Palestine Polytechnic University

Collage of IT and computer Engineering

Hebron, Palestine

AUTO METRO TRAIN

Team member:

Aseel AL-Makhammrah

Besan AL-Talahmah

Supervisor:

Dr. Amal Dweik

December 2019

Acknowledgment

First and foremost, we would like to thank God Almighty for giving us the ability and opportunity to undertake this project.

Our heartiest thanks are due to our parents for their love and kind support which helped us in the project. We know the thanks are not enough and there are not enough words to describe how thankful we are to them.

We take this opportunity to express our regards and sincere thanks to our supervisor Dr. Amal Dweik for her constant encouragement.

We would like to thank Eng. Wa’el Altakrori for his response and cooperation. Also, we would like to express gratitude to our families, friends and classmates for the unceasing encouragement, support and attention.

Abstract

Nowadays, modern technologies are helpful in all aspects of our life. Due to this, lots of development is done in the field of transportation. In previous years, with the use of regular trains, accidents occur due to various reasons, like human error, a signal errors and some other major problems. Human-operated metro trains have no control over time, which leads to missing the train schedule and affects the railway network management system.

To solve this problem, we have built a prototype for a driverless metro train. Driverless metro train improves the management system of the railway network, reduces human errors, consumes less power and it provides comfort and safety to passengers during their travels.

Index

List Of Table

List Of Figure

Chapter one

Introduction

1.1 Overview

In recent days' transportation using metro vehicles, helps in connecting cities with each other, and also serves as a fast way for people to travel, it's also the cheapest and the safest way when using public transportation.

A train without a driver allows a safer and better performance, it uses a control panel to control the train movement. The train travels between stations without any human interaction. The main idea behind a system like this is to make train traveling more efficient and accident free.

1.2 Description

This project was designed as a prototype of an automatic train which is used in most advanced countries. This train is provided with a control panel that allows it to automatic run between stations without human interaction. This driverless metro train tries to avoid any human errors.

This train stops automatically when it reaches the station, with the help of an infra-red sensor. Then, the train doors open automatically, so passengers can ride the train. With a predefined time, the doors are closed when the time is over.

The train doors are closed if the trains maximum capacity is reached, since the system is also fitted with a passenger counting unit, which counts the passengers entering and exiting the train. The number of passengers on the train is shown on the screen, and when the number reaches its limit, a message is shown on the screen saying that the train reached its maximum occupancy. When this message is shown on the screen, the doors are closed automatically even if the predefined time is not over.

The movement of the train is controlled by a microcontroller. The train is provided with a warning buzzer which warns passengers before closing the doors and before the train leaves the station.

In order to increase the systems safety, the doors will not close until no one is in the way, otherwise, a continuous warning sound will be used. In order to open and close doors correctly, sensors are attached to both ends inside of the shuttle.

1.3 Problem statement

Most of train accidents occur due to human errors, it is one of the most dangerous problems that threatens human lives all over the world, and not only to human lives, but also the train surroundings.

Some of the causes of these accidents are due to the inability of the drivers to control the train moments before the accident, the mistakes of the other driver, or to the overweight on the train, and other environmental causes that may affect the train movement. By observing all these points, such problems could be avoided by using an automated train with the right system implemented.

So, we decided to develop a self-operated train that tries to eliminate these problems in the system and reduces accidents.

1.3.1 Purpose and Motivation

Engineering is an idea created by a person to solve human problems in all aspects of life[1], regardless of the any developments in science, but the increasing number of people is in line with the increasing number of disasters. Our project aims to reduce one of these disasters.

[1]https://www.researchgate.net/publication/250284859_Idea_Engineering_Teaching_Students_how_to_Generate_Ideas?fbclid=IwAR3S8cJ5LnGkydDa6D-V004NUY87akbczzDD8FJ-IEKZkBOfbzKWuDGVAUc

Looking at the history of the disasters associated with the trains, the most prominent of which is the disaster that occurred in Egypt in recent times.

After looking into the cause of the accident, it was discovered that the main cause of the accident was human error.[2] So with the project we are proposing, we aim to achieve 2 goals, which are providing safety and comfort for people using the train. The first goal would be achieved by adding a self-driving functionality to the train, and with the help of IR sensors, the train would be able to detect any obstacles or dangers facing the train. We would achieve the second goal along with the first goal by limiting the number of passengers allowed to board the train at any given time, thus creating a safe and comfortable environment for the passengers.

1.3.2 Aims and Objective

The project aims to develop an automated train. To achieve these goals:

1-The system should be able to manage the movement of the train at all stop stations ,To achieve this:

- a- It has the capability of detection of all stop stations.
- b- Has the ability to decide whether it is in full capacity or not.

2- The management of stopping and movement of train, to achieve this ,it should has the :

- a- Ability to know the total number of passengers on the train at all times.
- b- Ability to open and close for an appropriate amount of time to allow passengers to enter and exit the train at each station.
- c- If the number of passengers exceeds the max limit, the train will not be able to move from the station, and will require some passengers to step off the train.

3- The Avoidance of obstacles. To achieve this:

- a- The train will stop if there is any object on the train track.

[2]https://www.tandfonline.com/doi/abs/10.1080/19439962.2019.1697774?journalCode=utss20&fbclid=IwAR1gDnbDm_AePIzIJxWKXBJkqtYIRx3_2Hd9Gk5-rp0qm6QcnhDBLiQT1hc&

1.3.3 System description

Our proposed system uses automation to take any human errors out of the equation, and also to reduce the number of people occupying the train at any given time, to help make the train ride safer and more pleasant for the people using the train.

The proposed system will use Arduino mega with a power source being a battery, and three infrared sensors are connected to the console, two of which are used to show the two terminals, and two others are used to control the train door.

The buzzer is used to warn the passengers, which is connected to Arduino, a group of LCD are connected to display the number of passengers on the train. The number on the LCD is calculated by counting the passengers that have gone in using the in-door, and the passengers that left the train using the out-door.

When the metro train reaches the station, it automatically stopes, then the doors will open, so a passenger can enter the train, the door is then closed after a pre-defined time.

1.4 List of Requirements

Some of the requirements for our project are:

a- It should be able to distinguish between animals and humans that enter on the train.
b- It should be able to count passengers.
c- It should be able to recognize the stop stations.
d- It should able to open and close doors on time.
e- It should be able to avoid obstacles.
f- It should be able to prevent exceeding the number of passengers on train.

1.5 Overview of the report

The outline of the report is as follows:

Next chapter “background”, contains the theoretical background and Literature review, Design options (hardware components and software component).

Third chapter “Design”, includes a detailed conceptual description of the system (HW and SW), detailed design, schematic diagrams, block diagrams, structural diagrams, and any necessary information about the design.

Fourth chapter “System Implementation and Validation”, includes a description of the implementation, implementation issues, implementation challenges and description of the method used to validate the system, validation results.

Fifth chapter “System Analysis and Discussion”, includes analysis and discussion about the results.

Sixth chapter “Conclusion”, includes summary, challenges, future directions, recommendations, and future work.

1.8. Constraints

This project is subject to the following restrictions:

- The project will not take into account the existence of intersections on the right track
- It is not allowed to enter more than one passenger at a time on the train.
- A person is considered a passenger if the length of passengers is 90 cm or more

Chapter two

Theoretical Background

2.1 Overview

This chapter introduces a theoretical background of the project, some description of the hardware and software components used in the system and it also discusses specification and design constraints.

2.2 Theoretical background

Many Self-operated machines are used in several areas. We read about it in newspapers almost every day, our project focuses on using these auto trains to solve the problems that rise from human failure.

Using an infrared sensor, the train recognizes the upcoming train station, when the sensors readings are from 1 to 5 millimeters from the white surface, a buzzing sound is omitted from the buzzer to alert passengers, and the system prepares to stop at the station.

After opening the doors to allow passengers to get on and off the train, the infrared sensors would count the people coming into the train through the in-door, and it would also count the people leaving the train with the sensor on the out-door. The number of passengers on the train is calculated by subtracting the number of people the left the train from the total number of people on the train, and the readings from the in-door sensor would be added to the passenger’s counter. The number of passengers is shown on a seven segment panel, and the doors would close when the time interval is up. The alarm would go off if the number of passengers exceeds the maximum number allowed, or if the doors were unable to close for any reason.

In addition, sensors are added at a suitable height on the doors so that the system would only count the people boarding the train and the animals or any other small objects that may interfere with the total number of passengers making the readings inaccurate.

2.3 Literature review

The idea of the project came from the need to reduce incidents that harms human life and nature in general. There is a project that is similar to ours, The Auto metro train shuttle between terminals. The AUTO METRO TRAIN shuttle between the stations allows you to get a smart train in this project. The train is programmed for a specific route. Each station is defined on the track and also determines the timing of the train stop and the distance between the two stations in advance.

This proposed system is an independent train and eliminates the need of any driver. Consequently, any human error is excluded.

In this project, the PIC microcontroller was used as the CPU. Whenever the train reaches the station, it stops automatically, according to the IR sensor. Then the door opens automatically so passengers can go into the train. The door is closed after a specified time in the controller by the program. Our project differs from the previous project by:

1. Regardless of the time specified for the doors to remain open, the passenger number appears on a seven-unit display on the selected controller.

2. The train will not be able to stop at the station when the number of passengers is the maximum so that passengers on the train would like to leave.

3 - Using the reading sensor to read the RIFD inside the train and in the door to determine the number of unit number of passengers, the distinction between human and other objects, and not the use of infrared sensors to count the passengers

2.4 Design options

Design options based on requirements analysis:

Table 2.1: H.W Requirement Analysis

Compare HW	**AT89S52 microcontroller** 	**Arduino Mega** 	**PIC** 	**We chose an Arduino mega because it is available at a lower price, it also has the required processing power in comparison with the PIC, and the speed of the implementation of the CLOCK is less, which is equivalent to 12Mbps. These specifications are considered a priority in our requirements.**
Requirements	**Options**			
1. Lower cost.	✓	✓	✓	
2.Power consumption.	✓	✓	✗	
3. Suitable size.	✓	✓	✓	
4. Number of pins is sufficient.	✓**[40 pins]**	✓	✓	
5. Relatively easier in programming.	✗	✓	✗	
6.CLOCK SPEED	✓	✓	✗	

Table 2.2 Features

Features	Ultrasonic sensor 	Infrared sensor 
Detection range	**• Suitable to detect objects which are less than 1 meter away. • Capable to place objects within 5 mm more accurately. • The object detection depends on shape, size and orientation.**	**• More appropriate for targets which are closer than 10 mm**
Ability to measure distance to soft objects	**• Not easily detected**	**• Easily detected**
Interference from light sources (e.g. sunlight, fluorescent tubes etc.)	**• Unaffected**	**• affected**
Frequency range	**• Operate from 20 kHz up to several GHz.**	**• 430 THz down to 300 GHz**
Wavelength range	**• Ultrasonic waves use wavelengths of about 1.9 cm or less.**	**• 700 nm to 1 mm**

** To the solve problem of having Obstacle in front the train.

We chose the ultrasonic sensor , because it's the most popular and is commonly used with microcontroller, Infrared sensors can't work in dark environments while Ultrasonic Sensors can, ultrasonic sensors are more reliable than IR sensors.

** To solve problem of detecting the station correctly ,

We chose Infrared sensor because ultrasonic. It's more difficulties in reading reflections from soft, curved, thin and small object,. While Infrared sensor can do that.

Table 2.3 S.W Requirement Analysis

Compare SW	**KEIL Software**	**Arduino IDE**	**Analysis** **We chose Arduino IDE to edit and debug the code to be uploaded on the 8051 microcontroller, since it has all the libraries and tools specialized to programmed it .**
Requirements	**OPTIONS**		
1. Open source.	✓	✓	
2. Easy to use.	✓	✓	
3. Suitable to the used Arduino mega	✗	✓	

Chapter Three

System Design

3.1 Overview

This chapter introduces a detailed description of the system, information of detailed design, schematic diagram, and block diagram.

