Automatic Braking of Locomotive System To Avoid Accident By Using Arduino Based Sonar And IR Sensor.

A thesis Submitted to the Department of Mechanical Engineering

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Declaration of Authorship

This thesis is a presentation of my original research work. Wherever contributions of others are involved, every effort is made to indicate this clearly, with due reference to the literature, and acknowledgement of collaborative research and discussions. The work was done under the guidance of Md. Sharful Insan, Lecture, Department of Mechanical Engineering, Sonargaon University.

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Abstract

Railway is the most popular and friendly transportation system of the largest part of the cities in the world. Train is widely used for comfortable and safe journey in a reasonable fare. People from different professions can effort it. Almost 10,000 billion freight tonne Kilometers and more than 5 billion Passengers of rail transport have been travelled around the world per years. The railway transportation system plays an important role for business as well as for leniency and safe travelling in modern life. But at every turn, the train is facing unexpected situation in travelling because of wrong signal, wrong track switching, insecure level crossing etc. for which collision have been occurred. As a result, lot of damages has been done in economic sector with lot of causalities which affect our progress. But we can avoid this unexpected collision and take prevention from the accident dynamically by using the collision detection technology which can be made by ultrasonic sound with a special embedded system. By using this technology can detect the obstacle and gradually slow down the speed by initiating the air brake to stop the train before the collision takes place.

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Chapter-One

1.1 Introdcution: Trains are the most agreeable, comfortable and relaxing of any form of long distance travel. Whether you are seeking spectacular scenery, luxurious carriages, heritage steam trains or epic long-distance journeys, perhaps aboard a sleeper, there is no better perspective on the world than from a railway carriage.

Bangladesh Railway also known as Bangla Rail is the state-owned rail transport agency of Bangladesh. It operates and maintains all railways in the country, and is overseen by the Directorate General of Bangladesh Railway. The Bangladesh Railway is governed by the Ministry of Railways and the Bangladesh Railway Authority. Its reporting mark is "BR".The Bangladesh Railway system has a total length of 2,855 route km. In 2009, Bangladesh Railway had 34,168 employees. In 2014, Bangladesh Railway carried 65 million passengers and 2.52 million tonnes of freight. The railway made 8,135 million passenger-kilometres and 677 million tonne-kilometres. Train accident aren't as common as other transportation accident, which perhaps is why aren't viewed as a major threat. Although railroads aren't used as often as they were is centuries past, they still remain quite active. In fact, trains are still quite common is the Bangladesh-particularly subways, commuter trains, trams etc. Unfortunately, when train accidents happen, they often result in serious injuries and facilities .There are a variety of reasons why train accidents occur most of which take place at crossings when cars try to"beat the train. when these accidents occur, they often involve the passengers, driver, and some passers by.While every case is unique, the most common causes of train accidents include:

1. Negligence

Railroad accidents due to negligence can be blamed on different groups. Some may be the fault of the railway company itselt, whereas others are because a conductor or railroad employee was negligent. Some accidents are even caused by the neglect of a government agency. or perhaps an equipment manufacturer can be a reason why the accident happened. One example of railway negligence is when a crossing arm is operated incorrectly. Another careless mistake is if the operator forgot or failed to turn on the signal light, which should have provided adequate warning. Common factor that contributes to this problem is the decades old, outdated technology still frequently used for railways and trains today. Better technology is available to Improve railway safety, but adopting these features often put on hold because it involves a hefty investment.

2. Human Error

If the conductor is inexperienced, train accidents can easily happen. Even those who have been working in the railroad industry for quite some time may make a mistake that harms other people, including passengers. Another growing problem with both experienced and new conductors is fatigue. They cannot operate the train safely if they are exhausted, yet they do so anyway due to pressure they face from their supervisors and company. Human error has always been one of the most common reasons for any accident. From poor judgment to vision issues to impaired reactions, these factors can (and do) contribute to train disasters.

Figure 01 : Train Accident because of Human Error.

3. Reckless Pedestrians & Drivers

Train accidents aren't always the fault of the train operator or company. Sometimes, a reckless or distracted pedestrian can cause a collision by standing on or crossing the tracks at the wrong time. In other scenarios, the driver of a car, truck, motorcycle or other motor vehicles can cause an accident by leaving their vehicle parked on a train track or trying to beat the train across a crossing.

4. Mechanical Failure

The train operator, railway employees and the company itself can do everything within their ability to follow all the required safety procedures, but a train accident can still happen. Mechanical failure and defective parts are more rare than other common causes of train collisions, but they do occasionally happen. Trains are large machines with complex systems and many moving parts. All of the different systems must work together perfectly to provide locomotive and electric povwer. If some piece of guidance equipment (Such as a rail switch) or safety equipment (such as a rail signal) fails, it can cause a deadly accident.

5. Speedy Trains

Time and again, car accident data proves that driving recklessly fast can lead to serious injuries and deaths. Trains are no exception. Many train accidents in recent years showed that the faster the train, the worse the consequences become in the event of a crash and the higher Likelihood of derailment.

6. Defective Tracks

Obstruction is a common issue with the tracks and can cause train derailment. Foreign objects left inadvertently at the site where the train will pass can be deadly. Conductors should be aware of their surroundings at all times to manage a potentially dangerous situation quickly and safely. However, in some cases, a conductor fails to see these obstacles at all or in time to stop a collision.

7.Derailments

A derailment is when a train runs often rail, either because of a collision with another object, a conductor error, mechanical track failure, broken rails, or defective wheels. A derailment doesn't necessarily mean the train leaves the tracks- some may be minor. However, a serious derailment can be catastrophic if it occurs while the train is moving at a high rate of speed.

8. Unprotected railroad crossings

More than 80 percent of crossings lack adequate warning devices such as lights and gates, and more than half of all railroad accidents occur at unprotected crossings. Tennessee residents know well that there are many unprotected railroad crossings across the state. Accidents at unprotected railroad crossings are most often caused by:

Poor visibility

Malfunctioning signals

Obstacles that block a drivers view

Conductor failing to sound an alarm

Driver distraction

Driver inebriation/intoxication

Driver trying to race the train

09.Stalled cars on the track

Cars rarely get stuck on railroad grade crossings. More common is when drivers stall out when slowing down to cross bumpy grades due to a poorly tuned engine. If this happens to you, first you try to start it again immediately. f it won't start, put your vehicle in neutral and ask for help to push your vehicle off the tracks. But if a train is rapidly approaching and there's no time to save your car, remember that your life and safety are first priority. Get as far from your vehicle as possible.

10. Suicides

Sadly, some people choose to take their own lives by standing on the tracks or jumping in front of a train. Federal statistics show that 266 people killed themselves by stepping in front of trains In 2017. Unfortunately, this tragic and desperate act also endangers other lives such as train crews, emergency responders, passengers and bystanders.

But we can avoid this unexpected collision and take prevention from the accident dynamically by using the collision detection technology which can be made by ultrasonic sound with a special embedded system. By using this technology can detect the obstacle and gradually slow down the speed by initiating the air brake to stop the train before the collision takes place.

Chapter-Two

2.1 Historical Background

Every year in many countries around the world occurred train accidents. Here are some accidents have been highlighted.

8 December 2010 – Bangladesh – Two passenger trains are in a head-on collision near Narsingdi. Nineteen people are killed.[1]

15 September 2011 – Belgium – Two trains collide at Aarlen, injuring 30–40 people, two seriously.[2]

25 June 2012 – Indonesia – 2010 Petarukan train collision - 36 people are killed and 60 are injured when a train runs into the back of another at Petarukan.[3]

12 October 2013 – Ukraine – 2010 Marhanets train and bus collision - At least 43 people are killed in a collision between a train and a bus at Marhanets. .[4]

19 July 2014 – Sainthia train collision occurred at Sainthia railway station in Sainthia, when the Uttar Banga Express collided with the Vananchal Express.
Casualties stand at 63 people dead and more than 165 people injured. .[5]

19 May 2014 – South Africa – 857 people are injured, 25 seriously, when a rearend collision occurs at Soweto. .[6]

23 July 2015 – China – Wenzhou train collision – Due to signal failure, a high-speed train rear-ends a stopped high-speed train at a speed of 99 km/h (62 mph) near Wenzhou in the province of Zhejiang, killing 40 people and injuring at least 192. .[7]

11 January 2016 - 5 persons were killed and 9 others, including a child, injured in a collision between the Delhi-bound Brahmaputra Mail and a stationary goods train. .[8]

22 May 2017 - The Hubli-Bangalore, Hampi Express collided with a goods train near Penukonda in Andhra Pradesh. 14 people were dead and 35 were injured in the collision.[9]

24 July 2018 – India – Medak district bus-train collision – A school bus is hit by Nanded Passenger train at an unmanned railway level crossing in Masaipet village of Medak district. 18 bus passengers died including 16 students. .[10]

15 September 2019 -A Karachi-bound express train has collided with a stationary freight train in Pakistan's central Punjab region, killing at least 6 people and injuring more than 150. .[11]

11 November 2020-At least 20 people were killed and nearly 70 injured when Zakaria Express collided into stationary coaches of Fareed Express at a railway station in Karachi. The engine of one train was completely destroyed. .[12]

12 November 2021-At least 16 people have died after two trains collided in Brahmanbaria's Kasba Upazila in an accident that prompted Prime Minister Sheikh Hasina to call on the government agencies to be vigilant to avoid recurrence of such calamity. .[13]

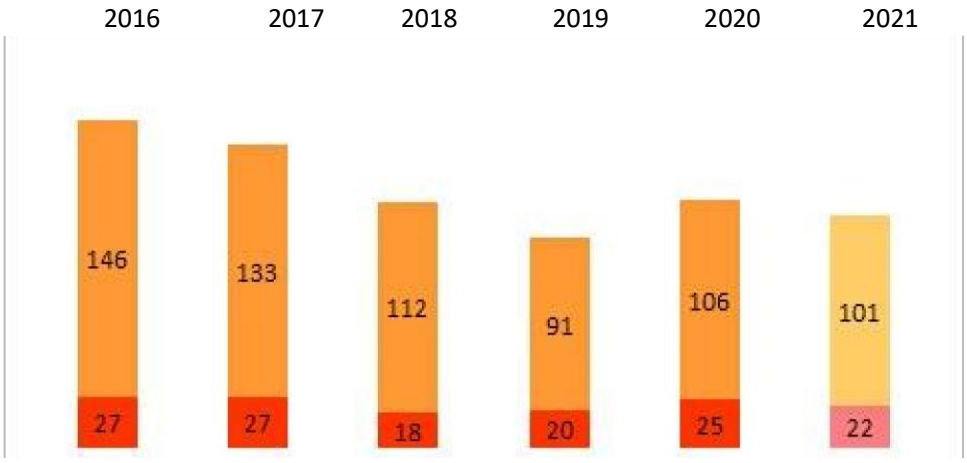


Figure 02 : Data Report of Train Collisions

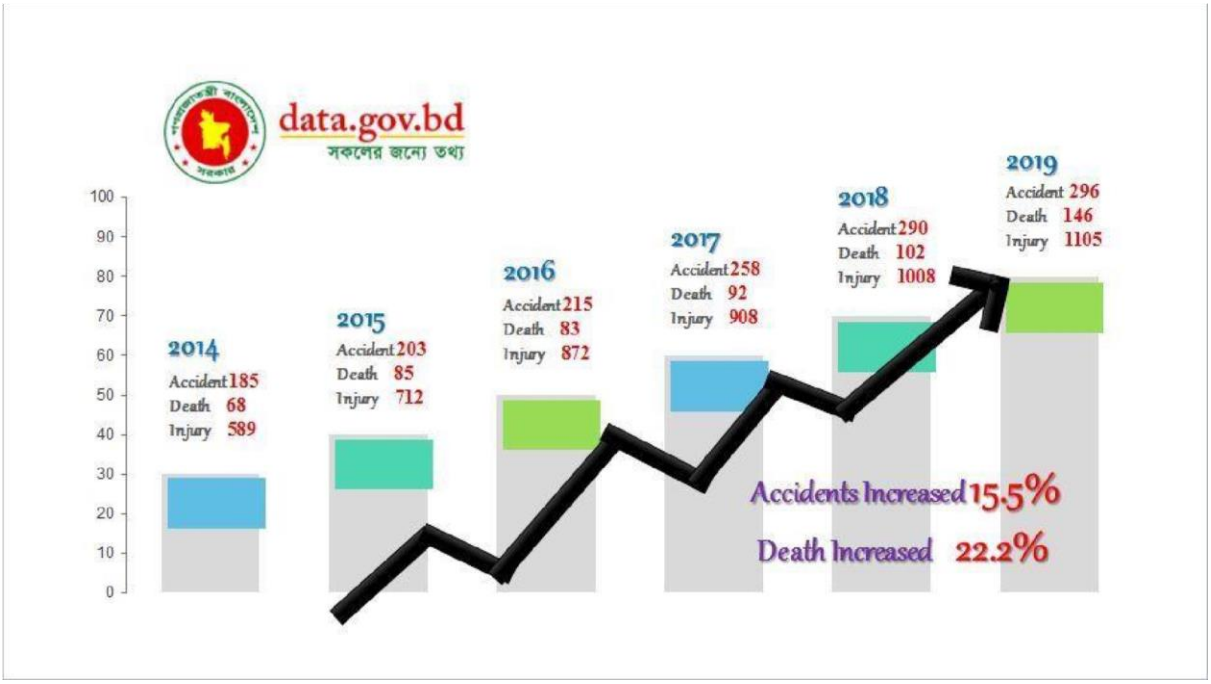


Figure 03 : Government Data Report on Rail Accidents

2.2 Objectives

In this study the followings are the main objectives:

- To ensure railway safety and unwanted collision .
- To develop traditional train signal system .
- To construct a demo train engine system by using sonar and IR sensor.
- To transmit signal to control room by using bluetooth system.

