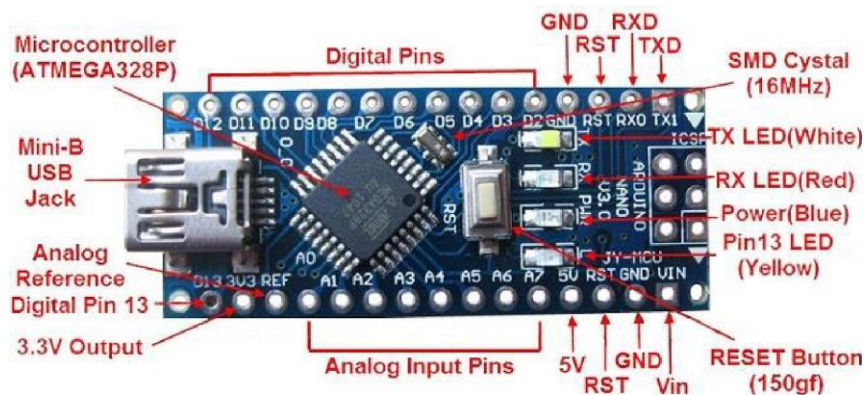- EEPROM: 1 KB
- Clock Speed: 16 MHz

Figure 3.3: How Arduino Nano looks like

Features:

- Automatic reset during program download
- Power OK blue LED
- Green (TX), red (RX), and orange (L) LED
- Auto sensing/switching power input
- Small mini-B USB for programming and serial monitor
- ICSP header for direct program download
- Standard 0.1 spacing DIP (breadboard friendly)
- Manual reset switch

The high-performance Microchip Pico Power 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1024B EEPROM, 2KB 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, a 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. By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.
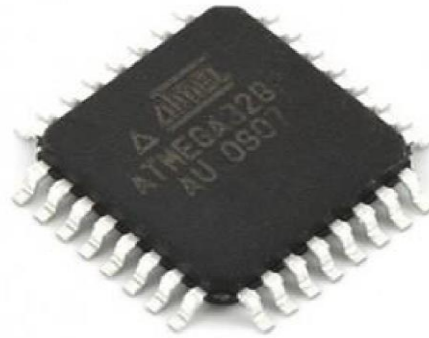
Micro-controller IC ATmega328p

Figure 3.4: Micro-controller IC AT mega 328p

3.3 Switch Mode Power Supply (SMPS)

A switched-mode power supply (switching-mode power supply, switch-mode power supply, switched power supply, SMPS, or switcher) is an electronic power supply that incorporates a switching regulator to convert electrical power efficiently. Like other power supplies, an SMPS transfers power from a DC or AC source (often mains power) to DC loads, such as a personal computer, while converting voltage and current characteristics.

Unlike a linear power supply, the pass transistor of a switching-mode supply continually switches between low-dissipation, full-on and full-off states, and spends very little time in the high-dissipation transitions, which minimizes wasted energy. A hypothetical ideal switched-mode power supply dissipates no power. Voltage regulation is achieved by varying the ratio of on-to-off time (also known as duty cycles). In contrast, a linear power

supply regulates the output voltage by continually dissipating power in the pass transistor. This higher power conversion efficiency is an important advantage of a switched-mode power supply. Switched-mode power supplies may also be substantially smaller and lighter than a linear supply due to the smaller transformer size and weight.

Figure 3.5: SMPS

Switching regulators are used as replacements for linear regulators when higher efficiency, smaller size, or lighter weight are required. They are, however, more complicated; their switching currents can cause electrical noise problems if not carefully suppressed, and simple designs may have a poor power factor.12V 5A Industrial SMPS Power Supply – 60W – DC Metal Power Supply – Good Quality – Non-Waterproof with Aluminum casing.

- Input Voltage: AC 100 – 264V 50 / 60Hz
- Output Voltage: 12V DC, 0-5A
- Output voltage: Adjustment Range: ±20%
- Protections: Overload / Over Voltage / Short Circuit
- Auto-Recovery After Protection
- Universal AC input / Full range
- 100% Full Load Burn-in Test
- Cooling by Free Air Convection
- High Quality and High Performance
- LED power supply with a metal body for hidden installation for LED lighting
- Design with Built-in EMI Filter, improve signal precision.
- Certifications: CE & RoHS

23

Switched-mode power supplies are classified according to the type of input and output voltages. The four major categories are:

- AC to DC
- DC to DC
- DC to AC
- AC to AC

A basic isolated AC to DC switched-mode power supply consists of

- Input rectifier and filter
- Inverter consisting of switching devices such as MOSFETs
- Transformer
- Output rectifier and filter
- Feedback and control circuit

The input DC supply from a rectifier or battery is fed to the inverter where it is turned on and off at high frequencies of between 20 kHz and 200 kHz by the switching MOSFET or power transistors. The high-frequency voltage pulses from the inverter are fed to the transformer's primary winding, and the secondary AC output is rectified and smoothed to produce the required DC voltages. A feedback circuit monitors the output voltage and instructs the control circuit to adjust the duty cycle to maintain the output at the desired level.

The basic working concept of an SMPS

A switching regulator does the regulation in the SMPS. A series switching element turns the current supply to a smoothing capacitor on and off. The voltage on the capacitor controls the time the series element is turned. The continuous switching of the capacitor maintains the voltage at the required level.

Design basics

AC power first passes through fuses and a line filter. Then it is rectified by a full-wave bridge rectifier. The rectified voltage is next applied to the power factor correction (PFC) pre-regulator followed by the downstream DC-DC converter(s). Most computers and small appliances use the International Electrotechnical Commission (IEC) style input connector. As for output connectors and pinouts, except for some industries, such as PC and compact PCI, in general, they are not standardized and are left up to the manufacturer.
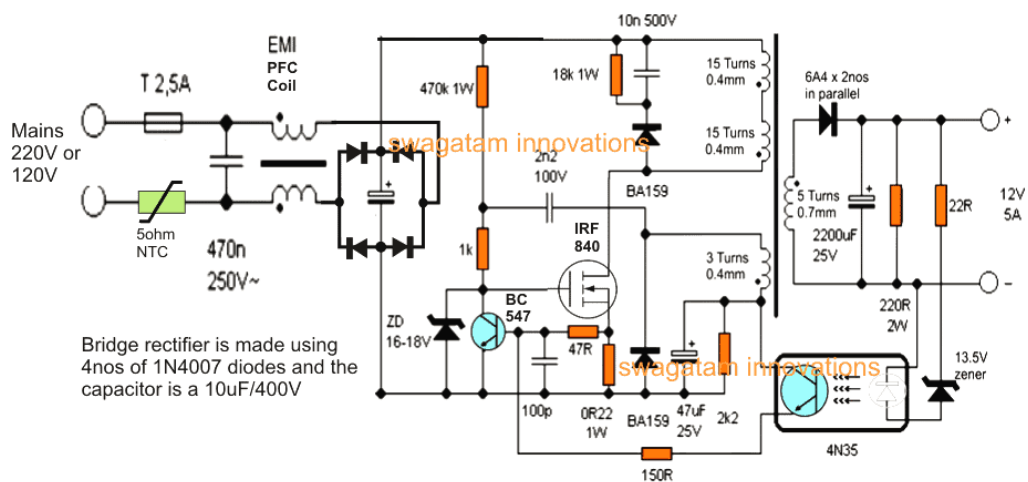

Figure 3.6: SMPS Circuit Design

There are different circuit configurations known as topologies, each having unique characteristics, advantages, and modes of operation, which determine how the input power is transferred to the output. Most of the commonly used topologies such as fly back, push-pull, half-bridge, and full bridge, consisting of a transformer to provide isolation, voltage scaling, and multiple output voltages. The non-isolated configurations do not have a transformer and the power conversion is provided by the inductive energy transfer.