3.2 Hardware Design

3.2.1 Arduino Mega

We will choose an ArduinoMega2560, as shown in Figure3.1, It includes a lot of digital input and output pins, 6 analog inputs, a reset button, a power jack, and a USB port. It includes everything required to hold up the microcontroller; simply attach it to a PC with the help of a USB cable and give it the supply to get started with an AC-to-DC adapter or battery.

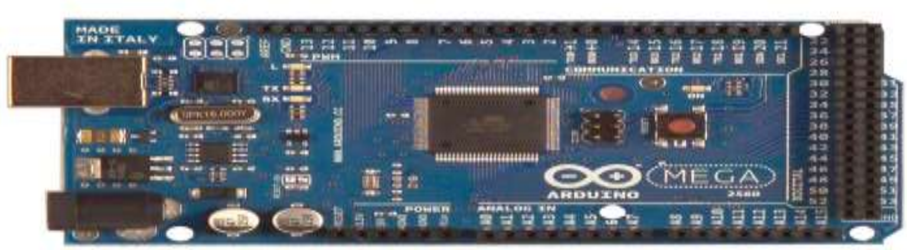

Figure 3.1: Arduino mega

3.2.2 L298N DC Motor Driver

The employed motor driver module circuit is known as L298D motor driver controller (shown in Figure 3.2) consists of 4 inputs and 4 outputs to control two DC motors. One of the main facility of L298D is to provide up to 600mA current at voltage variation from 4.5 V to 36V. The direction of rotation of a DC motor in forward and reverse can be controlled through combining different input logics. Another strong reason to choose this specific IC for movement control is the ability to control the speed of two motors using PWM from microcontroller which is required to control the robot for different modes.

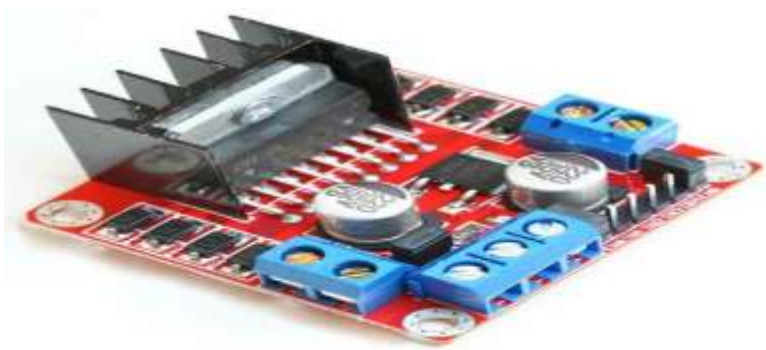

Figure 3.2 DC Motor Driver

3.2.3 LCD:

Winstar 16x2 Character LCD Display WH1602W is having two pinout interfaces on upper and bottom sides of the LCD module. This 16x2 lcd display has the outline size of 80.0 x 36.0 mm and VA size of 66.0 x 16.0 mm and the maximum thickness is 13.2 mm. WH1602W 16x2 LCD Displays are built-in controller ST7066 or equivalent. It is optional for + 5.0 V or + 3.0 V power supply. The LEDs can be driven by pin 1, pin 2, or pin 15 pin 16 or A/K. This type of module can be operating at temperatures from -20℃ to +70℃; its storage temperatures range from -30℃ to +80℃.

Figure 3.3: LCD

3.2.4 Infrared Sensor:

IR reflectance sensors contain a matched infrared transmitter and infrared receiver pair. These devices work by measuring the amount of light that is reflected into the receiver. Because the receiver also responds to ambient light, the device works best when well shielded from ambient light, and when the distance between the sensor and the reflective surface is small(less than 5mm). IR reflectance sensors are often used to detect white and black surfaces. White surfaces generally reflect well, while black surfaces reflect poorly

Figure 3.4 : Infrared sensor

3.2.5 DC Motor:

The motor used in this prototype is DC motor type. One motor out of two is used to drive train in forward direction while other is used to control the gate (open and close). External access pin EA (pin 31) is connected with Vcc because it is executed from internal program memory. As there no external memory, pins of port 0 must be connected externally to a 10K pull-up resistors as they are open drain. Reset pin must have the min. duration of 2 machine cycle. When power is turned on, the circuit holds the RST high for an amount of time that depends on the capacitor value and the rate at which it charges. To ensure a valid reset, the RST pin must be held high long enough to allow the oscillator to start up pulse two machine cycle. Thus, we had used 10uf capacitor with a resistor connected in series.

Figure 3.5: DC motor

3.2.6 Buzzer:

A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric. Typical uses of buzzers and beepers include alarm devices, timers and confirmation of user input such as a mouse click or keystroke. Buzzer is used to make sound before opening and closing the door. The buzzer will alarms three times as programmed.

Figure 3.6 Buzzer

3.2.7 Ultrasonic:

Ultrasonic sensors work on the principle of reflected sound waves and are used to measure distance, Sound waves are emitted by the ultrasonic sensor and they're reflected back if there is an object in front of it. The sensor detects these waves and measures the time it takes between transmitting and receiving those sound waves, the Distance is estimated by the time interval between sensor and object, It has higher sensing distance(in centimeters and inches) 2cm to 400cm measurement and It provides good readings in sensing large-sized objects with hard surfaces.

Figure 3.7 Ultrasonic

3.3 Software Design

Initially during the movement of the train, the ultrasonic calculates the distance, it calculates the distance between the train and any object if it is present, and if the distance between train and any obstruction is less than 20 cm then the train stops, if there is no obstruction, it takes a signal from the infrared sensor if it arrive to station , The infrared will be in the case of arrival at the station, if train arrived at the station, it will asked about the time of the train to stop at the station, if the specified time has not been completed, the process of counting passengers begins by opening the doors and displaying the number of passengers on the screen, if the time specified for the train ends in The station closes the doors and the train returns to movement if the number of passengers reach maximum the door closed and the system move .as shown in Figure 3.3.