2.3Literature Review : The literatures reviewed in connection with this study are summarized in this chapter. These include studies on accidents on three modes railways. The

general understanding of accident phenomenon, accident characteristics as well as previous studies on accidents in Bangladesh are discussed here. Several studies had been carried out on roadway, railway and waterway accidents in the past. In most cases, accident studies had been performed based on a single mode. Comparative studies of accidents on these modes were found rare. This chapter reviews the literatures concerning road accidents, railway accidents and waterway accidents separately.

2.4Accident Study

Generally, the accident study is carried out for the following purposes:

- To evaluate the existing facilities and to give support to the proposed design.
- To know the basic causes of accidents and suggest remedial measures at potential points.
- To justify economically, the proposed improvements.
- To compute financial loss due to accidents.

The primary objective of any accident study is to provide free, safe and quick movements on the way.

2.5 Railway Accidents

A rail accident is termed as any occurrence which does or may affect the safety of the railways, it's engine, rolling stack, permanent way, works, passengers or servants which either does or may cause delays to trains or loss to the railways (Arora and Saxena, 2006).

2.6 Classification of railway accidents

Railway accidents are classified under following heads:

01.Train Accidents

An accident that involves a train. Train accidents are further divided as:

- Consequential train accidents
- Other train accidents

Consequential train accidents: Include train accidents having serious repercussion in terms of loss human life, human injury, loss to railway property or interruption to rail traffic. Train accident under following classification will be termed as consequential train accidents:

- Collision

- Fire or explosion in trains
- Accidents at level crossing
- Derailment
- Miscellaneous

Other train accidents: All the other accidents which are not covered by the definition of consequential train accidents are to be treated as 'other train accidents'.

2. Yard Accidents

All accidents that take place in yard and do not involve a train are termed as Yard Accidents.

3. Indicative Accidents

In real term, they are not accidents but are serious potential hazards and include all cases of train passing signal at danger, averted collision, breach of block rules.

4. Equipment Failures

These include all failure of railway equipment i.e. failure of locomotives, rolling stock, permanent way, over-head wire, signaling and telecommunication equipment etc.

5. Unusual Incidents

These include cases related to law and order but not resulting in train accidents, train wrecking, causalities etc.

For statistical purposes, railway accidents have been classified into categories from 'A' to 'R' excluding 'I' and 'O'.

Class A - Collisions

Class B - Fire or explosion in trains

Class C - Trains running into road traffic and/or traffic running into trains, at level crossings.

Class D - Derailments

Class E - Other tram accidents

Class F - Averted collision

Class G - Breach of block rules

Class H - Train passing signal at danger

Class J - Failure of Engine and rolling stock

Class K - Failure of permanent way

Class L - Failure of electrical equipment

Class M - Failure of signaling and telecommunication

Class N - Train wrecking

Class P - Casualties

Class Q - Other incidents

Class R - Miscellane

Besides, accidents are divided into five classes in the book of 'General Rules for Pakistan

State Railways with the Subsidiary Rules of the Pakistan Eastern Railway' which is being used till now as a guideline in Bangladesh Railway. These are:

(1)Class A:

Accidents occurring in the course of working the railway involving;
Loss of life or serious injury to any person whether passenger, railway servant, trespasser or others.
Heavy damage to property to the extent of Rs. 20000 and upwards to railway stock or property or to public or private property.
Collisions between trains, one of which is a train carrying passengers or derailment of any train, or part of a train carrying passengers.

(2)Class B:

Damage to the line or works from excessive floods involving interruption to traffic, but not causing a train accident.

(3)Class C:

Running into or over cattle and level crossing gates.
Cases of running over obstructions on the line including road vehicles at level crossing, but not causing an accident specified under 'Class A'. Cases of train wrecking or attempted train wrecking.

(4) Class D:

Includes the following accidents not accompanied by loss of life, grievous hurt or serious damage:
Vehicles blown away.
Trains put on wrong line or running between stations without line clear.
Collisions and derailments not falling under 'Class A' and averted collisions or fire in trains or within railway limits.

Train parting – Breakings of draw bars of couplings which do not cause a train to part are not to be treated and reported as accidents under 'Class D'.

(5)Class E:

Engine failure- an engine is considered to have failed when It is unable, due to some defect or causes delay in route of one hour or more; or It has to be replaced by a relieving engine from another train or from the nearest engine changing station; or

The change of engine causes detention of at least one hour at the changing station.But, after the analysis of railway accident data of Bangladesh railway, it has been seen that mainly two types of accidents are frequent in Bangladesh. These are:

1)Collisions and

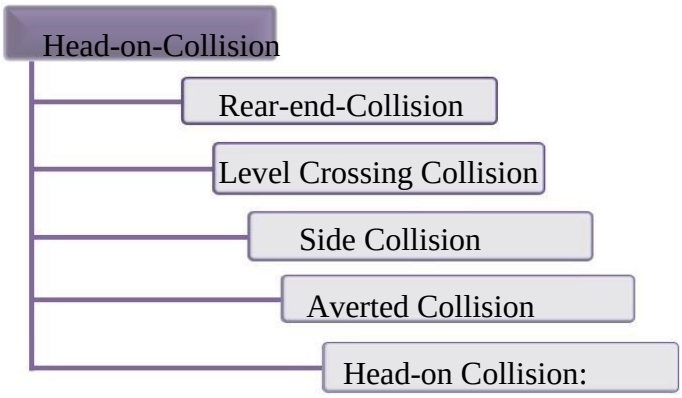
2) Derailments

2.7 Train collisions

Collisions are the most dreaded railway accidents. Collision means one train colliding with another train or any other rolling stock or any other road vehicle.

a) Classification of Train Collisions

Train collisions are classified in the collected raw data as,



A head-on collision is one where the front ends of two trains hit each other on the same track.

A head-on collision often implies a collision on a single line railway.

Rear-end Collision:

A rear-end collision is an incident where a train crashes into the train in front of it, usually caused by tailgating or panic steps. It may also be occurred when a train with higher speed runs into the rear of a preceding train.

Level Crossing Collision:

Level crossing collisions are also one of the most severe rail accidents which have the potential to injure railway staff and passengers as well as road users and pedestrians. Level crossings are well known as components of railway networks with the greatest risk of collision and possibly derailment. Level crossing fatalities can be divided into groups such as-Deaths due to collisions between trains and pedestrians, pedal cyclists or trams at the level crossings and Deaths due to collisions between trains and motor-vehicles at level crossings.

Side Collision:

Side/Flank collisions are one of the severe types of rail accidents that can occur between two trains at the track changing point. This type of crash occurs when one train strikes another train along its side. While the accident can be harmful for both trains involved, typically the individual who is struck has a much higher chance of suffering from severe injuries and damages.

Averted Collision:

It can be defined that is a particular serious accident that could have been averted and guarded against. An averted collision is a circumstance under which but for the vigilance shown by any person or people, a collision would have occurred, either in the block section or within the station limits between two trains or between a train and an obstruction.

Provided further that such an occurrence may not be treated as an Averted Collision; (Accident Manual, 2004)

If, outside the station limits, the distance between the two trains or the train and the obstruction at the time the train or trains have finally come to a stop, is 400 meters or more.

If, within the station limits, there is an intervening stop signal at danger governing the moving train and compliance by the moving train with the indication conveyed by the stop signal averted the collision between the trains or between the train and the obstruction.

Bangladesh Railway mentioned several causes of train derailments and categorized them into three major elements as shown in Table 2.

Figure 04 : Factors and causes of train derailment by BR

Group	Factors	Causes
A	Human Elements	a) Breach of block rules, wrong manipulation of block instruments and wrong setting of points etc. b) Passing of signals at danger c) Breach of block rules by Master and As Locomotive Master sistant
B	Technical Elements	a) Engines b) Vehicles c) Tracks

.The detailed and well-organized classification of train derailment causes are found from the report for European Railway Agency named “Assessment of freight train derailment

		d) Signaling and interlocking apparatus e) Other technical defects
C	Miscellaneous	a) Miscellaneous causes

risk reduction measures: Annex 1 to B2 – ‘Risk model and potential effectiveness of measures’ (European Railway Agency, 2019)”.

2.8 Definitions of some related terms

Permanent Way:

It is the railway track i.e. the rail-road on which trains run.

Components of a Track:

Rails – Rails are steel girders over which the train moves. They provide a continuous and level surface for train movement, provide lateral guidance to the train wheels, bear the wheel load.

Sleepers – Sleepers hold the rails in correct alignment and spacing, provide firm and even support to rails and transfer load to a wider area of the ballast.

Fasteners – They fix rails to sleepers.

Ballast – Transfer and distribute load to the sub-grade; help drainage.

Subgrade - Transfer and distribute load to soil (stabilized layer).

Rolling Stock:

Rolling stock is the collective term that describes all the vehicles that move on a railway.

Locomotive:

A locomotive is a railway vehicle that provides the motive power for a train. Traditionally, locomotives pull trains from the front.

Train:

A train is a set of vehicles, empty or loaded, worked by locomotive or any other selfpropelled unit including light engine/engines, or rail motor vehicles or a single rail motor vehicle, empty or conveying passengers, live-stocks, parcels, or goods which cannot be readily lifted off the track and running under a particular number or a distinct name from fixed point of departure to a fixed destination.

Train Wrecking:

Means the willful obstruction of or tampering with the permanent way, works or rolling stock, resulting in an accident to a train with or without loss of life or damage.

Breach of Block Rules:

When a train enters a block section without any 'authority to proceed' or with an improper authority to proceed, or is received on a blocked line not constituting an averted collision or when it enters or is received on a wrong line at a station or a Catch/Slip siding or sand hump, it constitutes breach of block rules.

Chapter Three

3.1 Arduino Uno:

The Arduino Uno is the most common and well Known of many boards that use raw input and output connections to process electronic information. 1hey are used to create electronic device such as a thermostat controlled over the Internet or a robot that can feed your pets when you're not home. The possibilities are endless. An Arduino board is displayed below in Figure.

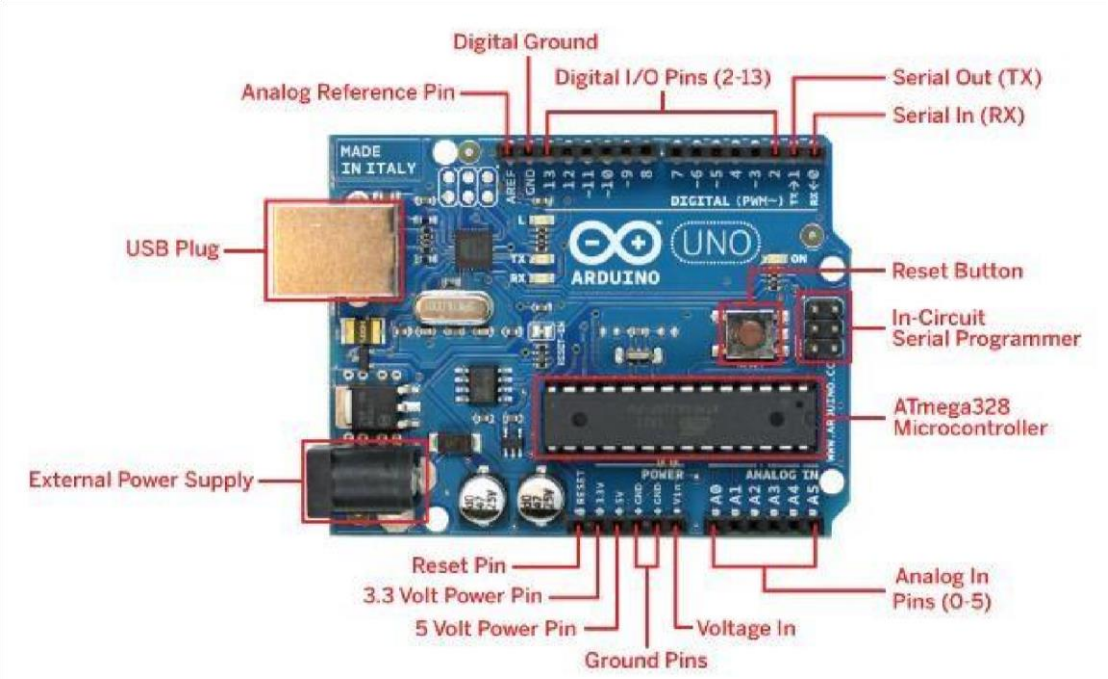


Figure 05 : Arduino Uno board with labeled parts

The Arduino gets power and communication from a computer through the USB cable. Power can also be provided through the power connector in Figure 1 once the program is loaded to the Arduino through the USB cable, the Arduino has the program stored and running. Once programed, all it requires to control the thermostat is power.