Advantages of switched-mode power supplies:

- Higher efficiency of 68% to 90%
- Regulated and reliable outputs regardless of variations in input supply voltage
- Small size and lighter
- Flexible technology
- High power density

Disadvantages:

- Generate electromagnetic interference
- Complex circuit design
- Expensive compared to linear supplies

Switched-mode power supplies are used to power a wide variety of equipment such as computers, sensitive electronics, battery-operated devices and other equipment requiring high-efficiency
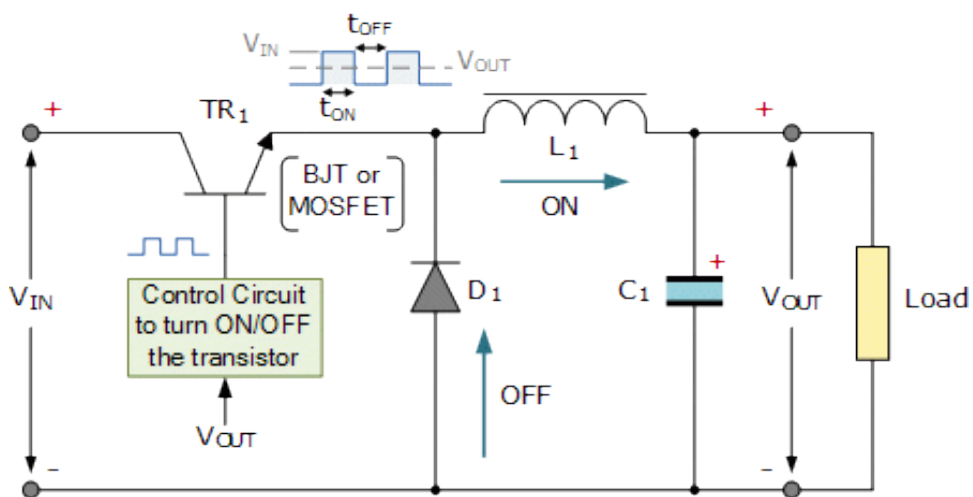
Switch Mode Power Supply

Figure 3.7: Power Supply Connection

Linear voltage IC regulators have been the basis of power supply designs for many years as they are very good at supplying a continuous fixed voltage output. Linear voltage regulators are generally much more efficient and easier to use than equivalent voltage regulator circuits

made from discrete components such as a Zener diode and a resistor, or transistors and even op-amps.

The most popular linear and fixed output voltage regulator types are by far the positive output voltage series and the 79 negative output voltage series. These two types of complementary voltage regulators produce a precise and stable voltage output ranging from about 5 volts up to about 24 volts for use in many electronic circuits.

There is a wide range of these three-terminal fixed voltage regulators available each with its own built-in voltage regulation and current limiting circuits. This allows us to create a whole host of different power supply rails and outputs, either single or dual supply, suitable for most electronic circuits and applications. There are even variable voltage linear regulators available as well providing an output voltage that is continuously variable from just above zero to a few volts below its maximum voltage output.

Most D.C. power supplies comprise a large and heavy step-down mains transformer, diode rectification, either full-wave or half-wave, a filter circuit to remove any ripple content from the rectified D.C. producing a suitably smooth D.C. voltage, and some form of voltage regulator or stabilizer circuit, either linear or switching to ensure the correct regulation of the power supplies output voltage under varying load conditions. Then a typical D.C. power supply would look something like this:

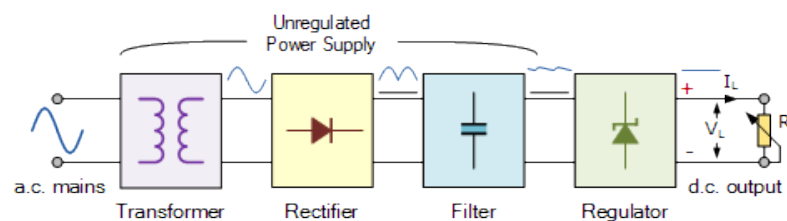### Typical DC Power Supply

Figure 3.8: DC Power Supply Step

These typical power supply designs contain a large mains transformer (which also provides isolation between the input and output) and a dissipative series regulator circuit. The regulator circuit could consist of a single Zener diode or a three-terminal linear series regulator to produce the required output voltage. The advantage of a linear regulator is that

the power supply circuit only needs an input capacitor, an output capacitor, and some feedback resistors to set the output voltage. The voltage supply is the main factor in it.

3.4 GSM Module

At the heart of the module is a SIM800L GSM cellular chip from Sim Com. The operating voltage of the chip is from **3.4V to 4.4V**, which makes it an ideal candidate for direct LiPo battery supply. This makes it a good choice for embedding into projects without a lot of space.

Figure 3.9: GSM Module

All the necessary data pins of the SIM800L GSM chip are broken out to a 0.1″ pitch header. This includes pins required for communication with a microcontroller over **UART**. The module supports the baud rates from **1200bps** to **115200bps** with Auto-Baud detection.
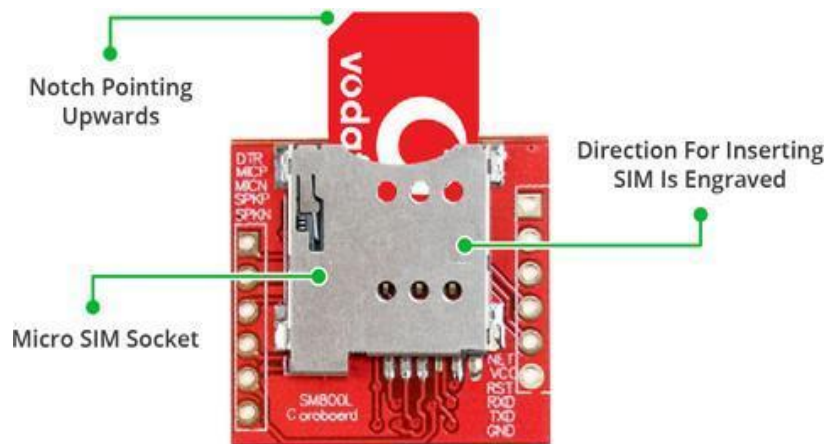

Figure 3.10: GSM Module Introducing

The module needs an external antenna to connect to a network. The module usually comes with a **Helical Antenna** and solders directly to the NET pin on PCB. The board also has a U.FL connector facility in case you want to keep the antenna away from the board.

There's a SIM socket on the back! Any activated, **2G micro-SIM card** would work perfectly. The correct direction for inserting a SIM card is normally engraved on the surface of the SIM socket. This module measures only 1 inch² but packs a surprising amount of features into its little frame. Some of them are listed below:

- Supports Quad-band: GSM850, EGSM900, DCS1800, and PCS1900
- Connect onto any global GSM network with any 2G SIM
- Make and receive voice calls using an external 8Ω speaker & electret microphone
- Send and receive SMS messages
- Send and receive GPRS data (TCP/IP, HTTP, etc.)
- Scan and receive FM radio broadcasts
- Transmit Power:
- Class 4 (2W) for GSM850
- Class 1 (1W) for DCS1800
- Serial-based AT Command Set
- FL connectors for cell antennae
- Accepts Micro SIM Card

SIM800L GSM Module Pinout

The SIM800L module has total 12 pins that interface it to the outside world. The connections are as follows:

Figure 3.11: GSM Module Pinout

29

NET is a pin where you can solder Helical Antenna provided along with the module.