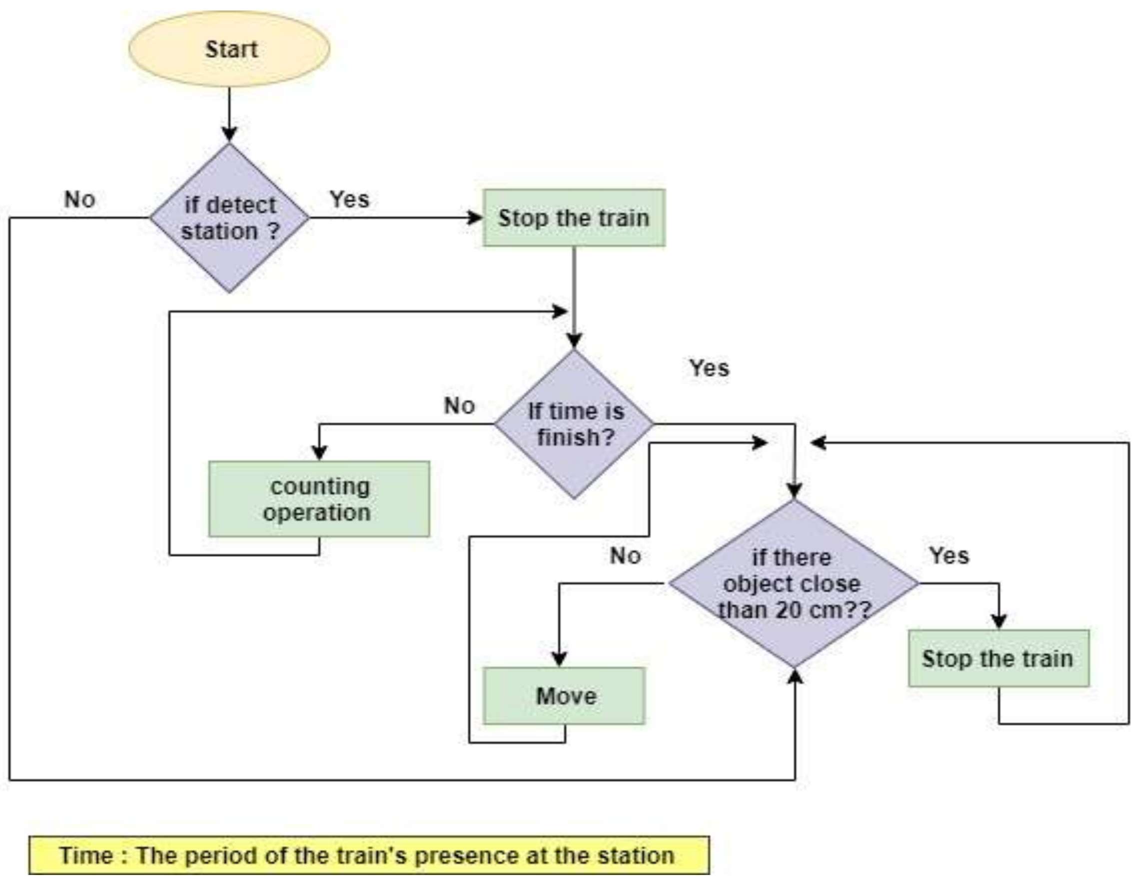

Figure 3.8: flow chart of arrive station

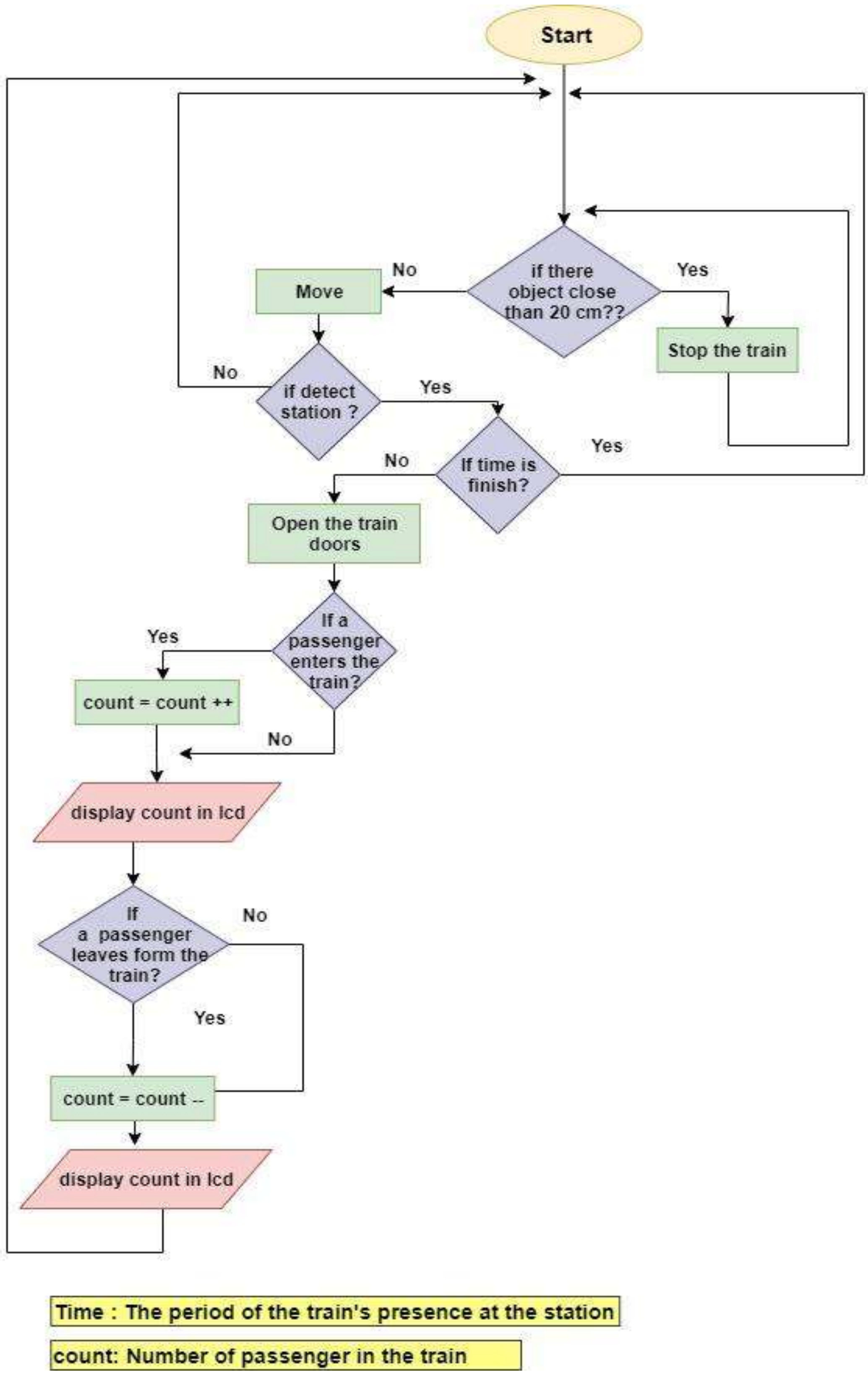

Figure 3.9: flow chart of auto metro

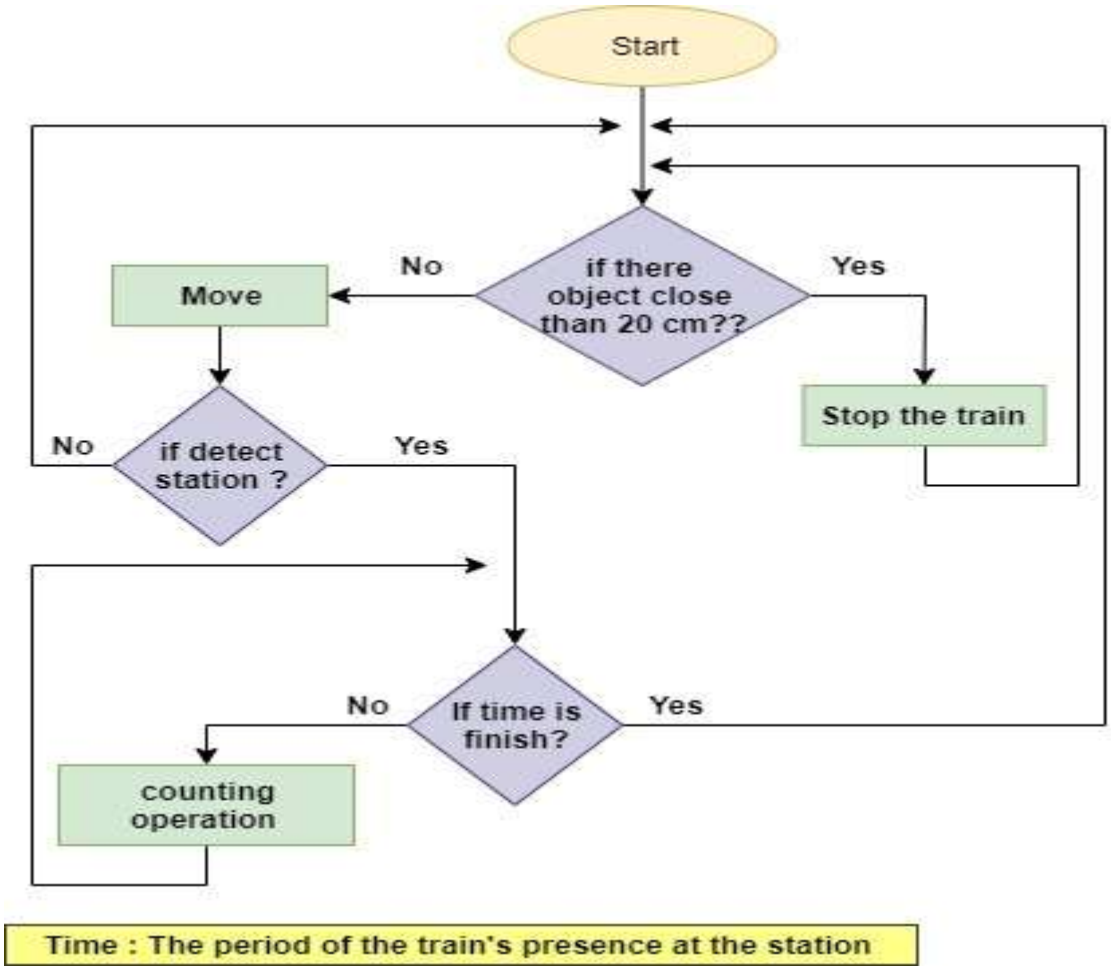

Figure 3.10: flow chart of detect obstacles

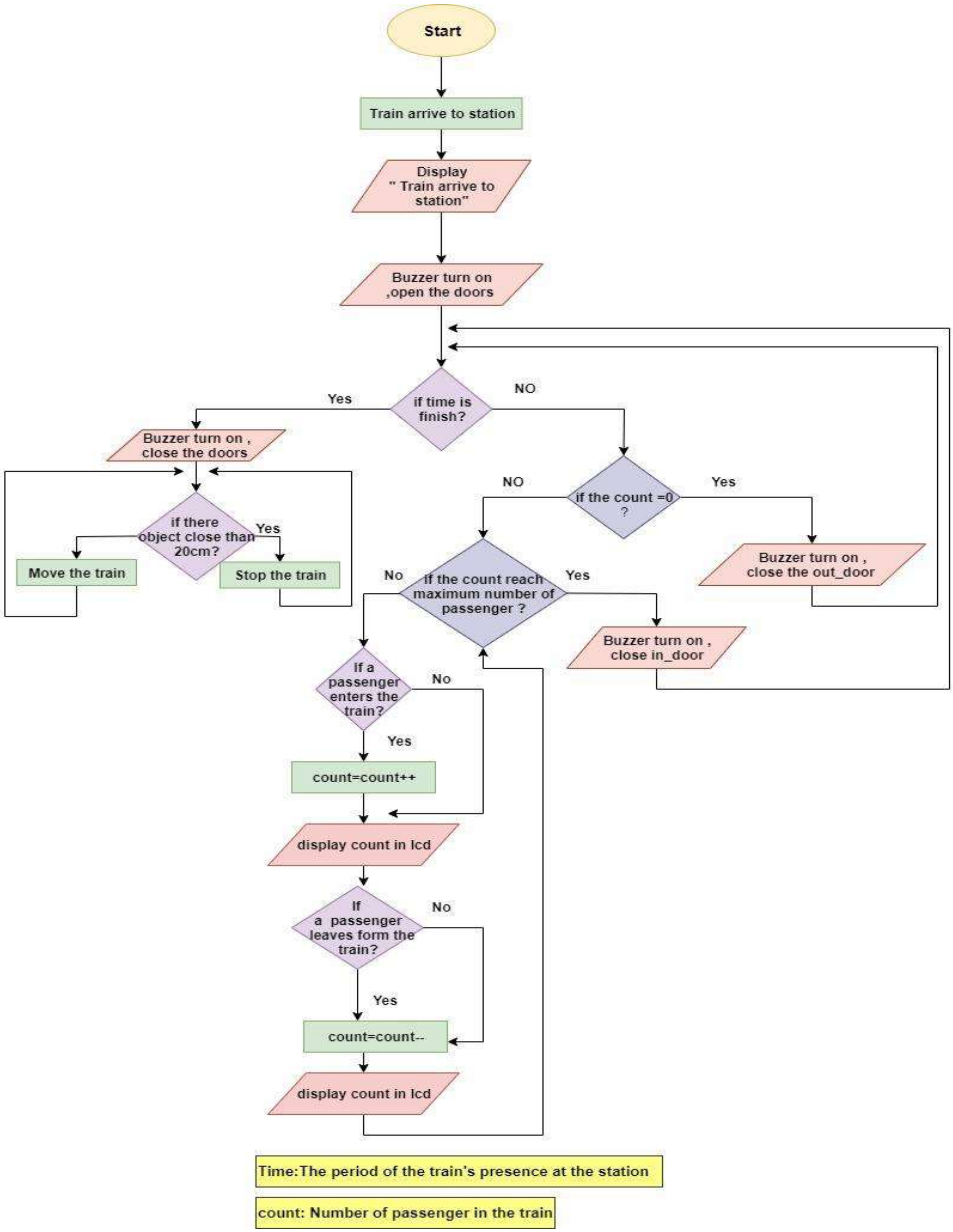

Figure 3.11: flow chart of counting passengers

3.4 Detailed system description

Figure 3.12 shows the diagram of the functional mass of the proposed system.

This system controls the motor, the ultrasonic sensor, one micro-switch, two diodes and a micro servo. Everything was connected and soldered on a circuit board. Before soldering, a circuit diagram was drawn, which is presented in figure 3.14.

When the system is turned on, the engine starts and two diodes located on the front of the train became lit simultaneously. When the ultrasonic sensor located on the front detects any obstacles, the engine responds by shutting down immediately. The micro-switch mounted on the side of the train gets activated when pressed upon arrival at the station. Commanding the engine to shut down and the door to open. After a programmed delay the door closes and the engine starts. as showing in figure 3.13