3.1.1 Power Requirements and Usage

The Arduino requires 5 volts DC and approximately I amp to run properly. If not supplied with the proper power it can act strangely or not run at all. With too much power supplied it can overheat and will be destroyed. Most smart phones, MP3 players, and other USB devices require the same 5 volts and 1 ampthat the Arduino reqúires. A 9-volt battery is optimal for supplying8 the Arduino with battery power. The Arduino will regulate the 9 volts down to 5 volts and work well. In the thermostat example in Figure 2, the power connector is used instead of a USB cable. This is because the program is already stored and running on the Arduino. Optimally, the power connector 1or this 3 example is providing 9 volts from a small transformer plugged into a nearby outlet so that the user doesn't have to replace batteries.

3.2 Programming

Once arduino IDE Is installed on the computer, connect the board with computer using USB cable. Now open the arduino IDE and choose the correct board by selecting
Tools>Boards> Arduino/Genuino Uno, and choose the' correct Port by selecting Tools>Fort. Arduino Uno is programmed using Arduino programming language based on Wiring.10 get it started with Arduino Uno board and blink the built-in LED, load the example code by selecting Files>Examples>Basics>Blink. Once the example code (also shown below) is loaded into your IDE, click on the "upload' button given on the top bar. Once the upload is finished, you should see the Arduino's built-in LED blinking.

3.3 Warnings:

The Arduino/Genuine Uno has a resettable poly fuse that protects your computers USB ports from short and over current. Although most computers their own internal protection, the fuse provides an extra layer of protection. If more than 500 mA is applied to the USB port, the fuse will automatically break the connection until short or overhead is removed.

3.4 Difference with other boards:

The Uno differs from all preceding boards in that do not use the FTDI USB to serial driver chip.Instated, it futures the Atmega16U2 (Atmega8U2 up to version R2) programmed as a USB to serial converter.

3.5 Power:

For a power souree, you have he optron of using the USB or a DC jack. Now it’s time to answer the following question: "If I connect both a DC adapter and the USB, which will be The power source ?’’

The 5V regulator is the NCPII17ST50T3G and the VIN of this regulator is connected Via D Jack input through the M7 diode, the SMD version of the famous. This diode provides revee polarity protection.

The output or the V regulator is connected to the rest of 5V net in the circuit and also to the input of the 3.3V regulator, LP2985-33DBVR. You can access 5V directly trom the power header 5V pin.

Another source of 5V is USBVCC which is connected to the drain of an FDN340P, a Pchannel MOSFET, and the source is connected to the 5V net. The gate of the transistor is connected tothe output of an LMV358 op-amp used as a comparator. The comparison is between 5V3 and Vin/2. when Vin2 i1s larger, this will produce a high output from the comparator and the F-channel MOSFET is off. If there is no VIN applied, the V+ of the comparator is pulled down toGND and V out is low, such that the transistor is on and the USBVCC is connected to V.

The LP2985-33DB VR is the 3V3 regulator. Both the 3V3 and 5V regulators are LDO (Low Dropout), which means that they can regulate voltage even if the input voltage is close to the output voltage. This is an improvement over older linear regulators, such as the 7805.

The last thing I'll talk about is the power protection that is provided in Arduino UNO.
As mentioned above, VIN from a DC jack is protected from reverse polarity by using a serial M7diode in the input. Be aware that the VIN pin in the power header is not protected. This is because it Is connected after the M7 diode. Personally, I don't know why they decided to do that when they could connect it before the diode to provide the same protection.

when you use USB as a power source, and to provide protection for your USB port, there is a PTC (positive temperature coefficient) fuse (MF-MSMFO50-2) in series with the USBVCC. This provides protection from over current, 500 mA. When an over current limit is reached, the PTC resistance increases a lot. Resistance decreases after the over current is removed.

3.6 The power pins are as follows:

VIN the input voltage Ardunio/Genuine board when it s using an external power source(opposed to 5v from USB connection or other regulated power sources). We can supplied voltage through this pin or if suplying voltage via the power jack, access if through this pin.
5v this pin outputs a related 5v from the regulator on the board, the can be supplied with power either from the DC power jack (7 -12 v), the USB connector (5v) or the VIN of the board (7-12v), supplying via the 5 v or 3.3 v pins bypasses the fegulator, and can damage your board, we don't advice it.

3V3: A3.3v Supply generated by the on-boad regulator. Maximum current draw is 50mA.
GND: Ground pin,
IOREF: This pin on the Arduino/Genuino boards provides the voltage reference with the microcontrollers operates, A properly configured shield can read the 1OREF pin voltage and select the approprate power source or enable voltage translators on the output to work with 5v or 3.3v.

3.7 Memory :

The ATmega328 microcontroller is the MCU used in Arduino UNO R3 as a main controller ATmega328 is an MCU from the AVR family; it is an 8-bit device, which means that its data-bus architecture and intenal registers are designed to handle 8 parallel data signals. ATmega328 has three types of memory:

3.7.1 Flash memory: 32KB nonvolatile memory. This is used for storing application, which explains why you don't need to upload your application every time you unplug arduino from its power source.

3.7.2 SRAM memory: 2KB volatile memory. This is used for storing variables used by the application while it's running.

3.7.3 EEPROM memory: 1 KB nonvolatile memory. This can be used to store data that must be available even after the board is powered down any then powered up again.

3.8 Communication:

Arduino/Genuino Uno has a number of facilities for communicating with a computer, another Arduino/Genuino board, or other microcontrollers, the A T mega328, provide, UART TTL (5v) serial communication, Which is available on digital pins 0 (RX) and I (TX), an Atmega 16U2 on the board channels this serial communication over USB and appears as a virtual comport to software on the computer, the 1602 firmware use the standard USB COM drivers, and no extenal drives is needed however, on windows if file is required. The Arduino Sotware (IDE) includes a serial monitor which allows simple textual to be sent to and from the board. The RXand TX LEDs on the board will flash when data is being transmitted via the USB to serial chipand USB connection to the computer (but not for serial communication on pins 0 and 1). ASoftware serial library allows serial communication on any of the Uno's pins. The ATmega328also support 12c (1W) and SPI communication. The Arduino Software (IDE) includes a wirelibrary to simplify of the 12c bus; sec the documentation for details, for SPI communication uses the SPI library.

3.9 Automatic (Software) Reset:

Rather than requiring a physical press of the reset button before and upload, the Arduino/Genuion Uno board is design in way that allowS it to be reset by Software running on a connected computer. One of the hardware flow control lines (DTR) of the A Tmega8U2/1602 is connected to the reset line of the A Tmega328 via a 100 Nano farad capacitor. When this line is asserted(taken law), the reset line drops long enough to reset the chip. The Arduino Software(IDE) uses this capability to allow you to upload code simply pressing the upload button in the interface toolbar, this means that the boot loader can have shorter timeout, as the lowering of DTR can be well-coordinated with the start ot the upload.

3.10 Arduino Details:

The Arduino Uno is a microcontroller board based on the Almega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, contains everything needed to support the microcontroller, Simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from processing boards in that it does not use the FTDI USB-to-serial driver chip. Instead, It features the Atmega328 programmer USB to serial converter.

3.11 Power (USB/Barrel Jack)

Every Arduino board needs a way to be connected to a power source. The Arduino UNO can be powered from USB cable coming from your computer or a wall power supply (like this) that is terminated in a barrel jack. In the picture above the USB connection is labeled

(1) and the barrel jack is labeled
(2). The USB Connection is also how you will load code onto your Adriano board.

3.12 Pins (5V, 3.3V, GND, Analog, Digital, PWM, AREF):

The pins on your Arduino are the places where you connect wires to construct a circuit (probably in conjunction with a breadboard and some wire. They usually have black plastic, headers, that allow you to just plug a wire right into the board. The Arduino has several different kinds of pins, each of which is labeled on the board and used for different functions.

GND (3): Short for, Ground" there are several GND pins on the Arduino, any of which can be used to ground your circuit.

5V(4) & 3.3 V(5): As you might guess, the 5V pin supplies 5 volts of power, and the 3.3V pin Supplies 3.3 volts of power. Most of the simple components used with the Arduino run happily off of 5 or 3.3 volts.

Analog (6): The area of pins under the, Analog in label (A0 through AS on the UNO) are Analog in pins. These pins can read the signal from an analog sensor (like a temperature sensor) and convert it imto a aigital value that we can read.

Digital (): Across from the analog pins are the digital pins (0 through 13 on the UNO). These pins can be used tor both digital input (like telling if a button is pushed) and digital output powering an LED)

PWM (8): You may have noticed the tilde (-) next to some of the digital pins (3, 5, 6,9, 10 and1 on the UNO). These pins act as normal digital pins, but' can also be used tor something called pulse-width modulation (PWM). We have a tutorial on PWM, but for now, think of these pins as being able to simulate analog output (like fading an LED in and out).

AREF (9): Stands for Analog reference. Most of the time you can leave this pn alone. lt is sometimes used to set an external reference voltage (between O and 5 volts) as the upper limit for the analog input pins.

3.13 Reset Button:

The reset button does pretty much the same as unplugging the board and plugging it back in. It restarts your program from the beginning The same thing happens when you program the board - the USB interface presses the reset button for you. That then enters the boot loader for a second or two so it can try and program ii. When you reset the board the LED on pin 13 should flash a couple of times while it's in the b0ot loader betore it runs whatever program you have programmed in. If that LED doesn't 1lash when you press the reset button then there is a serious fault with your board which will take further diagnostic.

3.14 Power LED Indicator:

Just beneath and to the right of the word UNO" on your circuit board, there's a liny LED next to the world, ON"(11). This LED should light up whenever you plug your Arduino mto a power source. If this light doesn't tum cn, there's a good change something is wrong. Time to re-check our circuit.

3.15 TX RX LEDs:

This seams incomplete as it does not address now to implement the said interrupts. Where 1 can see using ISR (UART_ RX_vect) and 1SR (UART_TX_vect), except they are only double buffered (small). So they would only trip quickly and once, on the completion of the initial byte. Or is that it TX's Um buffer is filled between, ready tor next and completely empty. After UART UDRE vect but before UART_ TX_vect. This would not be the case for Rx. Also the interrupts O; is needed to enable the ISRO vectors.

3.16 Main IC:

The black thing with all the metal legs is an IC, or Integrated Circuit (13). Think of it as the brains of our Arduino. The main IC on the Arduino is slightly different from board type of board type, but is usually from the Atmega line of TC's from the ATMEL company. This can be important, as you may need to know the IC type (along with your board type) before loading up a new program from the Arduino software. This can usually be found in writing on the top side of the IC. It you want to know more about the difference between various 1C's reading the datasheets is often a good idea.

3.17 Voltage Regulator:

The voltage regulator (14) is not actually something you can (or should) interact with on the Arduino. But it is potentially useful to know that it is there and what it's for. The voltage regulator does exactly what it says it controls the amount of voltage that is let into the Arduino board. Think of it as a kind of gatekeeper, it will turn away an extra voltage that might ham the circuit. Of course, it has íts limits, so don't hook up your Arduino to anything greater than 20 volts.

3.18 Description of ATmega328 Microcontroller :

The high-performance Microchip 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1KB 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 byteoriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8channels 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.