VCC supplies power for the module. This can be anywhere from 3.4V to 4.4 volts. Remember connecting it to a 5V pin will likely destroy your module! It doesn't even run on 3.3 V! An external power source like a Li-Po battery or DC-DC buck converters rated 3.7V 2A would work.

- RST (Reset) is a hard reset pin. If you absolutely got the module in a bad space, pull this pin low for 100ms to perform a hard reset.
- RxD (Receiver) pin is used for serial communication.
- TxD (Transmitter) pin is used for serial communication.
- GND is the Ground Pin and needs to be connected to the GND pin on the Arduino.
- RING pin acts as a Ring Indicator. It is basically the 'interrupt' out pin from the module. It is by default high and will pulse low for 120ms when a call is received. It can also be configured to pulse when an SMS is received.
- DTR pin activates/deactivates sleep mode. Pulling it HIGH will put the module in sleep mode, disabling serial communication. Pulling it LOW will wake the module up.
- MIC± is a differential microphone input. The two microphone pins can be connected directly to these pins.
- SPK± is a differential speaker interface. The two pins of a speaker can be tied directly to these two pins.

3.5 Relay

A relay is   an electrically operated switch.   Many   relays   use   an electromagnet to mechanically operate a switch, but other operating principles are also used, such as solid-state relays. Relays are used where it is necessary to control a circuit by a separate low-power signal, or where several circuits must be controlled by one signal.

The first relays were used in long-distance telegraph circuits as amplifiers: they repeated the signal coming in from one circuit and re-transmitted it on another circuit. Relays were used extensively in telephone exchanges and early computers to perform logical operations.

A type of relay that can handle the high power required to directly control an electric motor or other loads is called a contactor. Solid-state relays control power circuits with no moving parts, instead using a semiconductor device to perform switching.

Relays with calibrated operating characteristics and sometimes multiple operating coils are used to protect electrical circuits from overload or faults; in modern electric power systems these functions are performed by digital instruments still called "protective relays".

Magnetic latching relays require one pulse of coil power to move their contacts in one direction, and another, redirected pulse to move them back. Repeated pulses from the same input have no effect. Magnetic latching relays are useful in applications where interrupted power should not be able to transition the contacts.
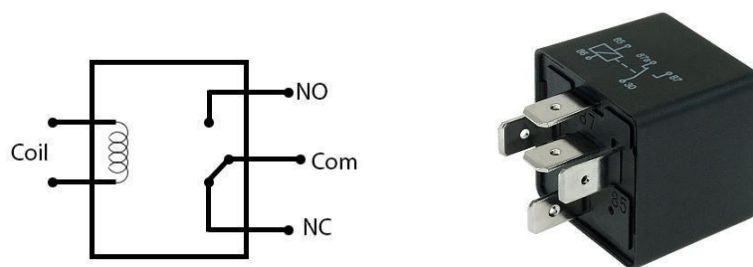

Figure 3.12: Relay

Magnetic latching relays can have either single or dual coils. On a single coil device, the relay will operate in one direction when power is applied with one polarity, and will reset when the polarity is reversed. On a dual coil device, when polarized voltage is applied to the reset coil the contacts will transition.

AC-controlled magnetic latch relays have single coils that employ steering diodes to differentiate between operate and reset commands.
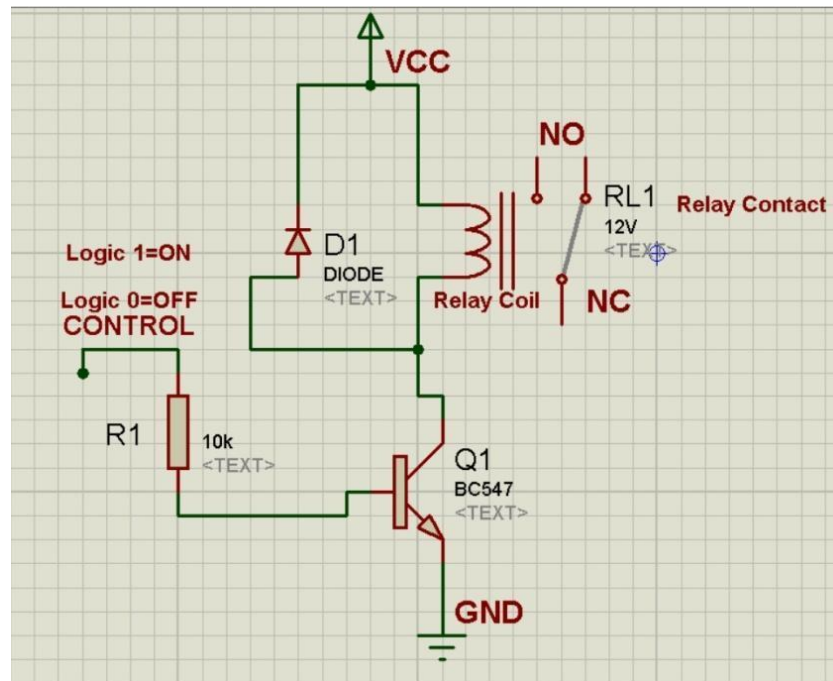

Figure 3.13: Transistor Switching Circuit.

The circuit above is called a low-side switch because the switch – our transistor – is on the low (ground) side of the circuit. Alternatively, we can use a PNP transistor to create a high-side switch: Similar to the NPN circuit, the base is our input, and the emitter is tied to a constant voltage.

A relay is an electrically operated switch of the mains voltage. It means that it can be turned on or off, letting the current go through or not. Controlling a relay with the Arduino is as simple as controlling an output such as an LED. The relay module is the one in the figure below.

This module has two channels (those blue cubes). There are other varieties with one, four, and eight channels.
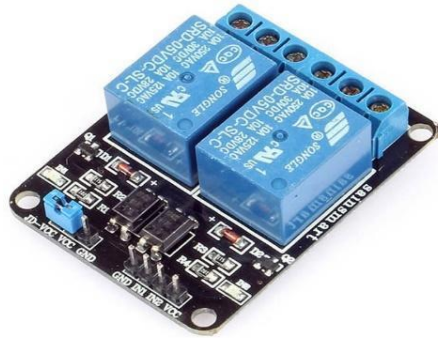

Figure 3.14: Relay Module.