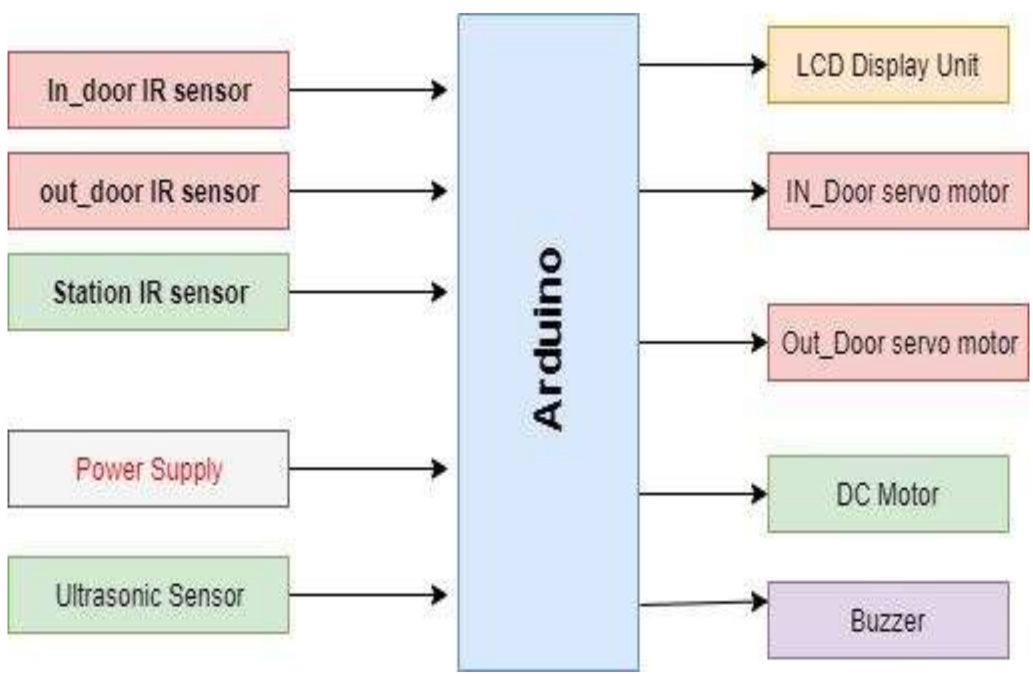

Figure 3. 12: Block diagram

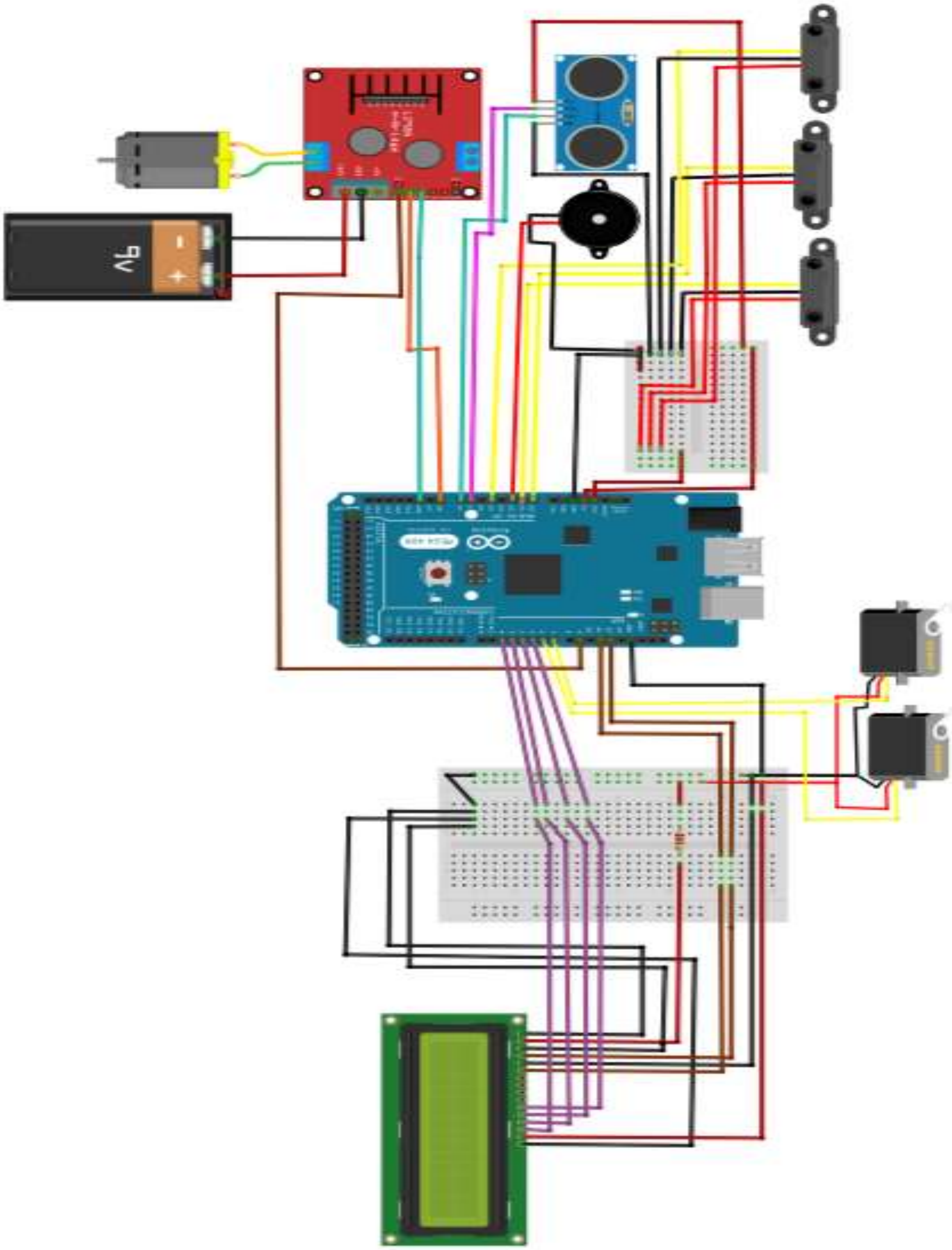

Figure 3.13: Block diagram for all system

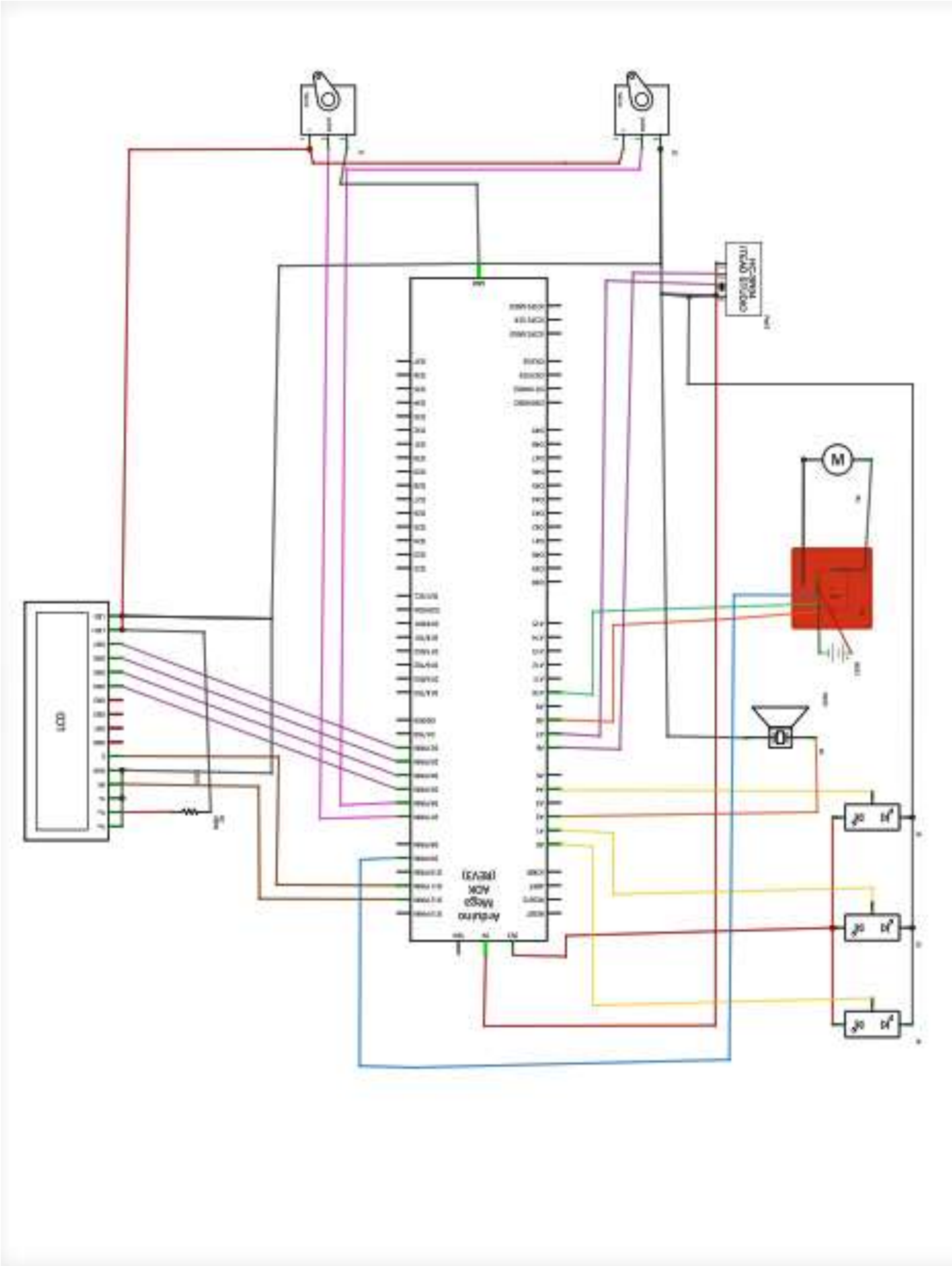

Figure 3.14: Schematic diagram for all system

3.5 Detailed and Schematic diagrams

In this section we explained the detailed and schematic diagram for all components and explain the schematic diagrams for the entire system as shown in Figures

3.5.1.Servo Motor with Infrared Sensor (IN Door):

In our project, we used Servo Motors to control the in-doors on the train. The input connects to the digital pin of (D6) on the Arduino board, and we used Infrared Sensor to count the number of passengers entering the train. The input connects to the analog pin (A1) on Arduino board as shown in the schematic diagram in Figure 3.16.

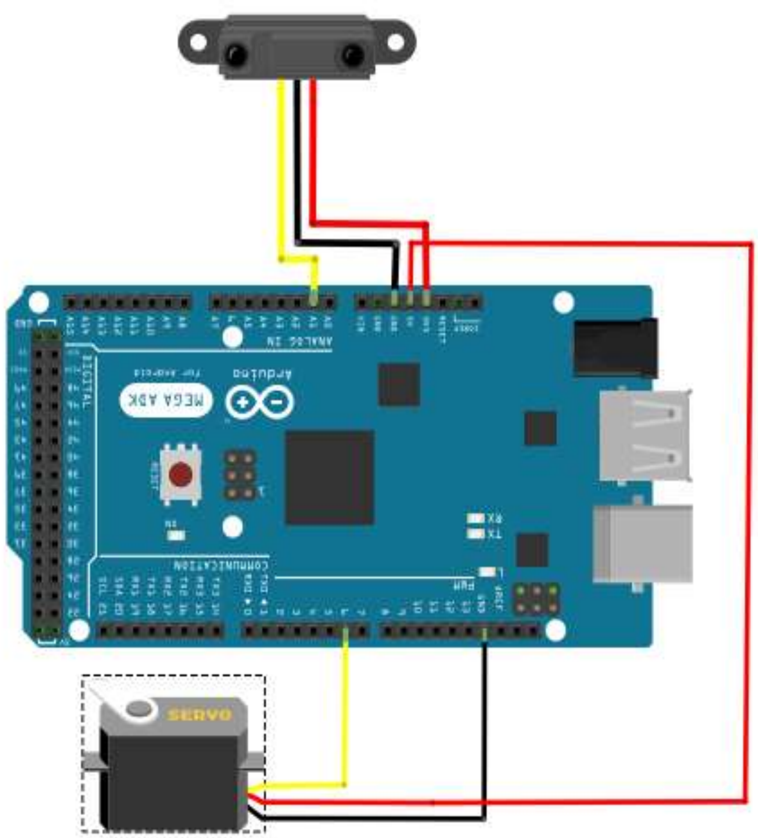

Figure 3. 15: Detailed design of Servo motor with Infrared sensor (In-door)