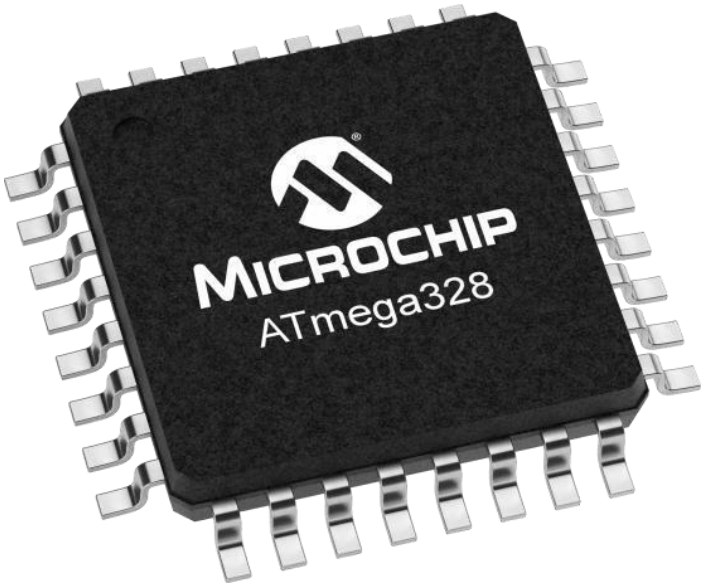


Figure 06 : ATmega 328 IC

3.18 Block Diagram Of ATmega328p :

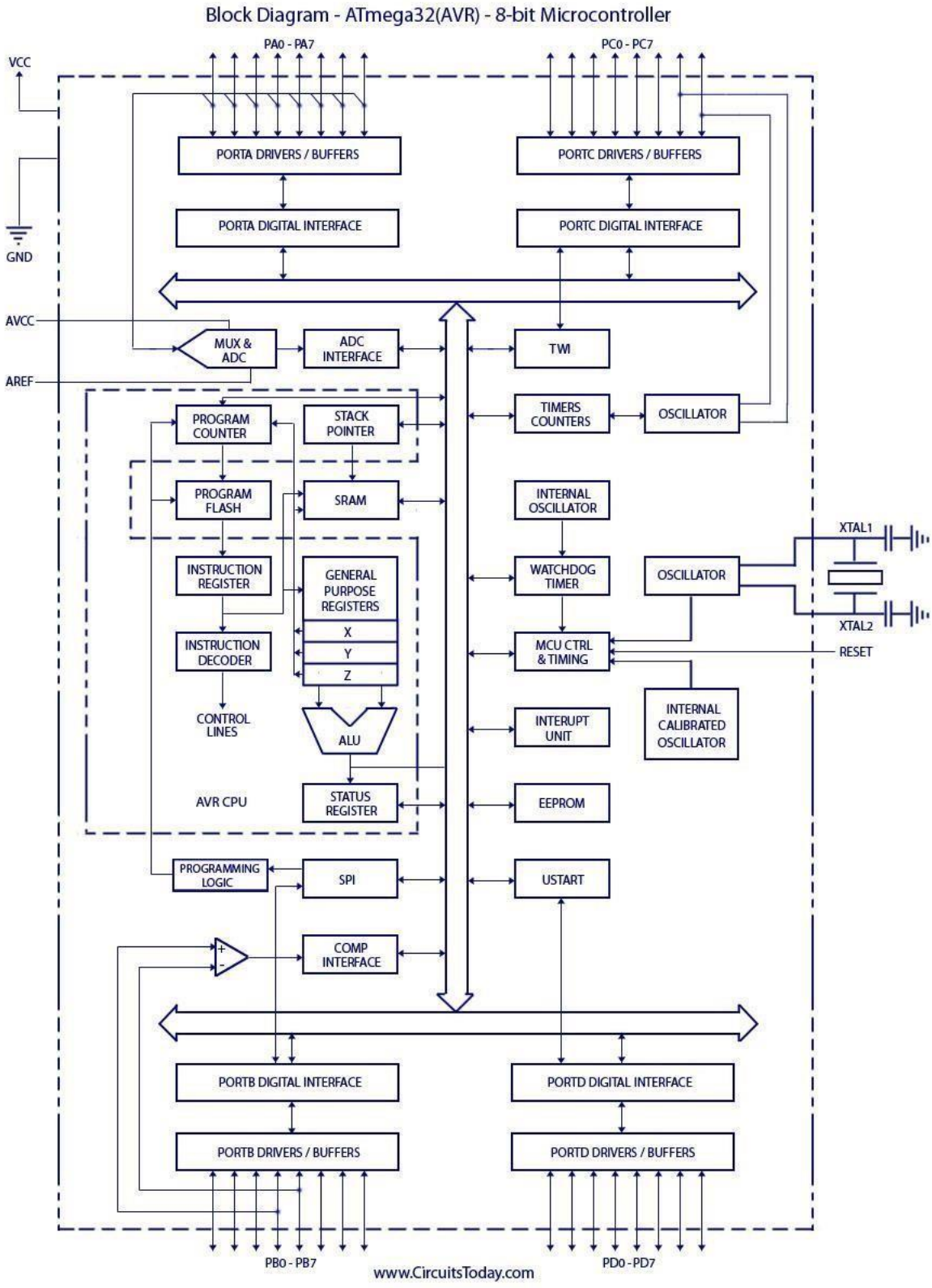


Figure 07 : Block Diagram Of ATmega328 IC

Chapter Four

4.1 Ultrasonic Sensor:

HC-SR04 Ultrasonic (US) sensor is a 4 pin module, whose pin names are VCC, Trigger, Echo and Ground respectively. This sensor is a very popular sensor used in many applications where measuring distance or sensing objects are required. The module has two eyes like projects in the front which forms the Ultrasonic transmitter and Receiver. The sensor works with the simple high school formula that

Distance = Speed × Time

The Ultrasonic transmitter transmits an ultrasonic wave, this wave travels in air and when it gets objected by any material it gets reflected back toward the sensor this reflected wave is observed by the Ultrasonic receiver module as shown in the picture below

.

Figure 08 : Ultrasonic Sensor Distance Measuring

Now, to calculate the distance using the above formulae, we should know the Speed and time. Since we are using the Ultrasonic wave we know the universal speed of US wave at room conditions which is 330m/s. The circuitry inbuilt on the module will calculate the time taken for the US wave to come back and turns on the echo pin high for that same particular amount of time, this way we can also know the time taken. Now simply calculate the distance using a microcontroller or microprocessor

.

Figure 09 : Ultrasonic Sensor Front and Back Side View

4.1.1 History Of Ultrasonic Sensor:

The history dates back to 1790, when Lazzaro Spallanzani first discovered that bats maneuvered in flight using their hearing rather than sight. Jean-Daniel Colladon in 1826 discovered sonography using an underwater bell, successfully and accurately determining the speed of

sound in water. Thereafter, the study and research work in this field went on slowly until 1881 when Pierre Curie's discovery set the stage for modern ultrasound transducers. He found out the relationship between electrical voltage and pressure on crystalline material. The unfortunate Titanic accident spurred rigorous interest into this field as a result of which Paul Langevin invented the hydrophone to detect icebergs. It was the first ultrasonic transducer. The hydrophone could send and receive low frequency sound waves and was later used in the detection of submarines in the World War 1.

On a note parallel to the SONAR, medical research also started taking interest in ultrasonics. In late 1930's Dr. Karl Dussik used a technique called hyperphonography which recorded echoes of ultrasonic waves on a sensitive paper. This technique was used to produce ultrasound pictures of the brain to help detect tumors and marked the birth of ultrasound imaging. After that, many scientists like Ian Donald, Douglas Howry, Joseph Holmes, John Wild and John Reid improved upon the various aspects of ultrasonic sensors in the medical field which enabled diagnosis of stomach cancers, ovarian cysts, detection of twin pregnancies, tumors etc. Industry too did not waste time in jumping on to the bandwagon and soon developed techniques like ultrasonic welding and non destructive testing at the outset of the 1960s

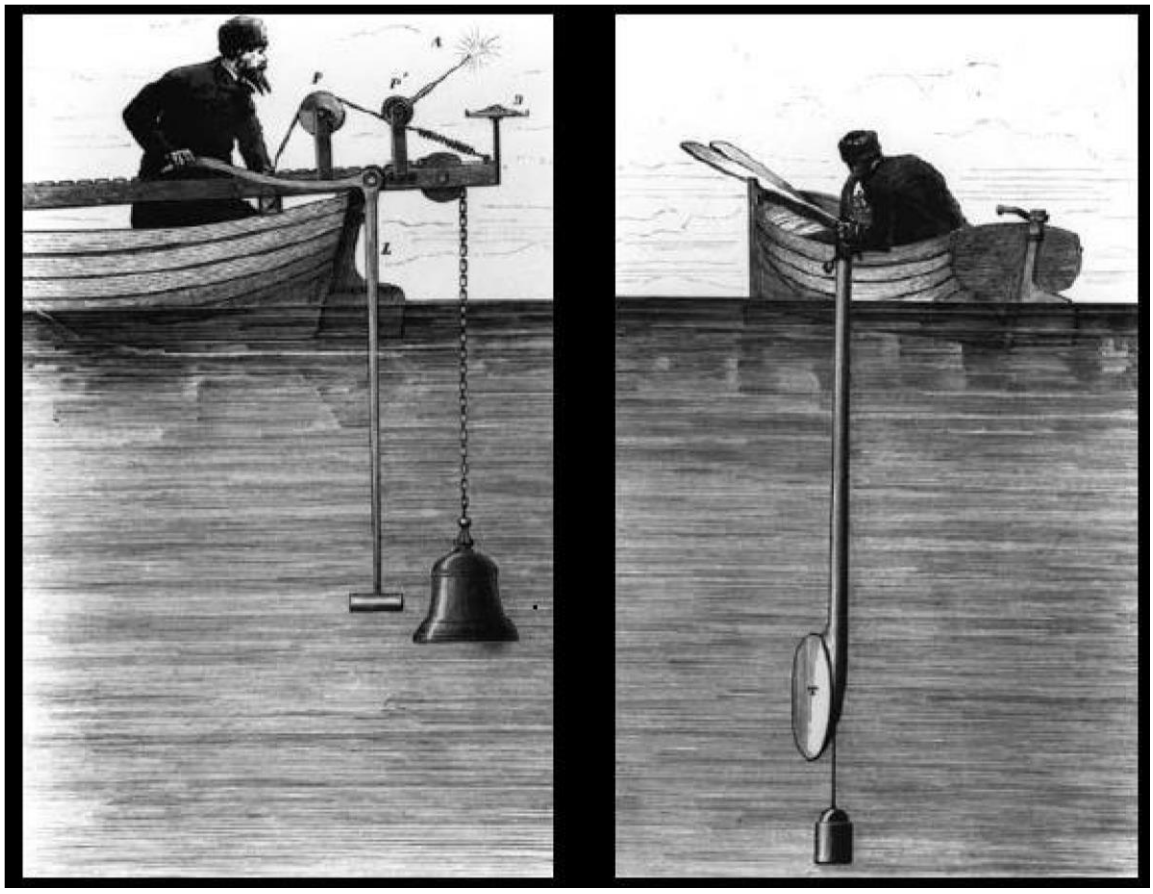


Figure 10 : History Of Ultrasonic Sensor

4.1.2 How Ultrasonic Sensors work?

Ultrasonic sensors are devices that use electrical–mechanical energy transformation, the mechanical energy being in the form of ultrasonic waves, to measure distance from the sensor to the target object. Ultrasonic waves are longitudinal mechanical waves which travel as a succession of compressions and rarefactions along the direction of wave propagation through

the medium. Any sound wave above the human auditory range of 20,000 Hz is called ultrasound. Depending on the type of application, the range of frequencies has been broadly categorized as shown in the figure below:

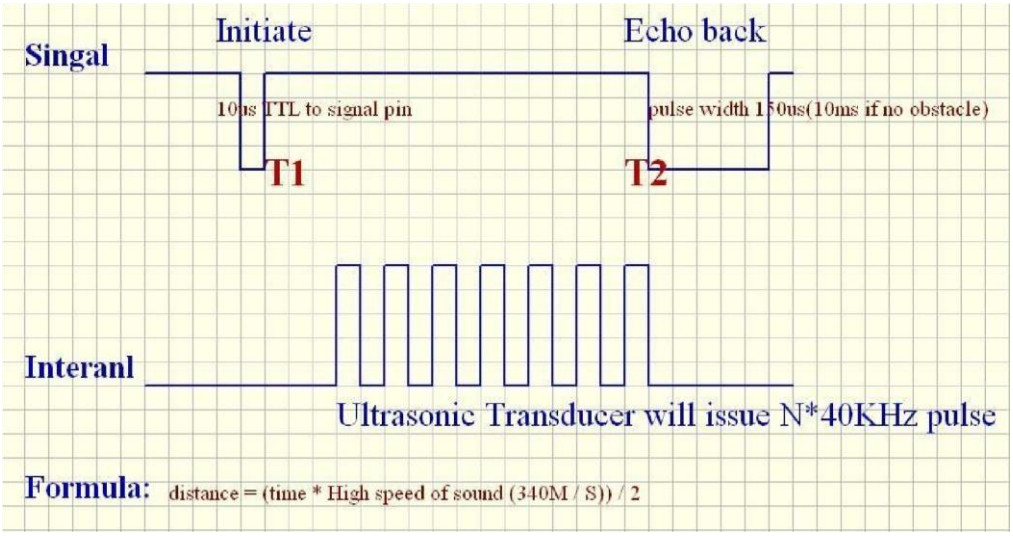


Figure 11 : Wave Of Ultrasonic Sensor

When ultrasonic waves are incident on an object, diffused reflection of the energy takes place over a wide solid angle which might be as high as 180 degrees. Thus some fraction of the incident energy is reflected back to the transducer in the form of echoes and is detected. The

distance to the object (r) can then be calculated through the speed of ultrasonic waves (v) in the medium by the relation

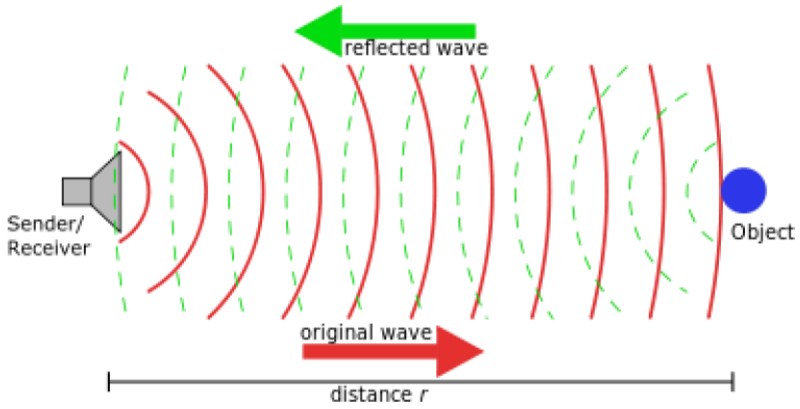


Figure 12 : Object Finding of Ultrasonic Sensor

Where‘t’ is the time taken by the wave to reach back to the sensor and ‘ ’ is the angle between the horizontal and the path taken as shown in the figure. If the object is in motion, instruments based on Doppler shift are used.