Mains voltage connections:

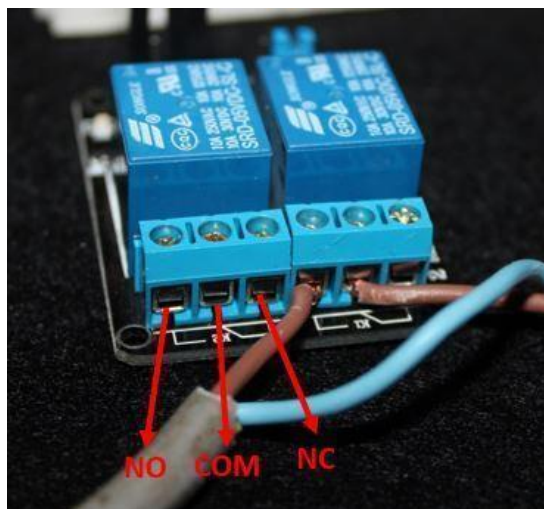In relation to mains voltage, relays have 3 possible connections:

Figure 3.15: Pin diagram of Relay Module

COM: common pin

NO (Normally Open): there is no contact between the common pin and the normally open pin. So, when you trigger the relay, it connects to the COM pin, and supply is provided to a load

NC (Normally Closed): there is contact between the common pin and the normally closed pin. There is always a connection between the COM and NC pins, even when the relay is

turned off. When you trigger the relay, the circuit is opened and there is no supply provided to a load.

Pin wiring:

The connections between the relay module and the Arduino are really simple:

Figure 3.16: Main Voltage Connection

- **GND**: goes to ground
- **IN1**: controls the first relay (it will be connected to an Arduino digital pin)
- **IN2**: controls the second relay (it should be connected to an Arduino digital pin if you are using this second relay. Otherwise, you don't need to connect it)
- **VCC**: goes to 5V

3.6 IR Sensor:

An infrared sensor is an electronic device that emits certain features around it and/or detects infrared radiation. Infrared sensors are capable of measuring the heat emitted by an object and detecting motion. In this project, we will control the fan and light automatically through the closed-loop system so the IR sensor for the system is definitely needed as a response.

Here the fan will turn on and the light will turn on when the IR sensor detects an object and the fan and light will switch off automatically when an object leaves the house.
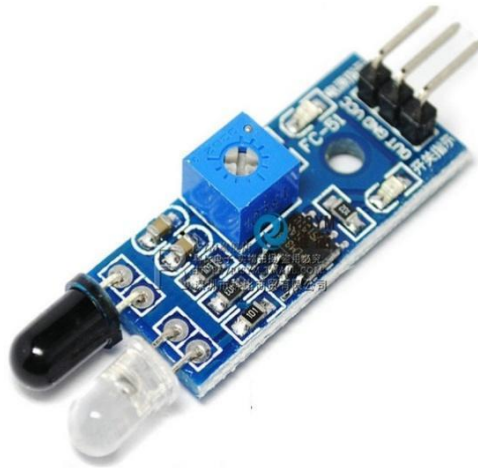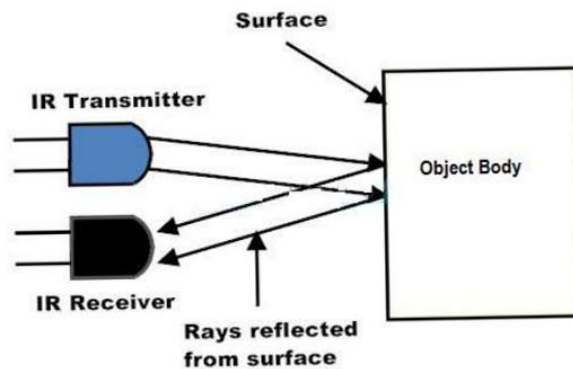

Figure 3.17: IR Sensor

Figure 3.18: IR sensor reflection System.

Principles of operation:

Sensor works with sense. When an object intersects the sensor light then the sensor detects something. Some infrared ray is deflected from the object and scene the length of this distance. In this sensor, we can make a fixed-length light and detect our exact object.

If some object comes in front of this sensor, then the sensor detects it and sends a signal in LED.
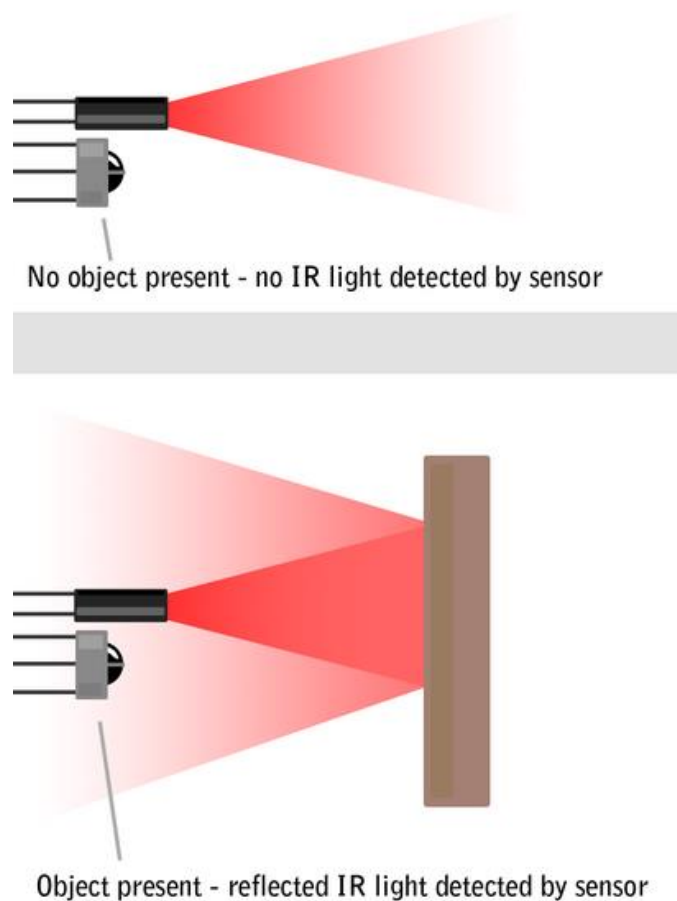
No object present - no IR light detected by sensor

Object present - reflected IR light detected by sensor

Figure 3.19: IR sensor Detection System.

3.7 5V Regulator IC

Voltage sources in a circuit may have fluctuations resulting in not providing fixed voltage outputs. A voltage regulator IC maintains the output voltage at a constant value. 7805 IC, a member of the 78xx series of fixed linear voltage regulators used to maintain such fluctuations, is a popular voltage regulator integrated circuit (IC). The xx in 78xx indicates the output voltage it provides. 7805 IC provides +5 volts regulated power supply with provisions to add a heat sink.

7805 IC Rating

- Input voltage range 7V- 35V
- Current rating Ic = 1A
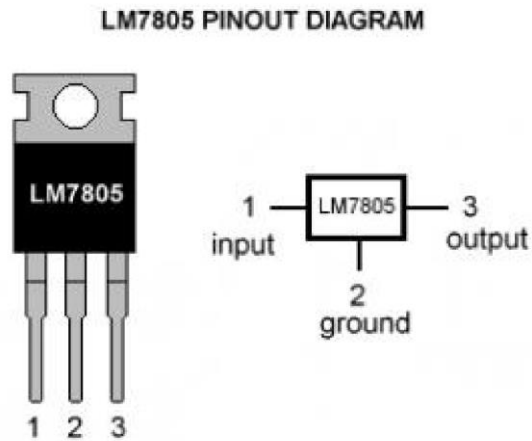- Output voltage range VMax=5.2V, VMin=4.8V

Figure 3.20: 5V Regulator IC

3.8 Buzzer

Piezo elements are actually one of the coolest crystals you'll play with. Flex them, they generate a voltage (pretty high, actually). Pass power through them, and they'll flex. Do it fast enough, and they'll start to make a sound! So besides making annoying little beeping noises, you could use it as a sensor to detect a knock or other similar vibration.