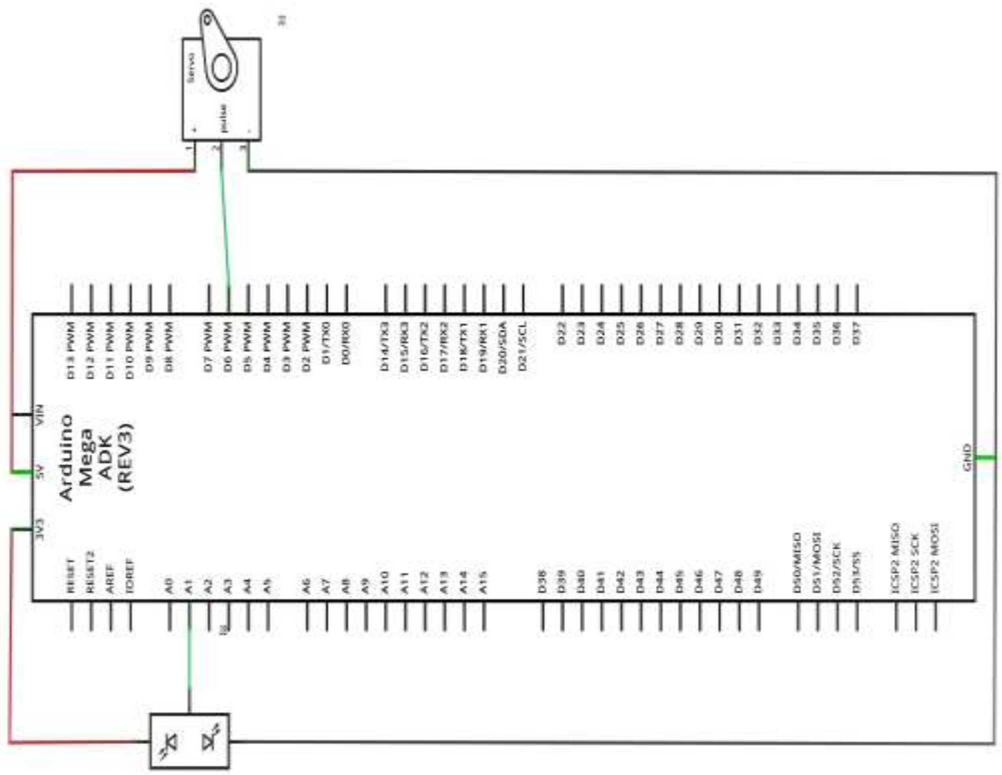

Figure 3. 16: Schematic diagram of servo motor with Infrared Sensor (in-door)

3.5.2.Servo Motor with Infrared Sensor (OUT Door):

In our project, we used Servo Motors to control exiting doors of train. The input connects to the digital pin of (D7) on the Arduino board and we will use Infrared Sensor to count the number of passengers leaving the train. The input connects to the analog pin of (A0)on the Arduino board as shown in the schematic diagram in Figure3.18.

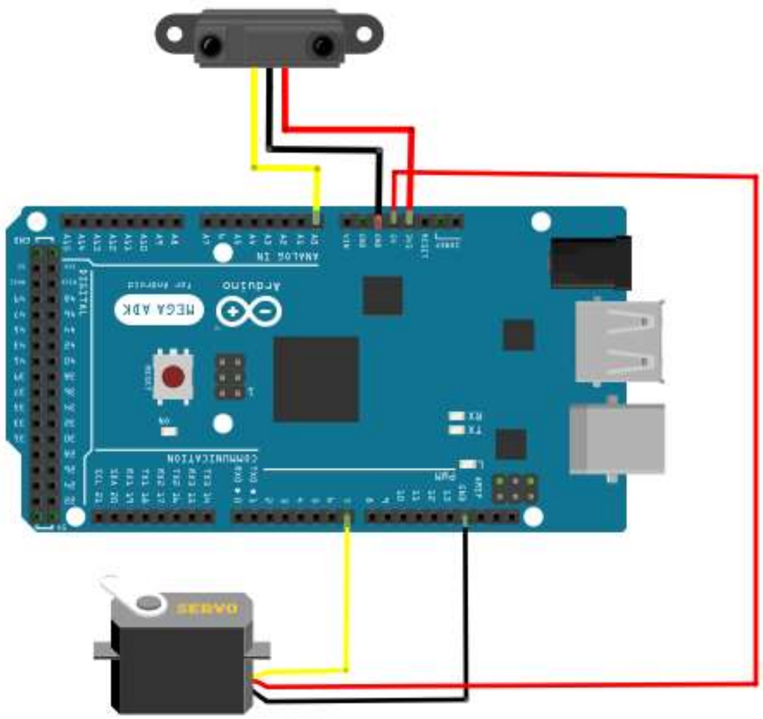

Figure 3. 17: Detailed design of Servo motor with Infrared sensor(exit door)

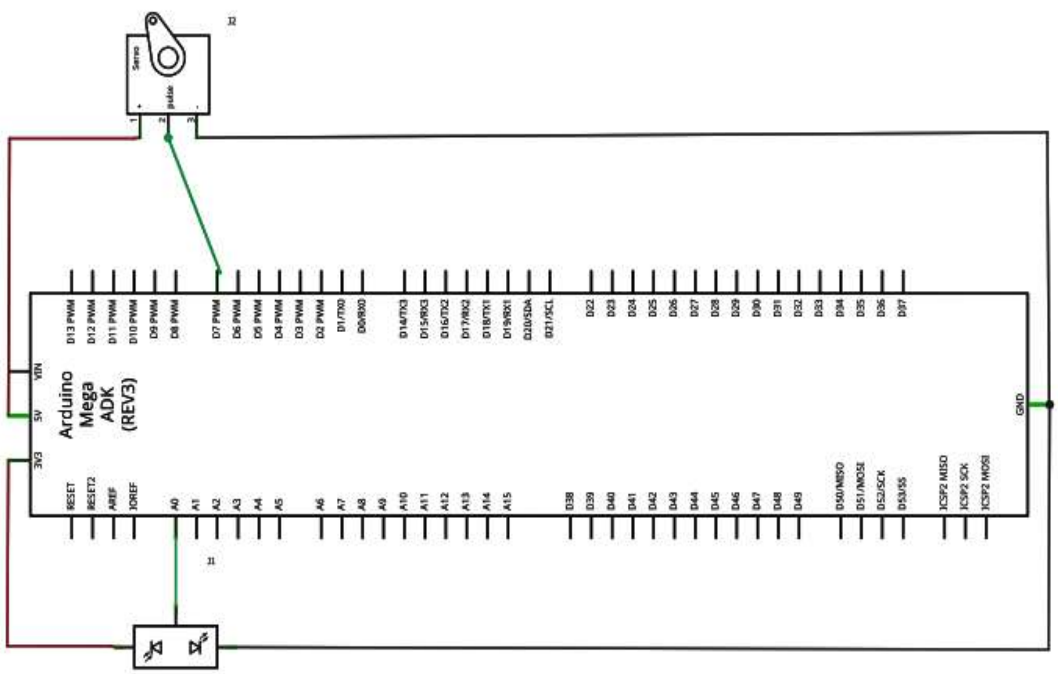

Figure 3. 18: Schematic diagram of servo motor with Infrared Sensor (exit door)

3.5.3-Infrared Sensor with Arduino mega2560 in station :

We used infrared sensor in this project to detect the train arrival to station. Figure3.19 shows the detail diagram for infrared sensors. The GND pin of the infrared sensor connected to the GND on the Arduino, and the VCC pin of the infrared connected to the 3.3V on the Arduino, and the D0 to analog pin (A3) on Arduino Board as shown the schematic diagram in Figure 3.20.

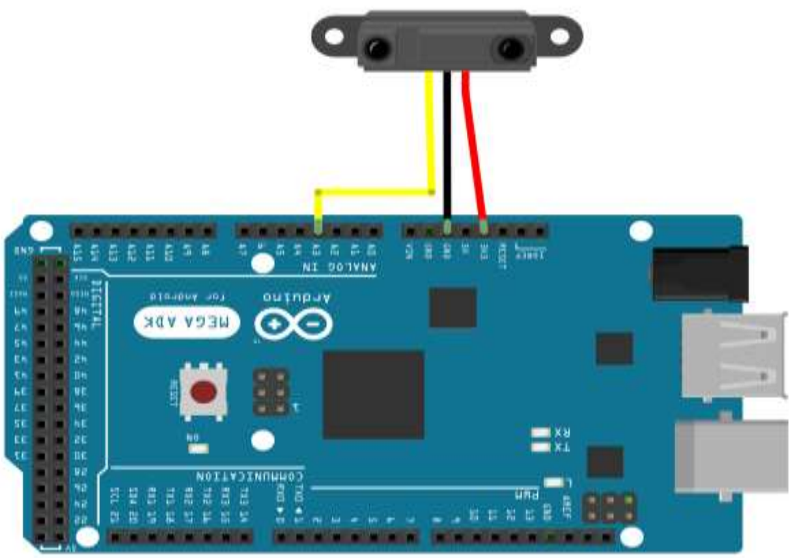

Figure 3. 18: Detailed design for Infrared Sensor with Arduino mega2560

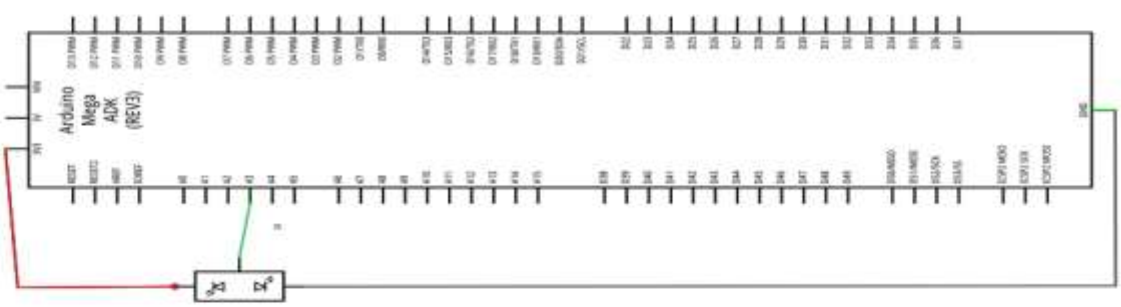

Figure 3. 19: Schematic diagram for Infrared Sensor with Arduino mega2560

3.5.4.LCD display with Arduino

We used LCD display in this project to show the number of passengers on the train as well as the status of the train. Figure3.21, shows the detail diagram LCD display. The (Vss, V0,R/W,LED-)pin of the LCD display connected to the GND on the Arduino ,the (VCC ,LDE+) pin of the LCD connected to the 5V on the Arduino , the RS pin in LCD connected to digital pin (12) on the Arduino , the E pin in LCD connected to digital pin of (11) on Arduino and the (DB4,DB5,DB6,DB7) pin in LCD connected to digital pin of (5,4,3,2) on Arduino as shown the schematic diagram in Figure 3.22**.**