4.2 IR Sensor Module :

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. These types of radiations are invisible to our eyes, that 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.

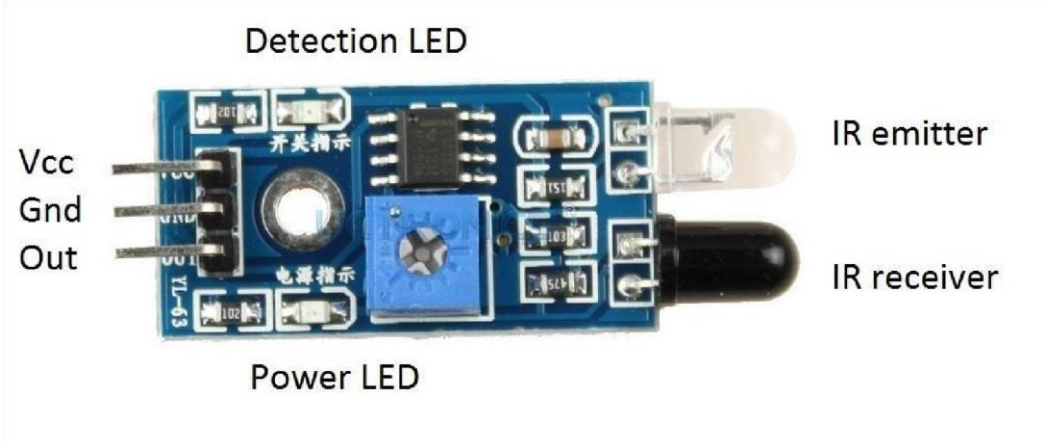


Figure 13 : IR Sensor Module

4.2.1 Infrared Radiation Theory

Infrared waves are not visible to the human eye. In the electromagnetic spectrum, infrared radiation can be found between the visible and microwave regions. The infrared waves typically have wavelengths between 0.75 and 1000µm.

The infrared spectrum can be split into near IR, mid IR and far IR. The wavelength region from 0.75 to 3µm is known as the near infrared region. The region between 3 and 6µm is known as the mid-infrared region, and infrared radiation which has a wavelength greater higher than 6µm is known as far infrared.

4.2.2 The Types of Infrared Sensors

Infrared sensors can be active or passive and they can be split into two main types:

4.2.2.1 Thermal infrared sensors – use infrared energy as heat. Their photo sensitivity is independent of the wavelength being detected. Thermal detectors do not require cooling but do have slow response times and low detection capabilities.

4.2.2.2 Quantum infrared sensors – provide higher detection performance and faster response speed. Their photo sensitivity is dependent on wavelength. Quantum detectors have to be cooled in order to obtain accurate measurements.

4.2.3 The Working Principle of Infrared Sensors

The physics behind infrared sensors is governed by three laws:

4.2.3.1 Planck's radiation law: Every object at a temperature T not equal to 0 K emits radiation.

4.2.3.2 Stephan Boltzmann Law: The total energy emitted at all wavelengths by a black body is related To the absolute temperature.

4.2.3.3 Wein's Displacement Law: Objects of different temperature emit spectra that peak at different wavelengths.

All objects which have a temperature greater than absolute zero (0 Kelvin) posses thermal energy and are sources of infrared radiation as a result.
Sources of infrared radiation include blackbody radiators, tungsten lamps and silicon carbide. Infrared sensors typically use infrared lasers and LEDs with specific infrared wavelengths as sources.

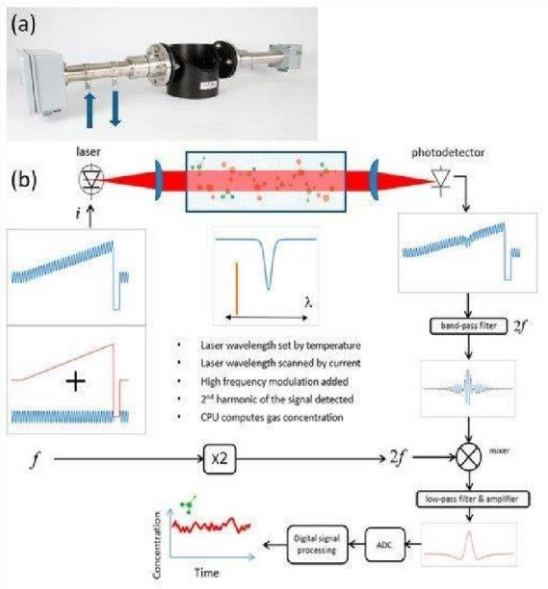


Figure 14 : Wein's Displacement Law of Infrared Sensors

4.3 Power Distributor :

This breadboard power supply is a companion module, which provides 5 V, 3.3 V to rails on a solderless breadboard. It is an extremely useful facility, which provides regulated voltage rails for project circuits. The module design is the form of a plug-in, which connects onto the breadboard. This module have regulated 5V USB output through for power other USB devices (your Arduino boards), which can be extremely useful. Can switch the power 5V and 3.3V to rail of breadboard. Each rail have self switcher of 5V/3.3V/OFF. On board have general switch for power on/off. Not need disconnect power jack. We use more powerful Voltage Regulators (LDO), for guaranteed 1A output to 5V and 800mA to 3.3V (big current for WI-FI projects)Short circuit and overheating protection. Input diode to protect circuitry from negative voltages or AC power supplies. LED power indicator.

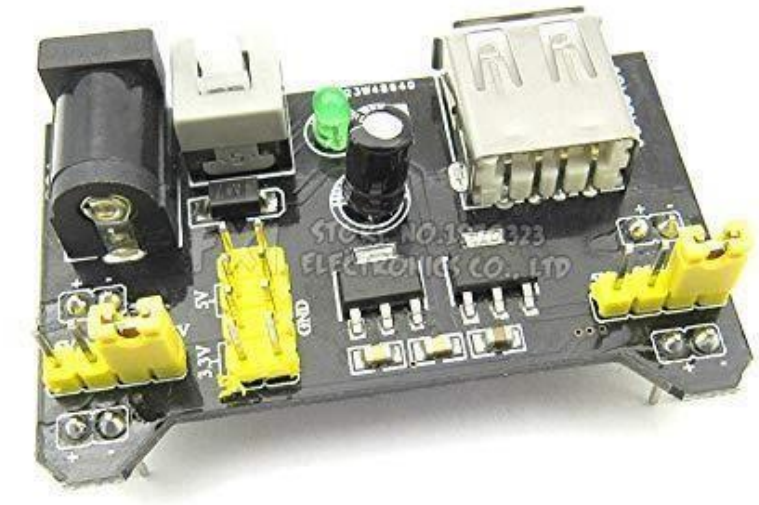


Figure 15 : Power Distributer

4.4 HC-05 Bluetooth Module :

The HC-05 module is familiar, cheap and designed for transparent wireless serial connection setup with Bluetooth SPP (Serial Port Protocol).

Another very important aspect, especially if you are at the beginning and want to use a Bluetooth module, you can find on the Internet a whole series of tutorials and guides to introduce you into wireless communication with robots.

This Bluetooth module covers 9 meters (30ft) of signals and works both as a master or as a slave. For example, a robot can be designed to be a master connected to a slave Bluetooth module or as a slave board to make a wireless connection with a PC.

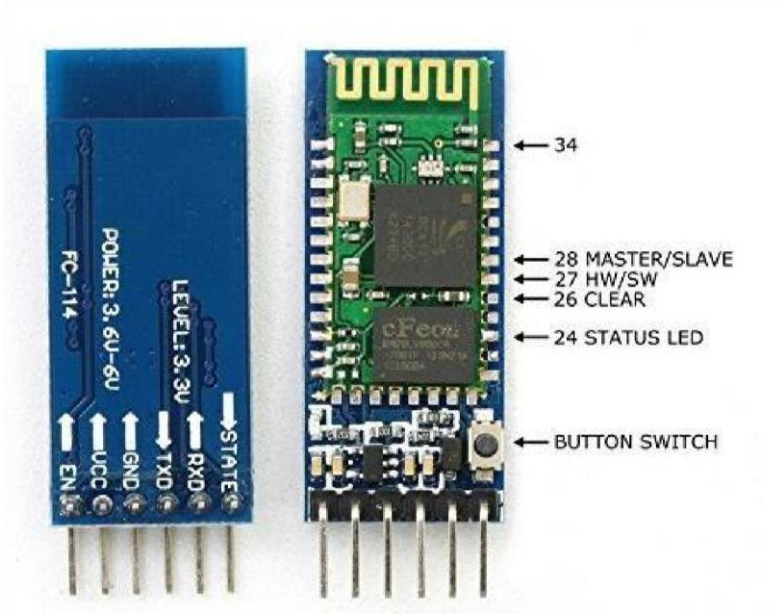


Figure 16 : HC-05 Bluetooth Sensor Module

4.4.1 Working Procedure of HC-05 Bluetooth Module :

HC 05/06 works on serial communication. The Android app is designed to send serial data to the Arduino Bluetooth module when a button is pressed on the app. The Arduino Bluetooth module at the other end receives the data and sends it to the Arduino through the TX pin of the Bluetooth module (connected to RX pin of Arduino). The code uploaded to the Arduino checks the received data and compares it. If the received data is 1, the LED turns ON. The LED turns OFF when the received data is 0.

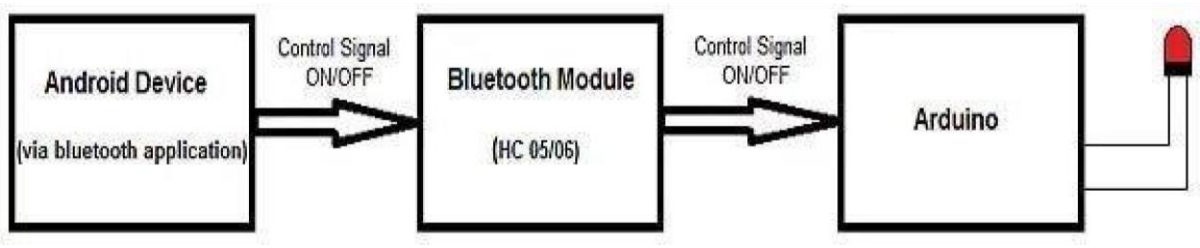


Figure 17 : Working Procedure of HC-05 Bluetooth Module

4.5 L298N Motor Controller Module :

H-Bridge's are typically used in controlling motors speed and direction, but can be used for other projects such as driving the brightness of certain lighting projects such as high powered LED arrays.

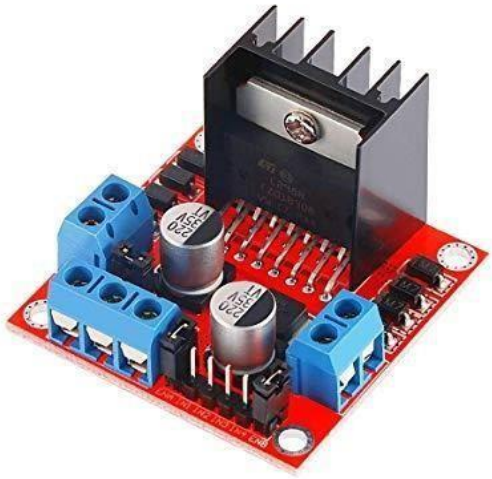


Figure 18 : L298N Motor Controller Module

4.5.1 How it works:

An H-Bridge is a circuit that can drive a current in either polarity and be controlled by *Pulse Width Modulation (PWM).