Figure 3.21: Buzzer

- Operating Voltage: 1.0 ~ 20.0V
- Rated Voltage: 3.0V
- Diameter: Ø12.5mm
- Total Height: 6.3mm
- Capacitance: 15,000pF

3.9 The Smoothing Capacitor

When there is a potential difference across the conductors (e.g., when a capacitor is attached across a battery), an electric field develops across the dielectric, causing positive charge (+Q) to collect on one plate and negative charge (-Q) to collect on the other plate. If a battery has been attached to a capacitor for a sufficient amount of time, no current can flow through the capacitor. However, if an accelerating or alternating voltage is applied across the leads of the capacitor, a displacement current can flow.

Figure 3.22: Capacitor

An ideal capacitor is characterized by a single constant value for its capacitance. Capacitance is expressed as the ratio of the electric charge (Q) on each conductor to the potential Difference (V). The SI unit of capacitance is the farad (F), which is equal to one coulomb per volt (1 C/V). Typical capacitance values range from about 1 pF ($10-12$ F) to about 1 mF ($10-3$ F). The capacitance is greater when there is a narrower separation between conductors and when the conductors have a larger surface area.

In practice, the dielectric between the plates passes a small amount of leakage current and also has an electric field strength limit, known as the breakdown voltage. The conductors and leads introduce an undesired inductance and resistance.

Capacitors are widely used in electronic circuits for blocking direct currents while allowing alternating currents to pass. In analog filter networks, they smooth the output of power supplies. In resonant circuits, they tune radios to particular frequencies. In electric power transmission systems, they stabilize voltage and power flow.
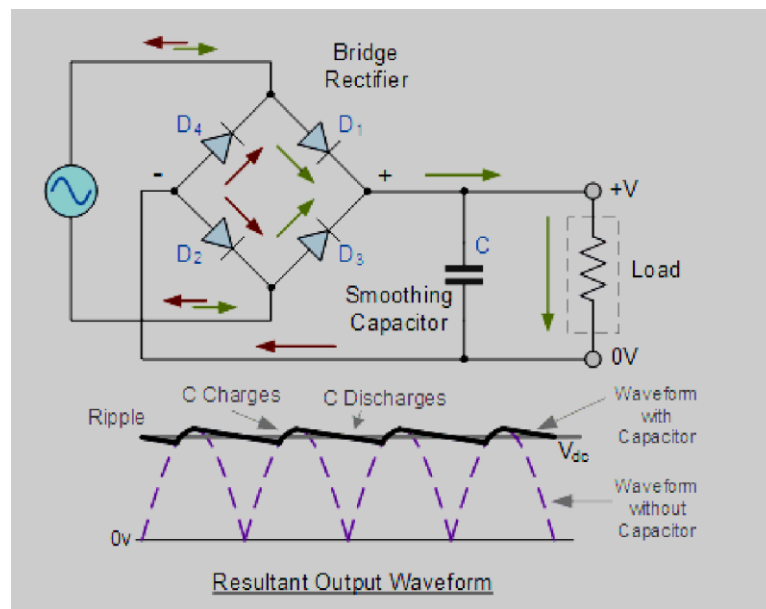

Figure 3.23: The Smoothing Capacitor with Full Bridge Rectifier

The full-wave bridge rectifier however, gives us a greater mean DC value (0.637 Vmax) with less superimposed ripple while the output waveform is twice that of the frequency of the input supply frequency. We can improve the average DC output of the rectifier while at the same time reducing the AC variation of the rectified output by using smoothing capacitors to filter the output waveform.

Smoothing or reservoir capacitors connected in parallel with the load across the output of the full wave bridge rectifier circuit increase the average DC output level even higher as the capacitor acts like a storage device as shown below.

Too low a capacitance value and the capacitor have little effect on the output waveform. But if the smoothing capacitor is sufficiently large enough (parallel capacitors can be used) and the load current is not too large, the output voltage will be almost as smooth as pure DC.

3.10 Resistor

A resistor is a passive two-terminal electrical component that implements electrical resistance as a circuit element. Resistors act to reduce current flow, and, at some time, act to lower voltage levels within circuits. Resistors may have fixed resistances or variable resistances, such as those founding thermostats, visitors, trimmers, photo resistors, hamsters, and potentiometers. The current through a resistor is in direct proportion to the voltage across the resistor's terminals. This relationship is represented by Ohm's law.

Figure 3.24: Resistor

Theory of operation**:**

The behavior of an ideal resistor is dictated by the relationship specified by Ohm 'slaw:
$$V = I.R$$

Ohm's law states that the voltage (V) across a resistor is proportional to the current (I), where the constant of proportionality is the resistance (R).

Equivalently, Ohm's law can be stated:
$$I = V/R$$

This formulation states that the current (I) is proportional to the voltage (V) and inversely proportional to the resistance (R). This is directly used in practical computations. For example, if a 300-ohm resistor is attached across the terminals of a12 volt battery, then a current of 12 / 300 = 0.04 amperes flows through that resistor.

3.11 Arduino Software

The digital microcontroller unit named Arduino Nano can be programmed with the Arduino software IDE. There is no requirement for installing other software rather than Arduino. Firstly, Select "Arduino Nano from the Tools, Board menu (according to the microcontroller on our board). The IC used named ATmega328 on the Arduino Nano comes pre-burned with a boot loader that allows us to upload new code to it without the use of an external hardware programmer.

Communication is using the original STK500 protocol (reference, C header files). We can also bypass the boot loader and programs the microcontroller through the ICSP (In-Circuit Serial Programming) header. The ATmega16U2 (or 8U2 in the rev1 and rev2 boards) firmware source code is available. The ATmega16U2/8U2 is loaded with a DFU boot loader, which can be activated by:

On Rev1 boards: connecting the solder jumper on the back of the board (near the map of Italy) and then resetting the 8U2. On Rev2 or later boards: there is a resistor that pulls the 8U2/16U2 HWB line to the ground, making it easier to put into DFU mode.

The Arduino Nano is one of the latest digital microcontroller units and has a number of facilities for communicating with a computer, another Arduino, or other microcontrollers. The ATmega328 provides UART TTL at (5V) with serial communication, which is available on digital pins 0 -(RX) for receiving the data and pin no.1 (TX) for transmitting the data.

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 .in file is required. The Arduino software includes a serial monitor which allows simple textual data to be sent to and from the Arduino 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 Software Serial library allows for serial communication on any of Nano's digital pins. The ATmega328 also supports I2C (TWI) and SPI communication. The Arduino software includes a Wire library to simplify the use of the I2C bus. Arduino