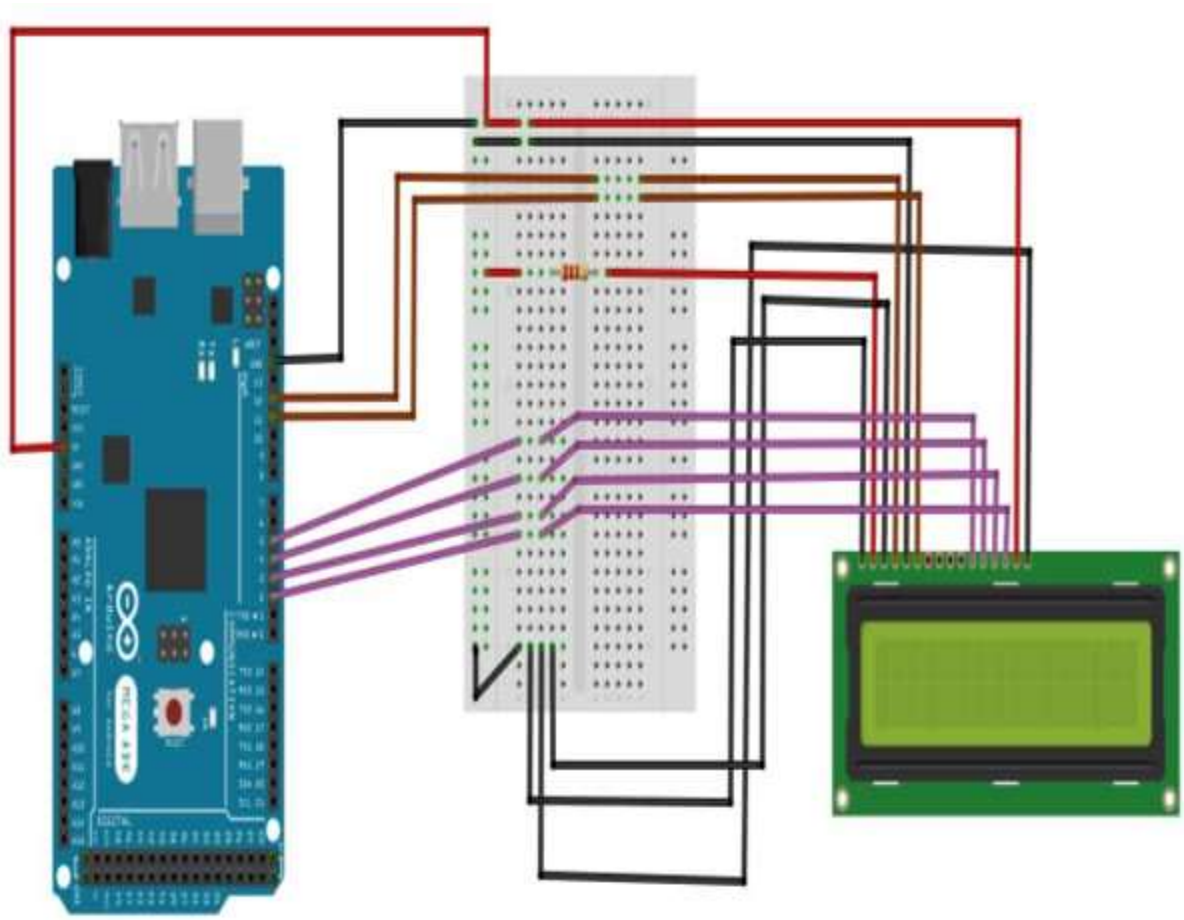

Figure 3.20: Detailed design for Infrared LCD Display

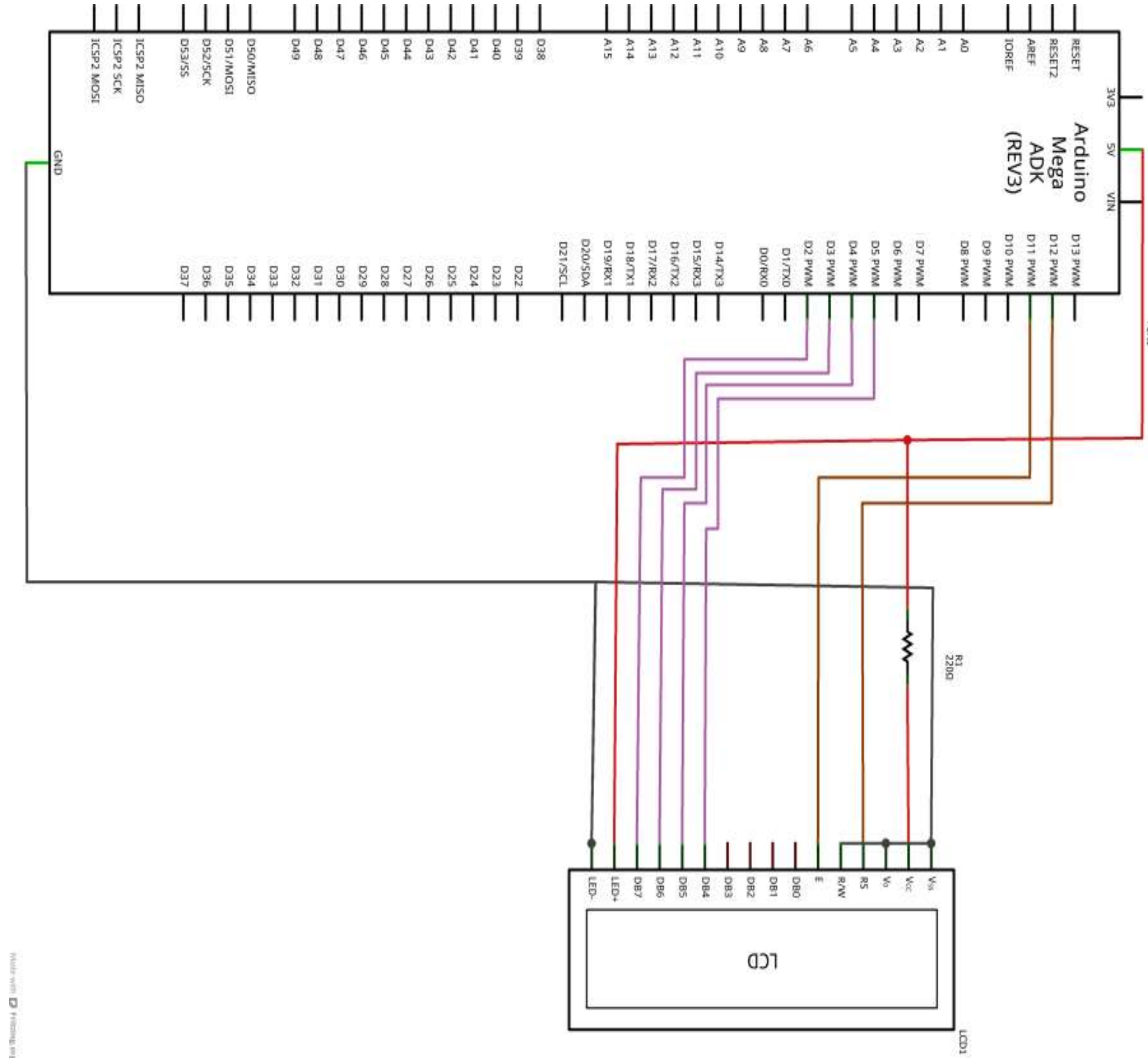

Figure 3. 21: Schematic diagram for Infrared LCD Display

3.5.5. Ultrasonic sensor:

The HC-SR04 Provide fast response time, which allow the train to respond quickly to the changing environment around it, as well as the distance to any obstacles the train may face. Figure 3.22 shows the detail design for the ultrasonic sensor.

It has 4 pins, Ground, VCC, Trig and Echo. The Ground and the VCC pins of the module needs to be connected to the Ground and the 5volt pins on the Arduino board, the trig and echo pins to (A6, A7) pin on the Arduino board as shown in the Schematic diagram in Figure 3.23.

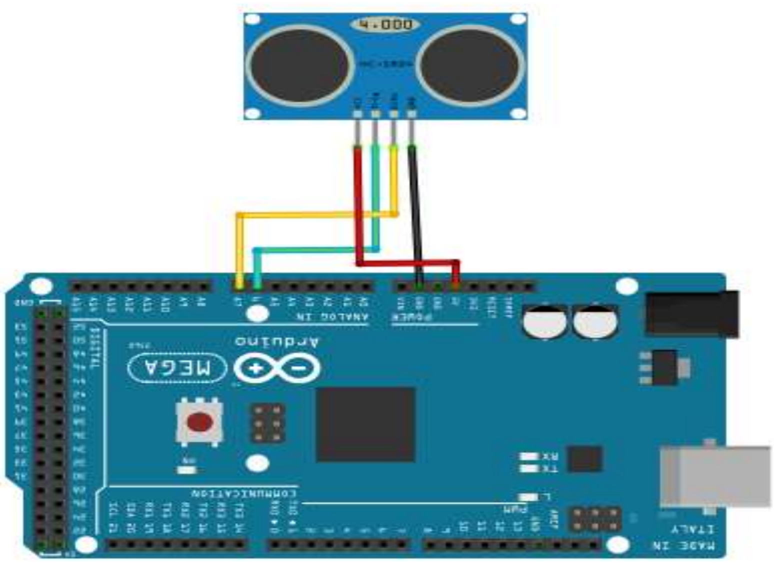

Figure 3. 22: Detailed design for HC-SR04

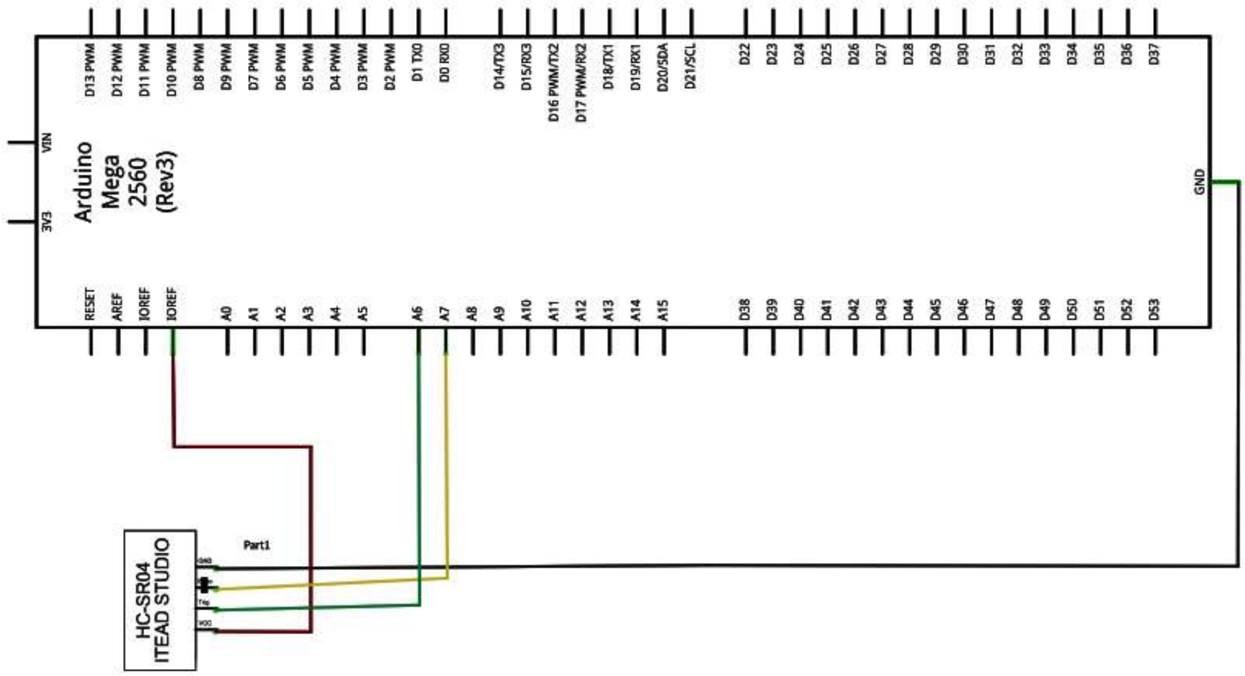

Figure 3. 23: Schematic diagram for HC-SR04

3.5.6. DC Motor with Driver Controller:

As we mentioned in chapter 2, The L298D motor driver controller, consists of 4 inputs, 4 outputs and 2 enable, we using 2 inputs, 2 outputs and 1 enable to control DC motors as shown in the detail design in Figure 3.24, in our project, we used DC Motors to control the direction and speed of the train. The two inputs connect to the digital pin of (D8 and D10) and enable connect to the digital pin (D9) on the Arduino board as shown in the schematic diagram in Figure 3.25.