Pulse Width Modulation is a means in controlling the duration of an electronic pulse. In motors try to imagine the brush as a water wheel and electrons as a the flowing droplets of water. The voltage would be the water flowing over the wheel at a constant rate, the more water flowing the higher the voltage. Motors are rated at certain voltages and can be damaged if the voltage is applied to heavily or if it is dropped quickly to slow the motor down. Thus PWM. Take the water wheel analogy and think of the water hitting it in pulses but at a constant flow. The longer the pulses the faster the wheel will turn, the shorter the pulses, the slower the water wheel will turn. Motors will last much longer and be more reliable if controlled through PWM.

4.5.2 Pins:

- Out 1: Motor A lead out
- Out 2: Motor A lead out
- Out 3: Motor B lead out
- Out 4: Mo (*Can actually be from 5v-35v, just marked as 12v*)
- GND: Ground
- 5v: 5v input (*unnecessary if your power source is 7v-35v, if the power source is 7v-35v then it can act as a 5v out*)
- EnA: Enables PWM signal for Motor A (Please see the "Arduino Sketch Considerations" section)
- In1: Enable Motor A
- In2: Enable Motor A
- In3: Enable Motor B
- In4: Enable Motor B
- EnB: Enables PWM signal for Motor B

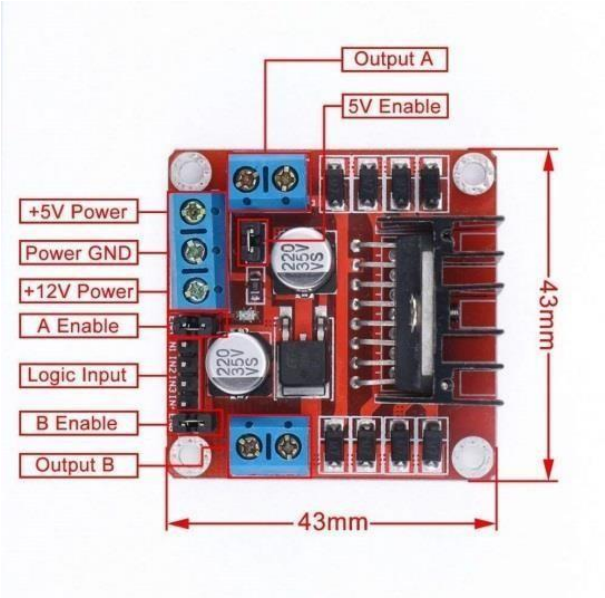


Figure 19: Pin Diagram Of L298N Motor Controller Module

4.5.3 Specifications:

- Double H bridge Drive Chip: *L298N*
- Logical voltage: *5V Drive voltage: 5V-35V*
- Logical current: *0-36mA Drive current: 2A (MAX single bridge)*
- Max power: *25W*
- Dimensions: *43 x 43 x 26mm*
- Weight: *26g*

Chapter Five

5.1 Project Planning:

This proposed Anti-Collision System (ACS) will have the significant impact on the railway safety. This Anti-Collision System (ACS) is made by ultrasonic sensor with microcontroller depended embedded system which can work on emergency air brake to control a high speedy train. Ultrasonic sound is used to measure the distance using sensor. When it detects any obstacle in front of the train then it runs the alarm with a red signal. If the system is in automatic mode then it activates the automatic brake otherwise it works according to Loco pilot's decision. If there is no obstacle found then it shows the green clearance signal. A flowchart of our proposed anti-collision system is shown in Fig-1

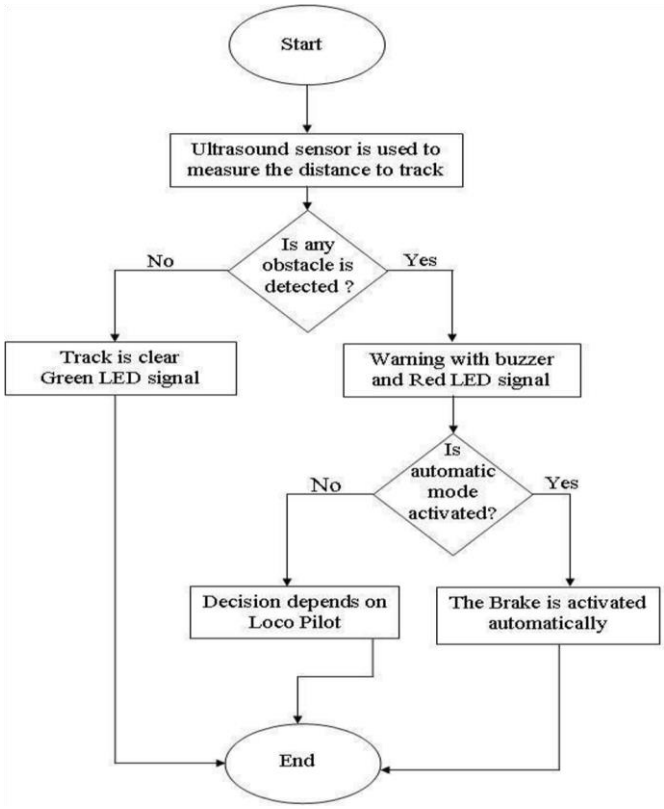


Figure 20: Flowchart Of Project

This flowchart (Fig-1) represents our proposed anti-collision system (ACS) working processes. There is an Ultrasound device which always check obstacle in front of the train and measured distance from sensor end to track. If there is no obstacle then it will show green signal and display track clearance message. If obstacle is detected then it will warning with buzzer and red signal and display obstacle distance from the train. In this Anti-Collision Device (ACD) there is a switch to select automatic or manual mode. If an automatic mode is activate then the emergency brake active automatically and control the train. On the other hand, if the manual

mode is active then it will detect an obstacle and warn to responsible loco pilot to activate the brake for control the train manually.

5.2 Project Demo Model :

This experiment comprehends that, it is one of the efficient and dynamic systems for collision object detection and anti- collision system. This technology is based on ultrasonic sound, IR sensor and an embedded system. It has been implemented both in hardware and software module which is capable of preventing any collision between objects and the train when it is in automatic mode at a specific distance. In this experiment we have used a track and an engine of a toy train where we have included our system. After placing the train on the track, it moves freely in absence of any barrier on the track. Next, a barrier is placed on the track. Since the train detects the obstacle using our system, it gradually slows down the speed by initiating the air brake and finally stops before the collision takes place. Green and red LED signals indicate presence of no obstacle or obstacle respectively**.** Our experiment is shown in figure below,

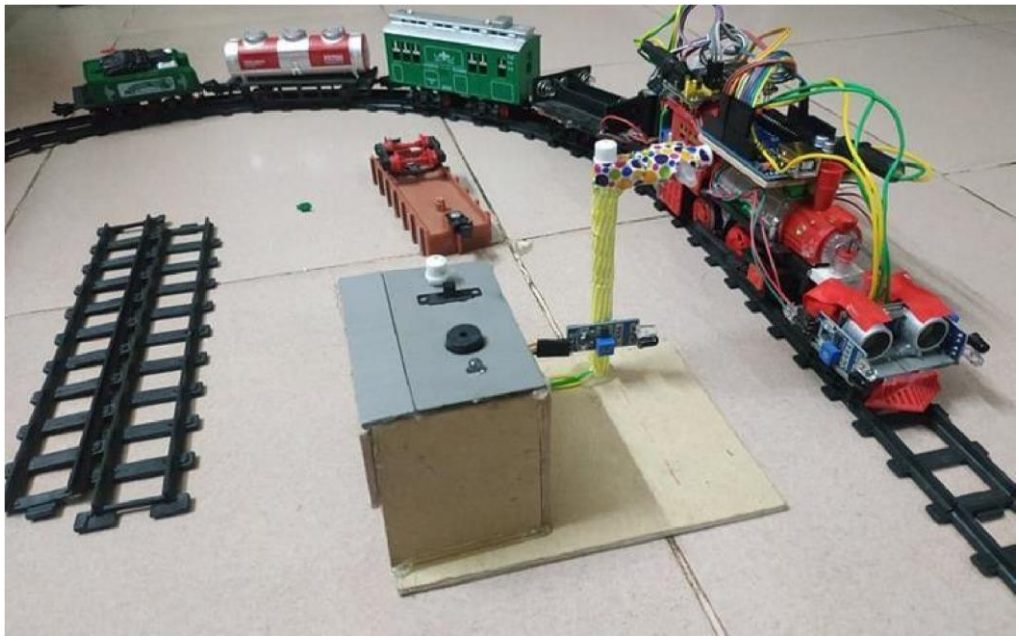


Figure 21: Demo Model Of The Project

The demo train velocity is 20cm per second. Object detect from 30cm distance and it will stop before 10cm ago.

The real train velocity is 70-80 km per hour. Object detect from 1km distance and it will be stopping before the object.

Fig-22: Experimental. No barrier is on the track.

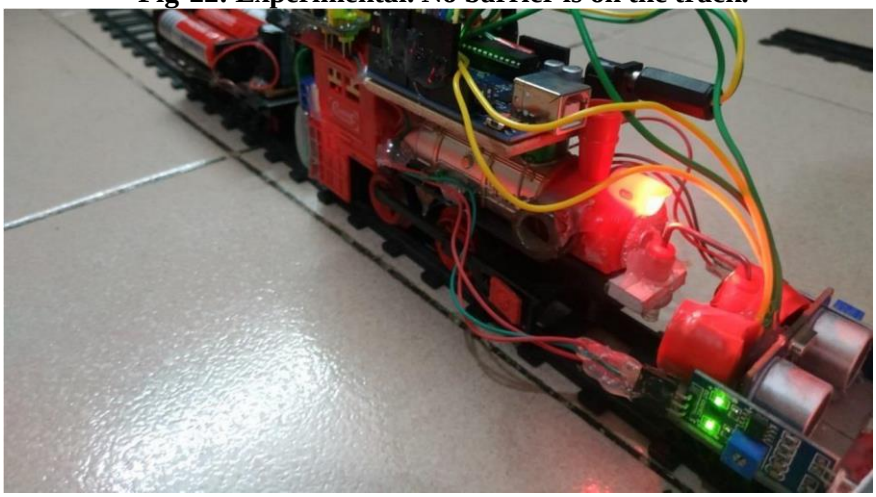


Fig-23: Experimental. A barrier is placed on the track.

In Fig-22 there is no obstacle on the track, therefore the train moves freely. On the other hand, in Fig-23 the train stops after observing an obstacle on the track.

In this project we use three main sensor i.e. one ultrasonic sensor and two IR sensor whose figure is below:

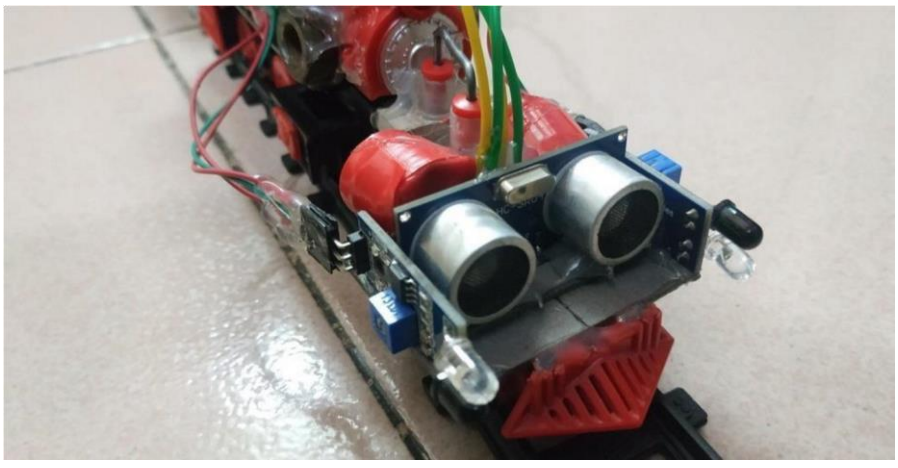


Figure 24 : Three Main Sensor

There are two type of light indicator, one is green and another is red. Green light is on when

no obstacle is found . And red light is on when obstacle is detected.