programs are written in C or C++ and the program code written for Arduino is called a sketch. The Arduino IDE uses the GNU toolchain and AVR Lab to compile programs, and for uploading the programs it uses argued. As the Arduino platform uses Atmel microcontrollers, Atmel's development environment, AVR Studio, or the newer Atmel Studio, may also be used to develop software for the Arduino.
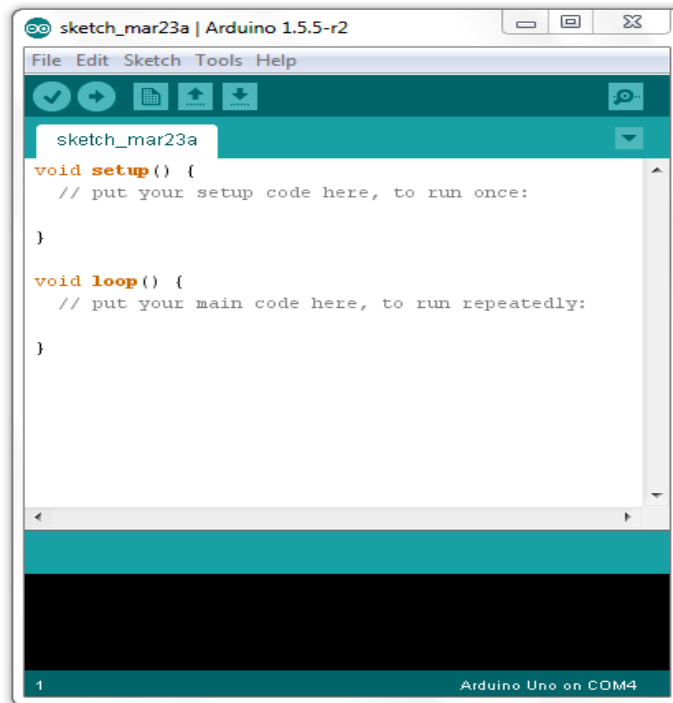

Figure 3.25: Arduino Software Interface IDE

Writing Sketches

Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension. ino. The editor has features for cutting/pasting and searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom righthand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

Burn Bootloader

The items in this menu allow you to burn a bootloader onto the microcontroller on an Arduino board. This is not required for the normal use of an Arduino or Genuino board but

is useful if you purchase a new ATmega microcontroller (which normally comes without a boot loader). Ensure that you've selected the correct board from the Boards menu before burning the bootloader on the target board. This command also set the right fuses.

Uploading

Before uploading your sketch, you need to select the correct items from the Tools > Board and Tools > Port menus. The boards are described below. On the Mac, the serial port is probably something like /dev/tty.usbmodem241 (for an Uno or Mega2560 or Leonardo) or /dev/tty.usbserial-1B1 (for a Duemilanove or earlier USB board), or /dev/tty.USA19QW1b1P1.1 (for a serial board connected with a Keyspan USB-to-Serial adapter). On Windows, it's probably COM1 or COM2 (for a serial board) or COM4, COM5, COM7, or higher (for a USB board) - to find out, you look for a USB serial device in the ports section of the Windows Device Manager.

On Linux, it should be /dev/ttyACMx , /dev/ttyUSBx, or similar. Once you've selected the correct serial port and board, press the upload button in the toolbar or select the Upload item from the Sketch menu. Current Arduino boards will reset automatically and begin the upload. With older boards (pre-Diecimila) that lack auto-reset, you'll need to press the reset button on the board just before starting the upload. On most boards, you'll see the RX and TX LEDs blink as the sketch is uploaded. The Arduino Software (IDE) will display a message when the upload is complete, or show an error.

Libraries

Libraries provide extra functionality for use in sketches, e.g. working with hardware or manipulating data. To use a library in a sketch, select it from the Sketch > Import Library menu. This will insert one or more #include statements at the top of the sketch and compile the library with your sketch. Because libraries are uploaded to the board with your sketch, they increase the amount of space it takes up. If a sketch no longer needs a library, simply delete its #include statements from the top of your code.

Serial Monitor

This displays serial sent from the Arduino or Genuino board over USB or serial connector. To send data to the board, enter text and click on the "send" button or press enter. Choose

the baud rate from the drop-down menu that matches the rate passed to Serial. begin in your sketch. Note that on Windows, Mac, or Linux the board will reset (it will rerun your sketch) when you connect with the serial monitor.

Please note that the Serial Monitor does not process control characters; if your sketch needs complete management of the serial communication with control characters, you can use an external terminal program and connect it to the COM port assigned to your Arduino board. You can also talk to the board from Processing, Flash, MaxMSP, etc (see the interfacing page for details).
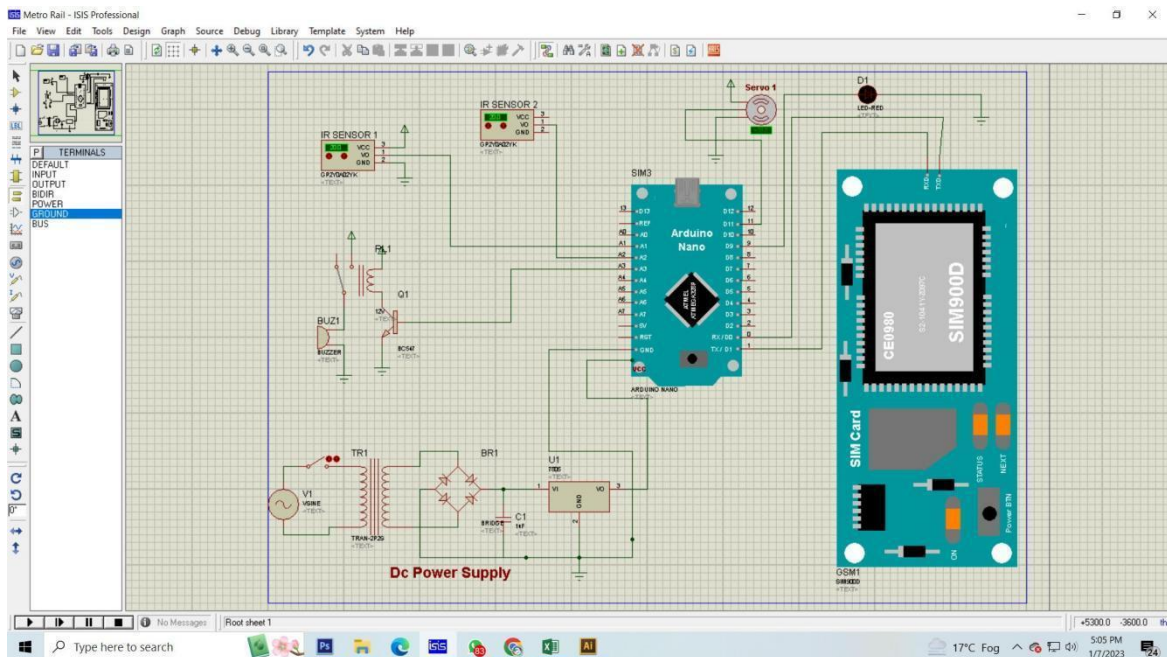
3.12 Proteus Software

Figure 3.26: Proteus Software Interface

The Proteus Design Suite is a proprietary software tool suite used primarily for electronic design automation. The software is used mainly by electronics design engineers and technicians to create schematics and electronic prints for manufacturing printed circuit boards. The first version of what is now the Proteus Design Suite was called PC-B and was written by the company chairman, John Jameson, for DOS in 1988.

44

Schematic Capture support followed in 1990 with a port to the Windows environment shortly thereafter. Mixed mode SPICE Simulation was first integrated into Proteus in 1996 and micro-controller simulation then arrived in Proteus in 1998.

Shape-based auto routing was added in 2002 and 2006 saw another major product update with 3D Board Visualization. More recently, a dedicated IDE for simulation was added in 2011 and MCAD import/export was included in 2015. Support for high-speed design was added in 2017. Feature-led product releases are typically biannual, while maintenance-based service packs are released as required.