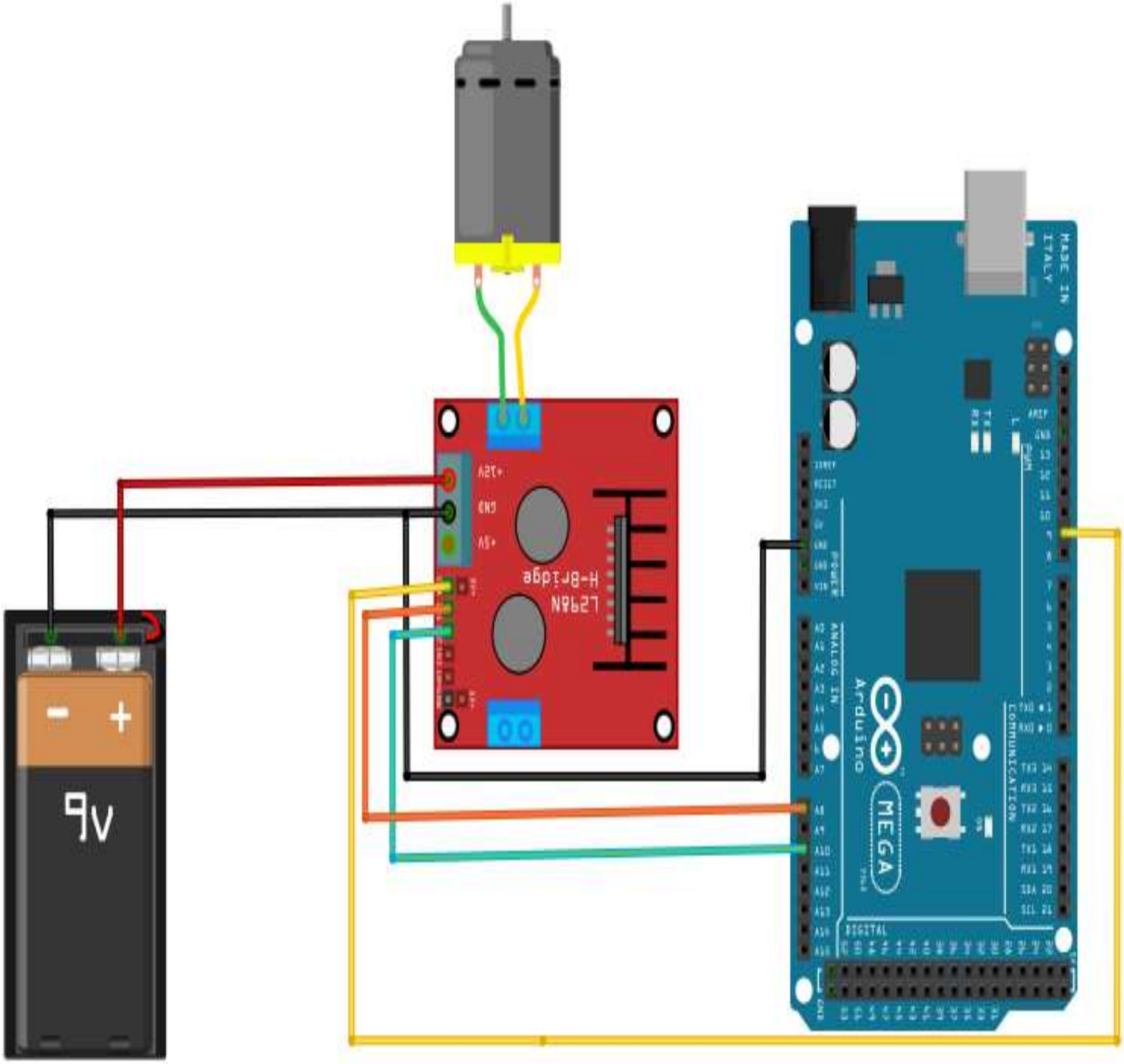

Figure 3. 24: Detailed design of DC motor with Driver.

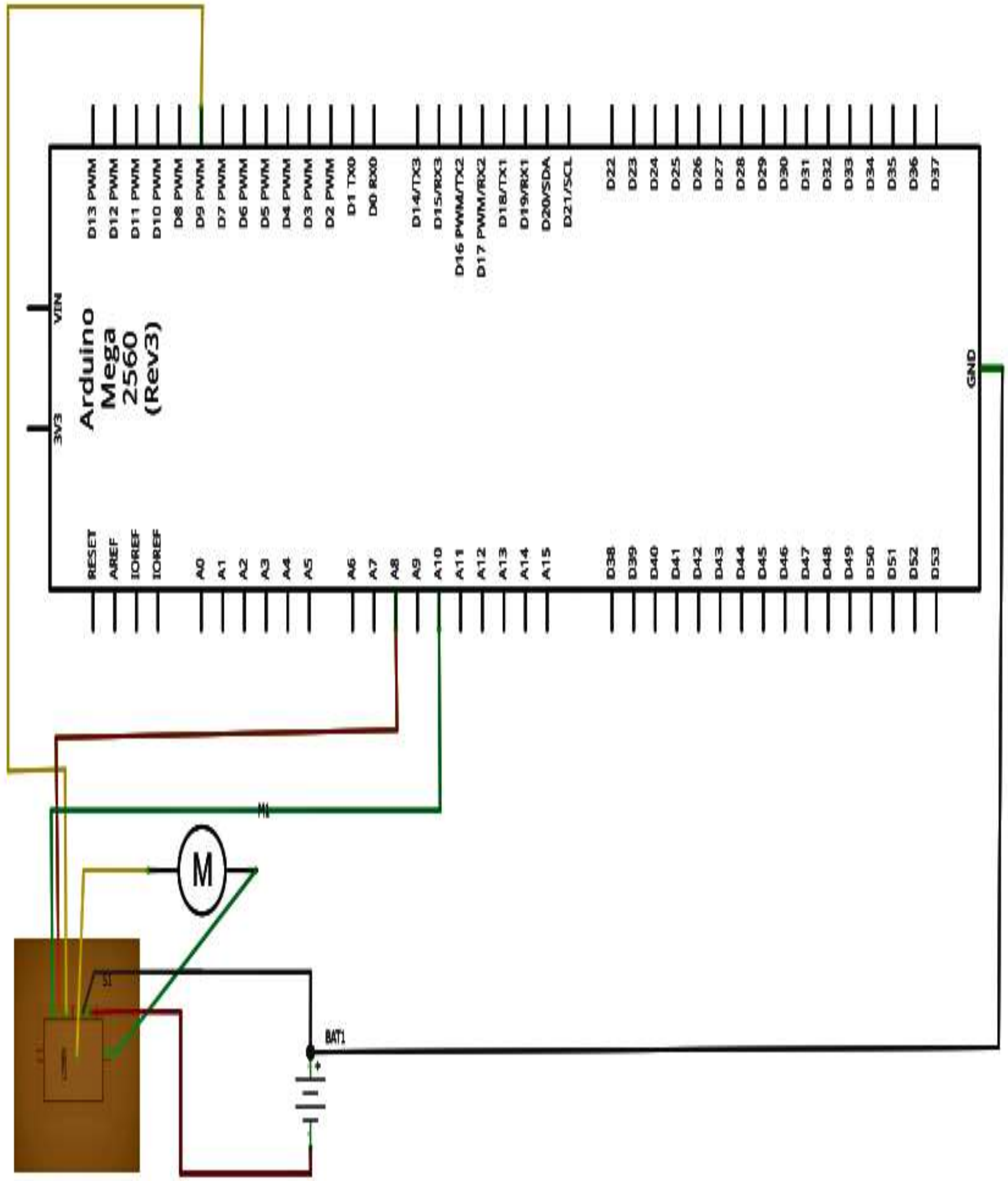

Figure 3.25: Schematic diagram of DC motor with Driver

Chapter 4

System Implementation and Validation

4.1 Overview

This chapter contains the description of the implementation, implementation issues, and implementation challenges and a description of the methods used to validate the system and the results.

4.2 Description of the implementation

This section will provide some information about the hardware and software implementations done throughout our project**:**

4.2.1 Software implementation

1- Arduino Software (Arduino IDE):

The code of all hardware components and sensors and their interfaces are written through the use of many functions and libraries. We needed to download Liquid Crystal libraries for LCD in order to display the number of passenger and the status of train. And we needed to download Servo libraries for servo motor in order to open and close the doors of the train.

4.2.2 Hardware implementation

Starting with Arduino mega 2560, we successfully connect the other system components as follows:

1. We connected Arduino mega 2560 with three infrared sensors. The first infra-red sensor uses digital pins in the microcontroller, which we place on one side of the train. Another two infra-red sensors used analog pins on the microcontroller, we placed them at

height of 3.15 cm on the entrances of the train to count adults and not count young children under two years of age, and any small objects or animals.

We put the height 3.15 cm instead to :

X : (90*7) /200 = 3.15cm

90cm: The length of a person over two years old .

7 cm : the height of door in the train model .

200 cm: The length of the door on the real train.

Result:

The first infrared sensors enabled the train to detect the station. The other two infra-red sensors, one of them is used to count the people entering the train, the other is for counting the people leaving the train and put the sensors in height of 3.15 cm enable to count passengers who are more than two years old

2. We connect the Arduino mega 2560 to two servo motors, and we put an infrared sensor next to the door of each motor, to help control the opening and closing of the doors.

Result:

The servo motor succeeded in opening and closing the doors that depend on the reading of the sensors, so that the door opens when the station is reached and closes at the end of the time interval.

3. We connected the Arduino Mega 2560 with the L298 driver, in order to control the movement of the train. We plugged the input pins into the driver using digital pins in Arduino, then we connected the output pins with a DC drive.

Result:

The motor enables the engine to move forward, and stop moving if it detects an object.

4. We connected the Arduino mega 2560 with buzzer, to sound the alarm.

Result:

The buzzer is used as a warning when the number of passengers on the train is at its maximum, it’s also used when opening and closing the doors and when the train is moving.

5- We connected Arduino mega 2560 with an LCD display.

Result:

The LCD is used to display the number of passengers on the train and the status of the train.

6. We connect Arduino mega 2560 with ultrasonic sensors to computes distances. The ultrasonic sensor uses digital pins in the microcontroller, which we placed in the front of the train.

Result:

The ultrasonic sensors enable the train to avoid obstacles.

4.3 System Validation and Testing

4.3.1 Hardware Testing

1. Motors test:

We tested the motor with L298D motor driver and connected it directly to the Arduino mega to make the train move forward, and stop.

2. Infra-red sensor testing:

To test the infrared sensor response, we connected it with the Arduino Mega as shown in Figure 4.1, and the results are shown over the serial which show in Figure 4.2. It displays the number of passengers in the event of entry and exit on the screen, but in the process of our examination we have shown the results using the serial monitor to show how it counts correct**.**

Figure 4. 1 : Test Infrared sensor (IN door , OUT door)

We also deal with the case of the number of passengers reaching the maximum occupancy, so if the number of passengers reaches 10, it shows on the screen that the train is full so closed the doors as Show as in Figure 4.3.

3. Ultrasonic sensor Testing:

To test the measurement of the ultrasonic sensor, we connect it with the Arduino mega2560. The distances measured with the Ultrasonic sensor is printed on the serial as with the state of the train in Figure 4.4, and the result shown in Figure 4.5

Figure 4.2: Test Ultrasonic in serial

4. Servo Motors test:

We tested the motors and connected them directly to the Arduino mega, to make the doors opening and closing according to the train state.

5. LCD test:

We tested liquid crystal and connected it directly with Arduino mega, to print on the LCD the state of the train.