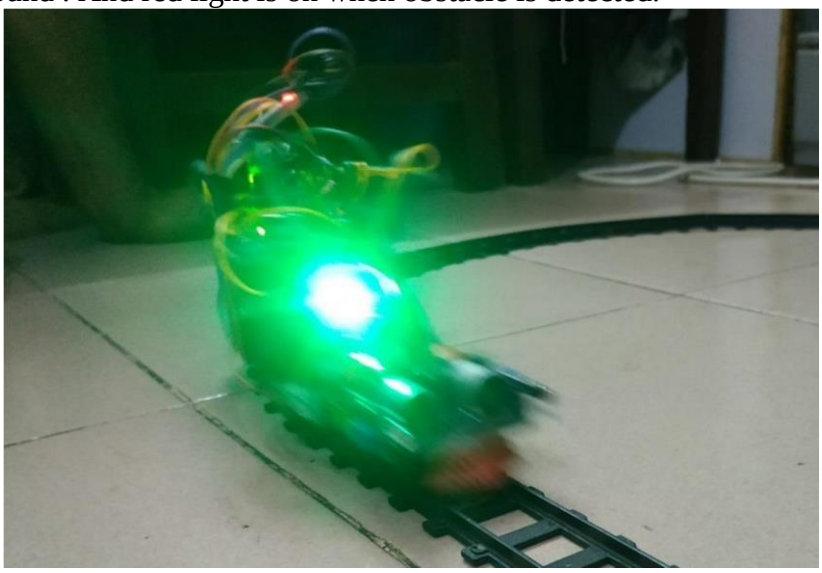


Figure 25 : Green Light Indicator

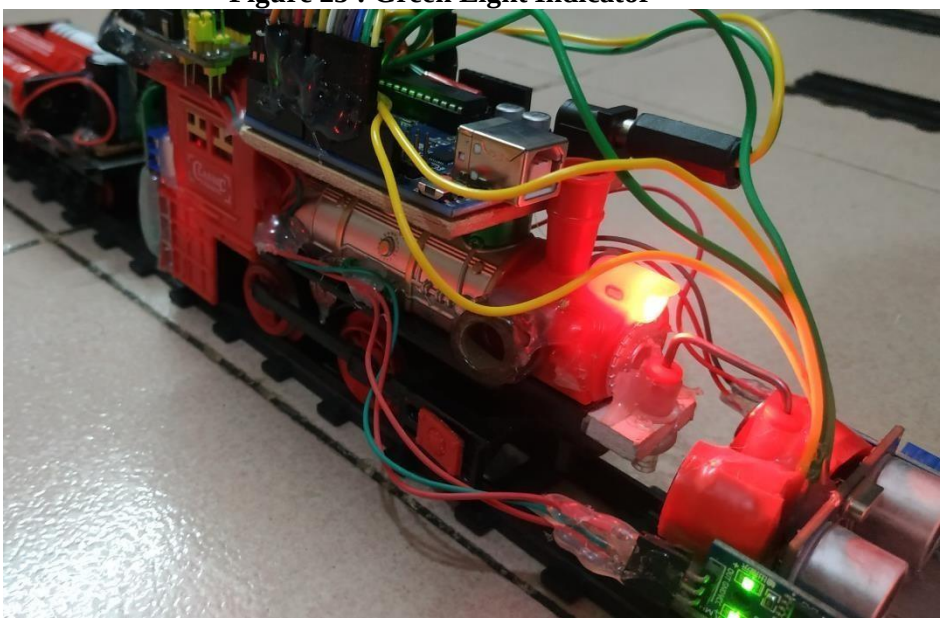


Figure 25 : Red Light Indicator

For power supply we are build a powerful battery back with three Ultra Fire battery which give us 3.7V each. We are connected as series connection.

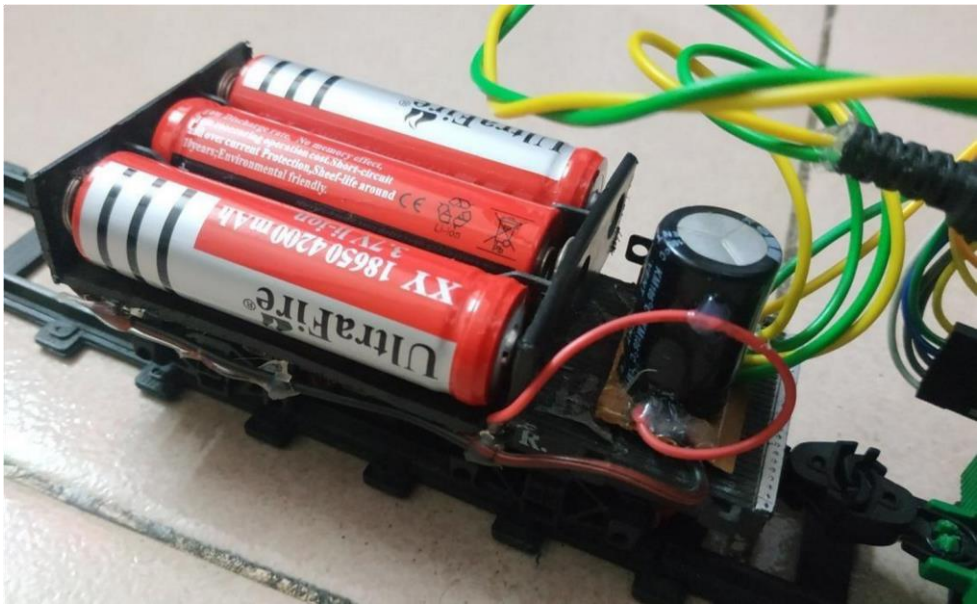


Figure 26 : Battery casing

We are developed our traditional rail signal system which are manual and fully wireless signal system. In manual system we attach a IR sensor with the signal pillar. So that when a train break the signal our system will automatically inform in control room by giving a beep sound and light indicator .

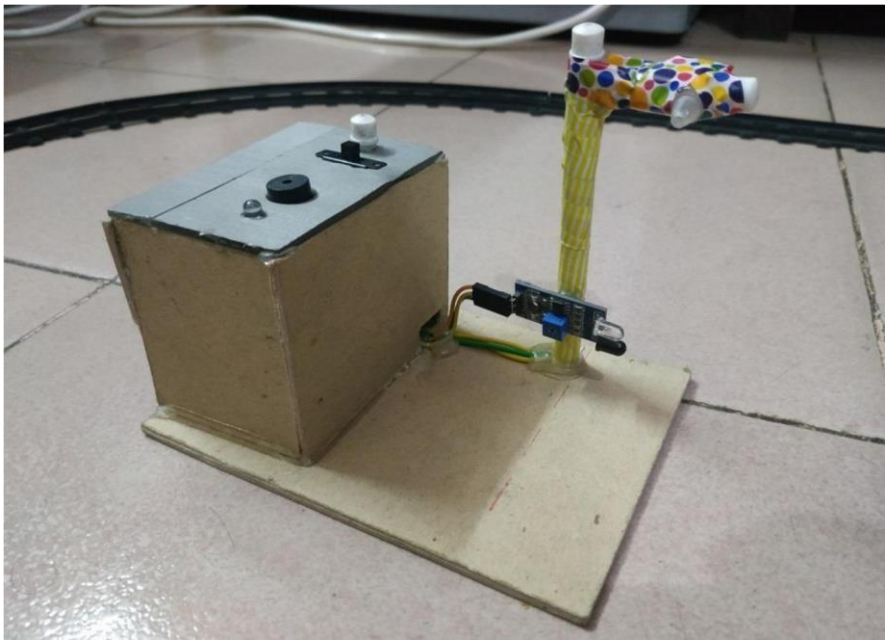


Figure 27 : Automated Traditional Signal System

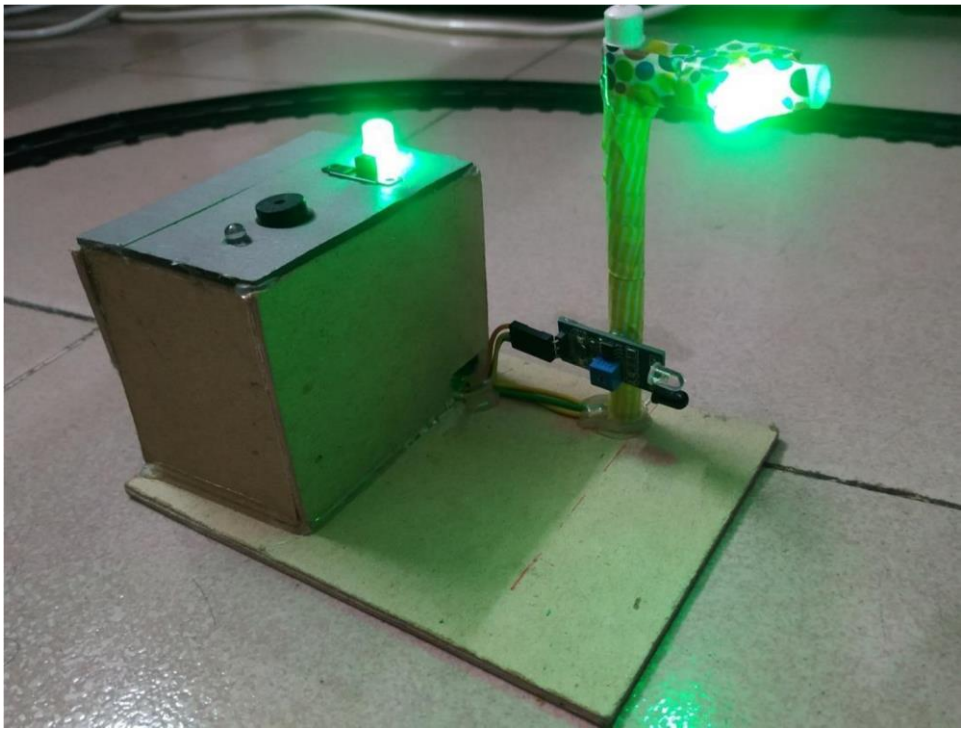


Figure 28 : Automated Traditional Signal System (Giving Green Signal)

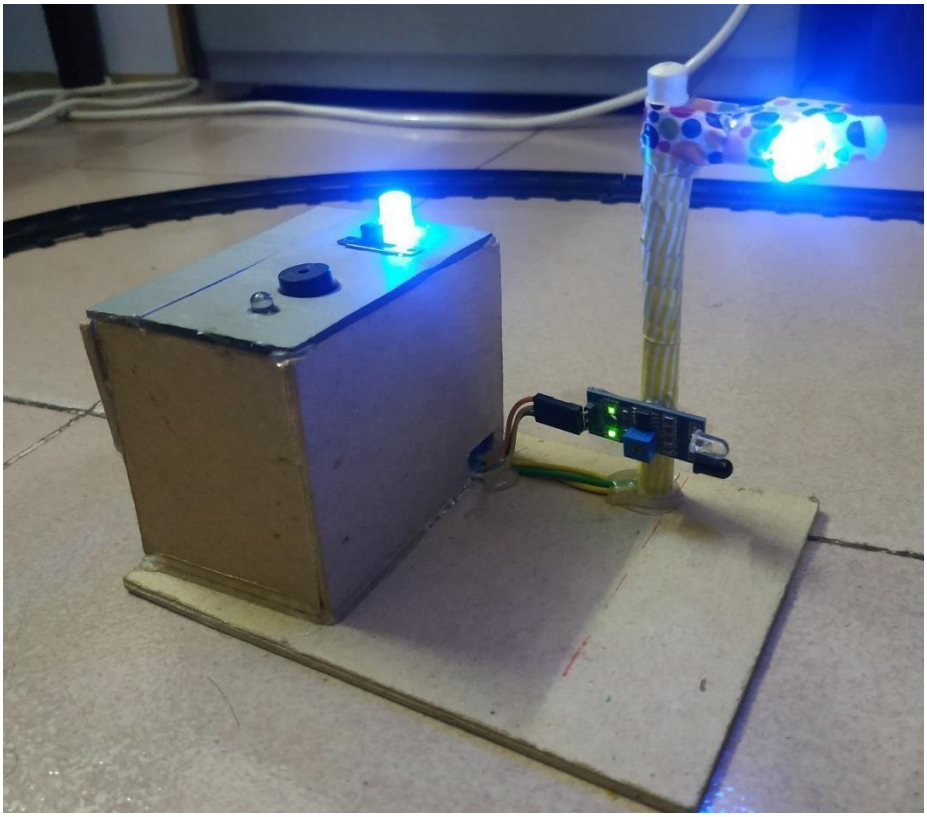


Figure 28 : Automated Traditional Signal System (Giving Blue Signal)

For Fully wireless signal system we set pair of Bluetooth devise. One the control room and another is in the train. Both device are securely connected with each other by IP address.