4.1 Block Diagram

The block diagram here is representing the whole circuit and the components of the project. Here we have used standardized symbols and lines.
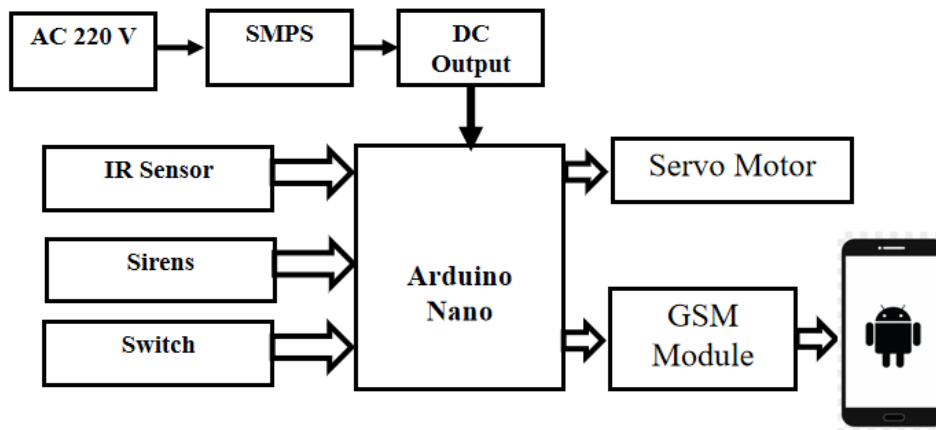

Figure 4.1: Block Diagram of Our System

4.2 Schematic Diagram

The schematic diagram here is representing the electrical circuit and the components of the project. Here we have used standardized symbols and lines.
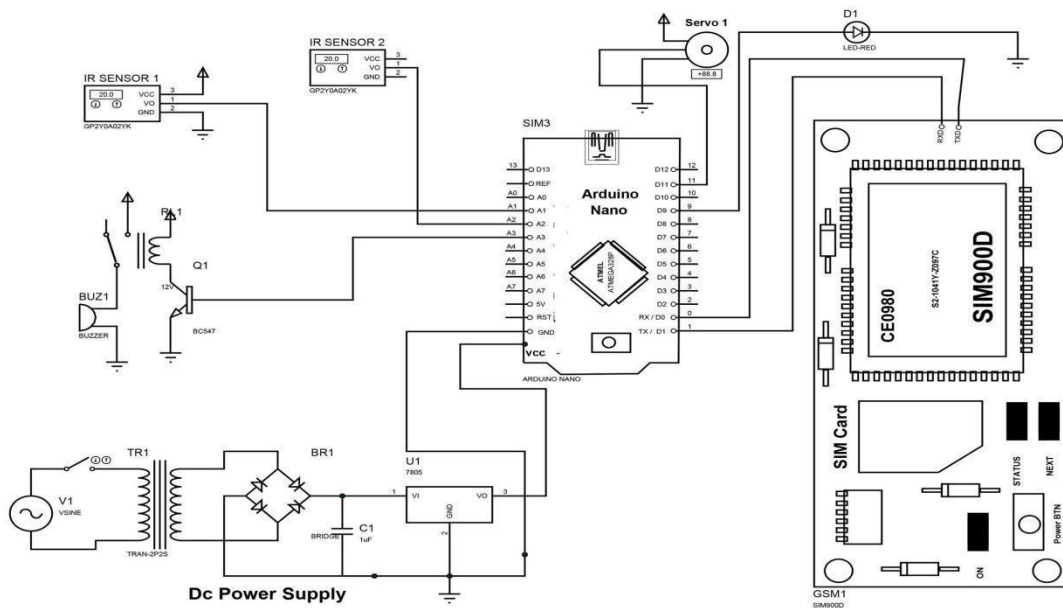

Figure 4.2: Schematic Diagram of Project

4.3 Working Principle

The way our **Automatic Motion Sensing Barrier Gate Control System with Automated Sirens and Signal System** works is that we take the 220V rms from the supply voltage and then give it to the SMPS, the SMPS has a step-down transformer inside that stepped that voltage down to 5V DC. We feed this voltage to the Arduino Nano Micro-controller for it to run.

This project has two gates. When the train arrives at the gate, the IR sensor will sense the train and send a signal to Arduino Nano. That signal will command the servo motor to close the gate. then sirens will ring and send a text to the gateman's phone. The gate will open automatically after the train leaves. When the train is close to the next IR sensor the train will automatically slow. This is the main procedure of our system.