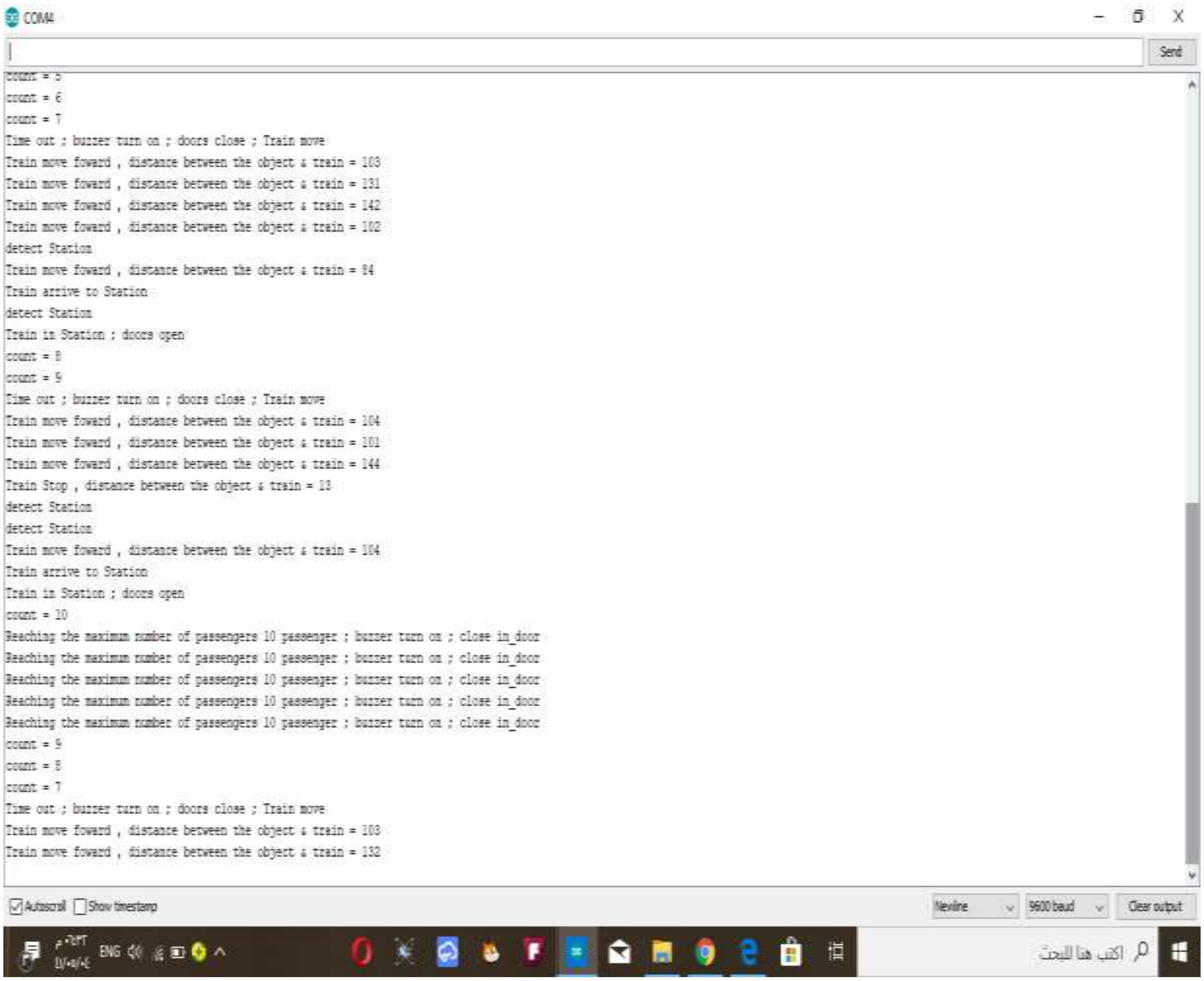

Figure 4.3: Test all system in serial

4.3.2 System Testing

1. Testing the movement of doors (opening and closing). We designed and implemented the movement of doors based on two infra-red sensors

(IN door, OUT door). The sensors are installed on the doors.

2. Then the train's arrive to station was tested, using a sensor placed in front of the train to identify the station and stop on it.

3. Then the DC motion status was tested, using a drive motor to control the condition of the motor.

4. If the measured distance value for the ultrasonic sensor is less than 20 cm, then the train will stop.

4.4 Analysis and results

By the end of the implementation process, we merged all of the components together.

Obtaining an automated system. We put the LCD, two infrared sensors and the Arduino in the second cart, and we connected the Ultrasonic and Motor Drive in the first cart along with the infrared sensor

The system is shown in Figure 4.6.

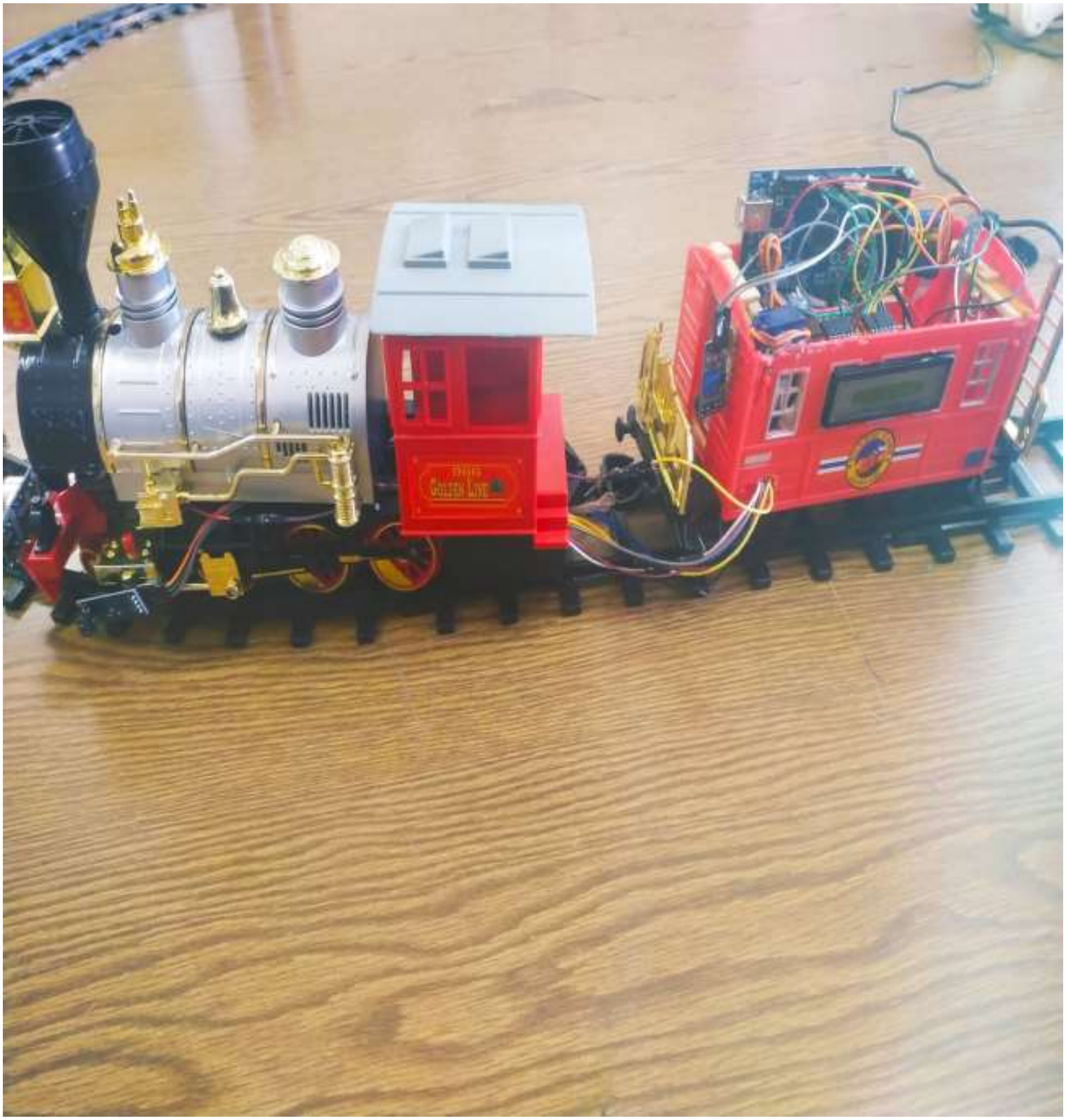

Figure 4. 4 : the system

4.5 LCD Reading:

Figure 4.5: Moving

Figure 4.6 : detect station

Figure 4.7 : Arriving

Figure 4.8 : counter the passengers

Figure 4.9 : Time Out

Chapter 5

System analysis and discussion

5.1 Overview

This chapter provides analysis and results ‘discussion and system error rate.

5.2 System analysis

After the system implementation:

a- All experiments were done in the experiment room so that they were tested.

b- The train followed its designated path.

c- The doors were opened and closed correctly.

d- The number of passengers were correctly counted and enabled the close and opening of the doors as required.

e- The train stopped at the designated stations correctly. It also stopped whenever something is appeared to cut its path.

5.3 Analysis and discussion about the results

1. movement of the doors: the (IN and, OUT doors), the servo was set to rotate at an angle between 35 degrees and a 180 degrees so the doors would open and close correctly.

The doors would close after the time interval has passed or if the number of passengers has reached the its limit. With this implantation we would have achieved the goal of reducing the number of passengers inside the train, and kept the train running on schedule.

2. Sensors readings at the doors: we have put them at height of 3.15 cm in order to count adults and not count young children under two years of age, and any small objects or pets.)

3. Train arriving at the station: the sensor is placed on the bottom so it can detect the train station and the train would stop where it’s supposed to.

4. DC motor movement: we’ve noticed that the trains don’t move stop correctly because of the timer implemented in the code. We have solved this problem so the train stops immediately if it’s faced with any obstacles on the track (railway).

5. Ultrasonic sensor testing: we’ve put the sensor on the front of the train so it’s able to determine if an obstacle was detected or not.

We took into account the appropriate height to take the correct readings form the sensor.

Chapter 6

Conclusion

6.1 Summary

These days the mishaps of trains are expanding step by step. Of these real mischances are happening because of human issues. A man can do a misstep yet a customized processor doesn't have a shot of doing blunder. This is the primary explanation for this venture. This is an exceedingly propelled innovation which is as of now utilized as a part of created countries, for example, Japan, Germany, France and so forth. By utilizing this auto metro prepare the timings of the prepare will be correct and it keeps away from a great deal of burden to the travelers. This venture will incredibly lessen the human mediation in the control of trains and subsequently spares a great deal of time and cash. In this manner the venture "AUTO METRO TRAIN" is enormously valuable in all angles.

6.2 challenges

The first challenge was how to choose the model to be Strong, balanced, reliable and safe. The second challenge faced was the components of the model, Quality components such as a servo motor and ultrasonic sensors that are damaged quickly the quality of the wires was poor.

6.3 Recommendations and future work

Through more developments and improvements, this system will have more functionality Produce more reliable results, to improve this model there are some Additions and changes should be done.

1. We can combine automatic system announcement to notify passengers about the next stop
2. We can introduce a RFID-based ticketing system into each station.
3. We can also implement GPS tracking to show the status of Train.

REFERENCES

[1] GuruprasadPatil [1], Dr.C.RRajashekhar [2] - Rfid Based Metro Train System , International Journal of Advancements in Research & Technology, Volume 3, Issue 5, May-2014 ISSN 2278-7763

[2] Akshatha R. , Dr. J Meenakumari -Enhanced &Integrated E-Ticketing - An One Stop Solution, International Journal of Advance Research in Computer Science and Management Studies,Volume 3, Issue 6, June 2015

[3] PrakashRatan , Chandra Jogi -Auto Metro Train to Shuttle Between Stations - International Journal & Magazine of Engineering, Technology, Management and Research ,Volume No: 2 (2015), Issue No: 5 (May)

[4] R.Valarmathi, G.Karthika -Smart Ticketing System in Metro Rail -International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering ,Vol. 3, Special Issue 3, April 2014

[5] Thabit Sultan Mohammed1, WiisamFahmii All--Azzo 2,, Mohammed Ahmed Akaak3,Mohammed Laheeb Suroor4 Full Automation in Driverless Trains: A Microcontroller-Based Prototype -International Journal of Advanced Research in Electrical, Electronics and Instrumentation Engineering Vol. 3, Issue 7, July 2014