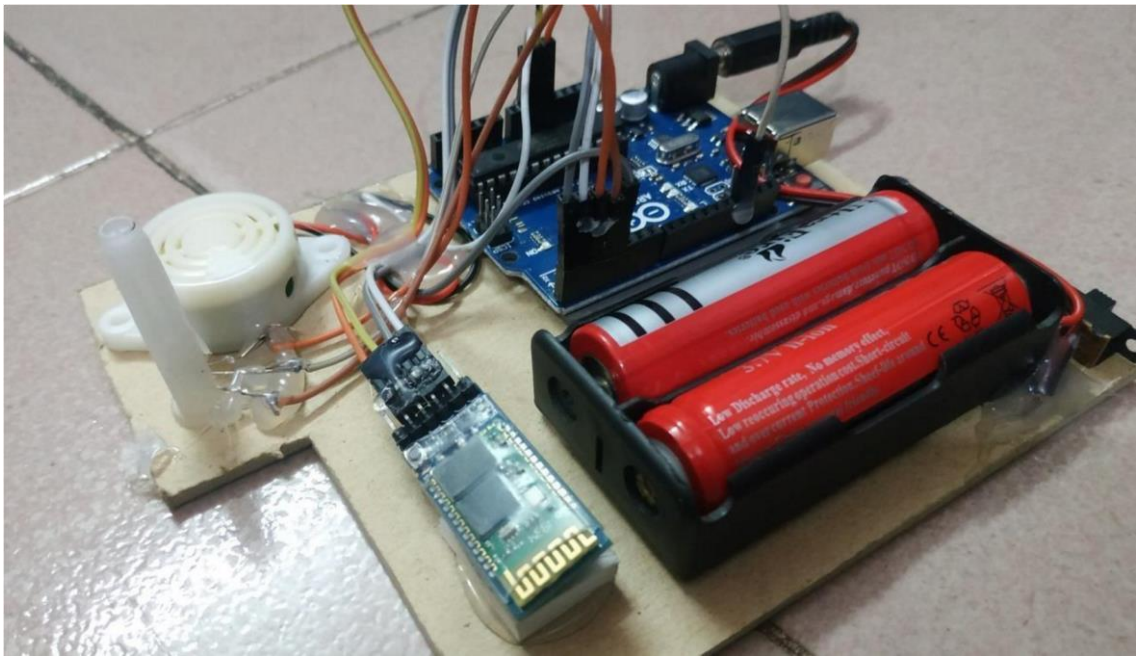


Figure 28 : Wireless Signal System

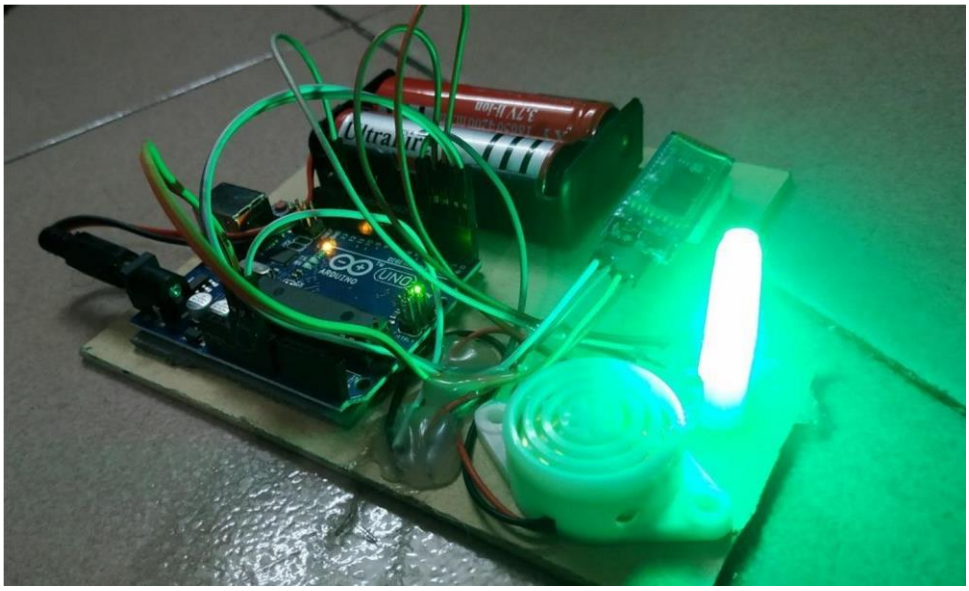


Figure 29 : Wireless Signal System (Giving Green Signal)

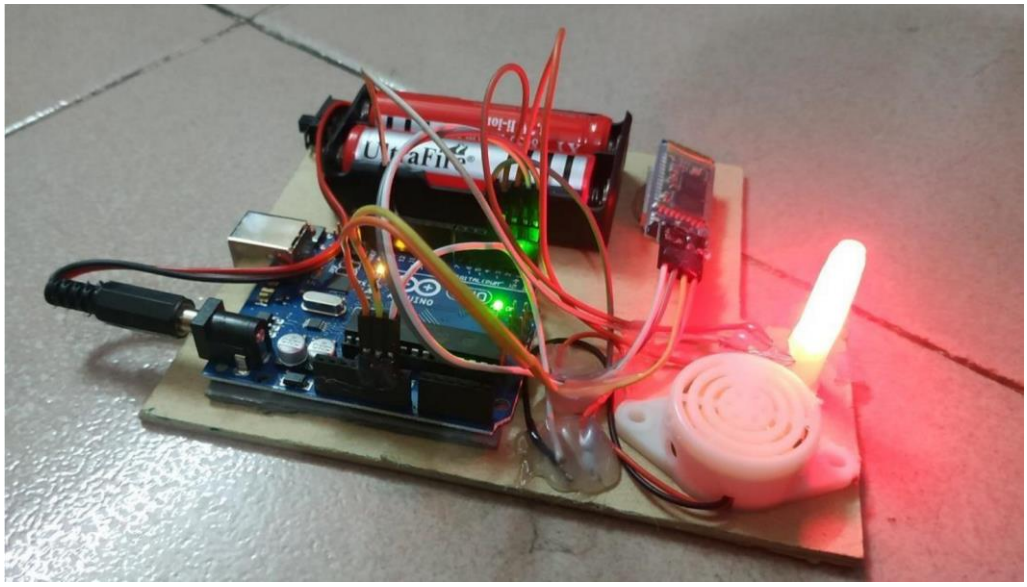


Figure 30 : Wireless Signal System (Giving Red Signal)

Figure below can describe you who we attested all our project component .

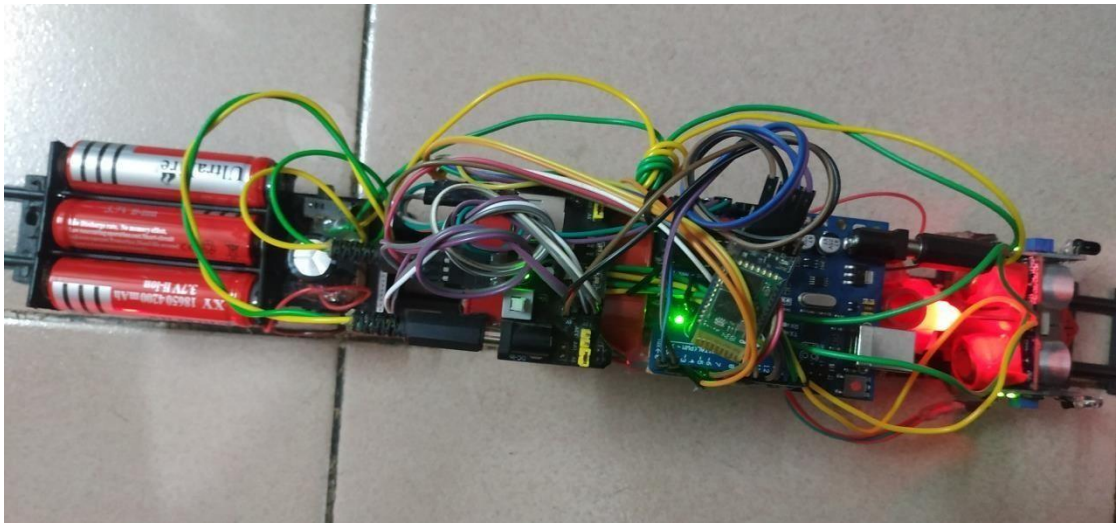


Figure 31 : Top view of the project

CHAPTER SIX

Conclusion:

In this paper, we have designed and implemented an innovative technology for collision objects detection and avoiding technique that can prevent any kind of collision with train efficiently. We are confident that incorporating our Anti Collision System with Railway system, it is possible to improve the safety of Railway.

Comparative analysis suggests that during the study period, railway were the most hazardous than any other mode. The average accident rate during the study period was found to be 11.5 accidents per 100 km railway route. Accident fatalities and injuries were higher in rail accidents than any other mode. So, rail was found to be the most dangerous mode of transportation in terms of accident fatalities and injuries. The average accident casualty rate during the study period was found to be 4 casualties per 100 km railway route.

CHAPTER SEVEN

Future Recommendation

Based on the findings from rail accident analysis, the following recommendations may be made for the improvement of railway safety:

(i) Derailments are the predominant type railway accident in Bangladesh. Track maintenance at adequate standard is a fundamental requirement of permanent way to avoid derailments and provide acceptable riding quality for traffic being carried. Bangladesh Railway needs to make adequate arrangement for mechanical maintenance to ensure safety and adequate riding quality.

(ii) Existing tracks (e.g. main, loop, branch, yard lines) should be improved and fitness evaluation should be done as per standard limits. Automated track condition measurement technology like UGMS, AGENT, GRMS can be used for precise and swift evaluation.

(iii) Concrete sleepers should be used instead of wooden and steel sleepers for newly laid track. Construction of meter guage (MG) track may be discouraged and existing MG track can be converted to broad guage (BG) track gradually because of its higher stability which makes it less proneness to accidents.

(iv) Anti-theft fittings and fastenings should be used. Computer based interlocking system can be used to prevent points movement under train.

(v) Inspection and adjustment of various defects in wheel, brake, suspension system and body of a vehicle should be done regularly and appropriately. Age-old and 207 defective locomotives, coaches, wagons and rolling stocks should be cancelled or restricted in use.

(vi) To avoid collisions at level crossings, proper signs, signals and markings should be ensured at level crossings. Accidents due to collision among vehicles can be reduced by avoiding human errors. Trained and skilled manpower should be appointed. Anticollision devices should be set-up. Proper lighting facility should be ensured. Provision should be kept for controlling speed in specific vulnerable areas.

(vii) There should be co-ordination among railway, road and local authorities to ensure safety at the interfaces (i.e. level crossings). Grade-separation at level crossings should be imposed where feasible.

(viii) People should be discouraged to walk over rail tracks during a train signal. Moreover cell-phone use at that time should be avoided. Rail tracks should not beallowed to be used by vendors, hawkers and others for various purposes. Laws should be imposed and implemented effectively to avoid these dangerous activities.

(ix) To prevent signal disregard or over-shooting type accidents, the automatic warning devices should be introduced.

(x) Bangladesh Railway should carry out intensive social awareness on a regular basis, to educate general people and make them aware of the provisions of Motor Vehicles Act and Railway Act through mass media

(xi) GPS based vehicle tracking system should be introduced to control all train movements.

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Appendix

```
int ir1R  = A0; int
ir2L  = A1; int en1
= 3; int echo  = 5;
int trig  = 6; int m1
= 7; int m2    = 8;
int red   = 9; int
green = 10; int blue
= 11 ; int horn  =
13; long    duration ;
float   distance ; int
IRR, IRL ;  int
Speed= 225 ;

void setup() { pinMode(ir1R,INPUT);
pinMode(ir2L,INPUT);  pinMode(echo,INPUT);

pinMode(en1,OUTPUT); pinMode(trig,OUTPUT);
pinMode(m1,OUTPUT); pinMode(m2,OUTPUT);
pinMode(red,OUTPUT);
pinMode(green,OUTPUT);
pinMode(blue,OUTPUT);
pinMode(horn,OUTPUT);

Serial.begin(9600);

delay(100);

digitalWrite (horn,HIGH);
delay(2000); digitalWrite(horn,
LOW); delay(50); }
```

```
void loop() {

  digitalWrite ( trig,LOW);
delayMicroseconds(2);   digitalWrite
(trig,HIGH);   delayMicroseconds (10);
digitalWrite (trig,LOW);   duration =
pulseIn(echo,HIGH);    distance =
duration*.034/2 ;

  IRR = analogRead(ir1R);
  IRL = analogRead (ir2L);

  if (distance <25){

  digitalWrite (m1, LOW);   digitalWrite
(m2, LOW);   digitalWrite (green ,
LOW);   digitalWrite (red ,
HIGH);   digitalWrite (blue , LOW);
  Serial.write('1');
     }

 if(IRR < 350){

  digitalWrite (m1, LOW);   digitalWrite
(m2, LOW);   digitalWrite (green ,
LOW);   digitalWrite (red ,
HIGH);   digitalWrite (blue , LOW);
  Serial.write('1');
  }

 if(IRL < 348){

  digitalWrite (m1, LOW);   digitalWrite
(m2, LOW);   digitalWrite (green ,
LOW);   digitalWrite (red ,
HIGH);   digitalWrite (blue , LOW);
  Serial.write('1');
  }else {

  digitalWrite (green , HIGH);
digitalWrite (red , LOW);   digitalWrite
(blue , LOW);   digitalWrite (m1,
HIGH);   digitalWrite (m2, LOW);
analogWrite
(en1,Speed);
  Serial.write('0');
  }}
```