4.4 Our Final Project View

Here we have shown the final project overview with appropriate marking. Like train, rail line, board etc.
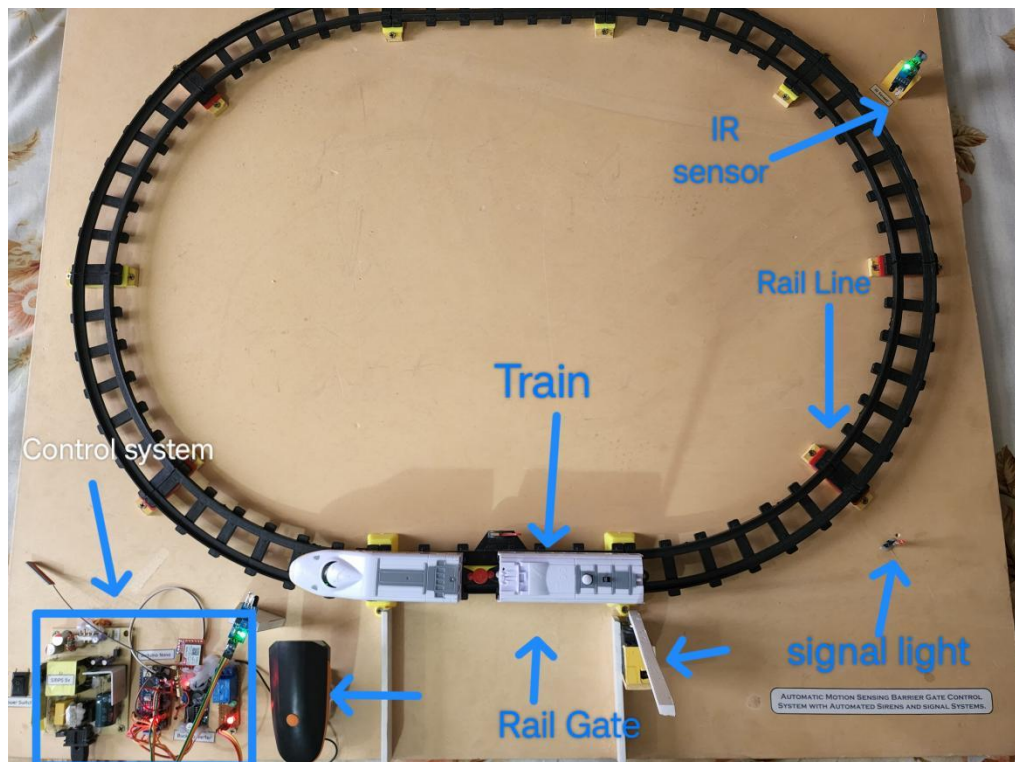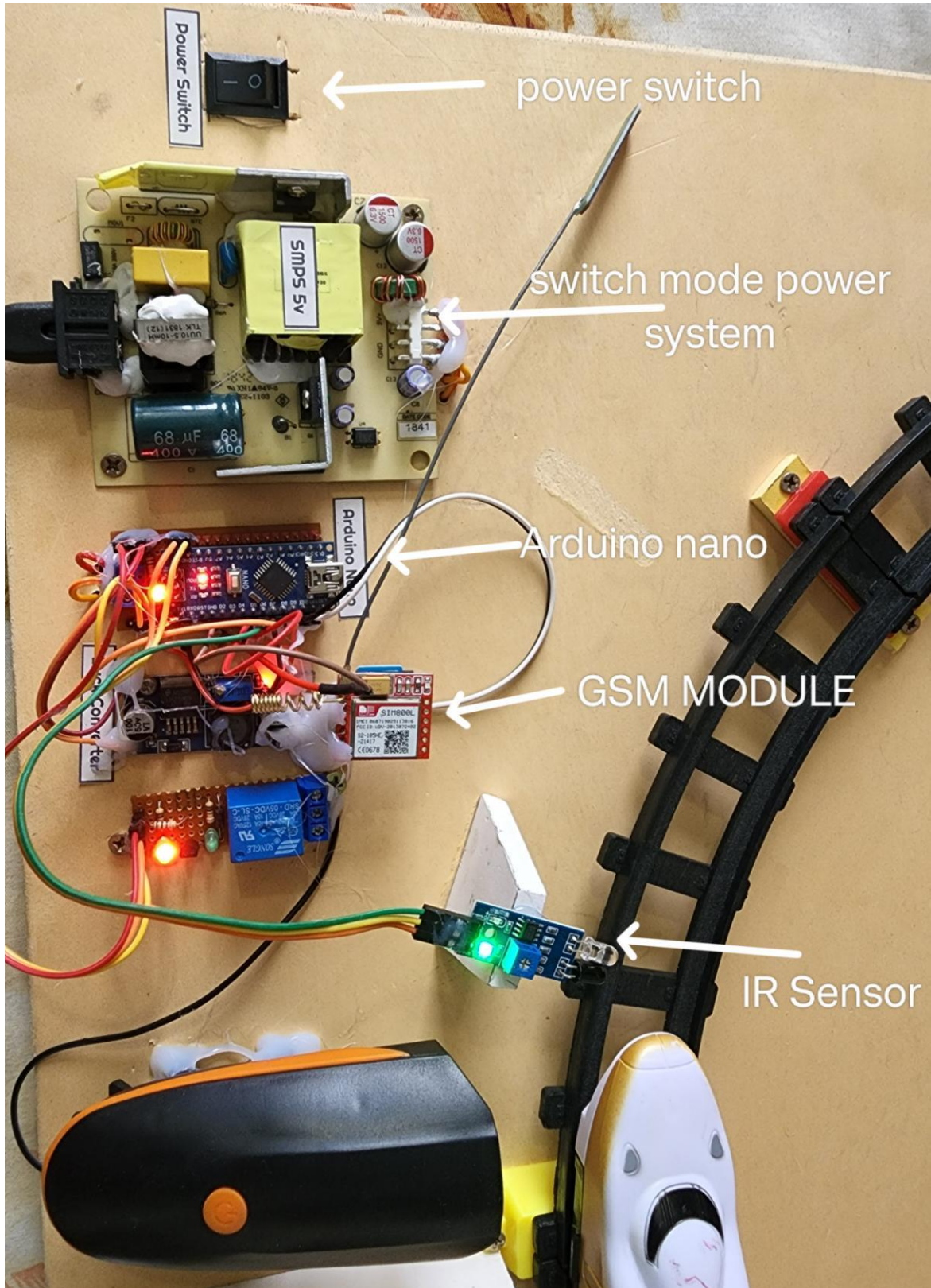

Figure 4.3: Our Final Project Overview

FIGURE 4.4: Our Final System Overview

5.1 Discussion

While working on our project, we did face some difficulties as it is a very complex system but the end results, we came up with were quite satisfactory. We have put the whole system through several tasks to validate our work and also have taken necessary notes for future improvements. Some future recommendations that we have involve improvement in system design and wiring, adding features for more efficiency.

5.2 Results included (Mobile Signals)

Now, it's time to talk about the results. We have written our commands using the Arduino IDE and the following things can happen:

- After powering this project then it will be able to operate.
- Then the train will run on the line.
- When the train crosses the IR sensor in front of the gate then the system sends a text to the gateman, automatically controlling the gate and buzzer ring.
- When the train comes in front of another IR sensor then the train will be slow.
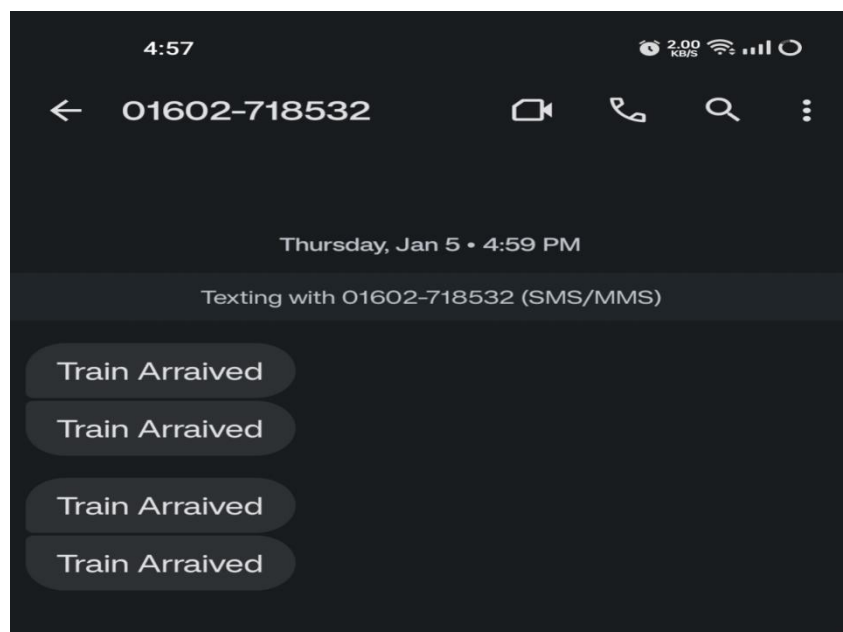

Figure 5.1: GSM sends an alert to gateman's mobile when the train is in front of gate

5.3 Advantages

There are many advantages of our project because of its accuracy. Some of the advantages are pointed out below:

- Minimize railway accidents.
- Automatic text sends to gateman's phone.
- Less power consumption with the best utilization.
- The system is user-friendly.

5.4 Applications

This project has applications in many fields due to its necessity. We have selected a few of them and they are given below:

- Automatic Railway Gate Control purpose
- Automatic Railway Gate Sirens purpose
- Automatic SMS To the Railway Gateman's Phone purpose
- Automatic Signal If Any Object Detected on The Railway purpose

CHAPTER 6
CONCLUSION

6.1 Conclusion

To save human life and vehicles from miserable train accidents is a challenge of the era of modern science and technology. The working model was fabricated within the laboratory premises. The results exhibit that it is one of the expedient approaches for a secure railway system. The IR sensors detect the train stuck on the level crossing very quickly and communicate with the control unit and send the text to the gateman's phone. Another IR sensor detects the train and slows the train. The control unit takes proper steps which lead the train and vehicle's movements either to move forward or to stop to avoid the collision. Consequently, this is able to play a great contribution to railway gate automation with reliability and lower cost.

6.2 Future Scope

- In the future, we make it more efficient.
- In the future, we are thinking about adding more features to the system such as sensors and monitoring cameras.

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52

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