ATTENDANCE COUNTER

AND ROOM SECURITY MONITOR

USING ULTRASONIC SENSOR

A Final Project Report

Presented to

The Faculty of Engineering

By

Muhammad Fikri Van Gobel

002201500008

in partial fulfillment

of the requirements of the degree

Bachelor of Science in Electrical Engineering

President University

June 2020

DECLARATION OF ORIGINALITY

I declare that this final project report, entitled "Attendance Counter and Room Security Monitor Using Ultrasonic Sensor" is my own original piece of work and, to the best of my knowledge and belief, has not been submitted, either in whole or in part, to another university to obtain a degree. All sources that are quoted or referred to are truly declared.

Cikarang, Indonesia, June 2020

Muhammad Fikri Van Gobel

APPROVAL PAGE

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By

Muhammad Fikri Van Gobel

002201500008

Approved by

Hendra J. Tarigan, BS, MS, Ph.D.

Final Project Supervisor

Antonius Suhartomo Ph.D.

Head of Study Program

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Sincerely,

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ABSTRACT

This project aims to create a multifunction system in order to count the number of students being present in the classroom and also help maintain the building security. This prototype works when someone comes into the classroom within a distance range between 1 cm and 12 cm or within a distance range: 13cm-25cm when a–person leaves the classroom. Arduino MEGA processes the information and sends it to the LCD for a display. When the classroom is empty because there is no session in progress, the ultrasonic sensor detects movements within a distance range: 1cm-12cm, meaning that someone is coming into the classroom. Accordingly, the security system buzzer that serves as an alarm turns on. Arduino along with an ultrasonic sensor can automatically count the number of people entering and leaving the room. Simultaneously, the system is capable of knowing the total number of people who remain inside the room and notifies the user through the LCD within a certain period of time. The system alerts the user in the event of the presence of unwanted persons who attempt to enter the class room beyond the specified time.

Keywords: Ultrasonic sensor, Arduino Mega, attendance counter, security room sensor

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF FORMULA

CHAPTER 1
INTRODUCTION

1.1 Background

We live in a society, which requires us to meet certain people in certain places whether to discuss, learn or just physically hang around. As a student I go to college. In college I attend classes and the lecturer or speaker may be absent on a certain day. Attendance is defined as the action or state of going regularly to or being present at a place or event. The attendance of students is maintained by schools and colleges. The manual attendance record system is inefficient and more time is required to record the attendance of each student [1]. Hence a system is needed, which will solve the issue of the manual attendance. The existing conventional method of attendance is done manually, where the lecturer manually inputs the attendance record of all students making it time consuming and inefficient. The other challenge is that technology-based systems are quite expensive. An automatic attendance management system will help save time and money by eliminating a great deal of manual processes. Such a system saves many hours of counting.

Unwanted visitors may enter a room at any given time without being detected. Advances in electronic and information technology have also helped in the development of reliable security systems [3]. Many electronic devices are used for shop security systems. Such systems maintain the security at all times and protect the asset owned. The utilization of such systems is expected to protect us from theft or intruders.

In this final project, the author wants to combine the use of attendance counter and security sensors. The author aims to create a classroom setting prototype, where the lecturers know exactly the number of person present and monitor the naughty students who leave the classroom in the middle of a lesson and do not return. The security system that utilizes Arduino will be setup in such a way according to the duration of each lecture session. The security system will also equip the security sensor in order to maintain the safety of the classroom itself and inform us as to whether or not the classroom is being used. This feature will notify the building security guards when unwanted people enter the class during a non-class time period.

1.2 Problem Statement

This final project will focus on combining the use of attendance counters and security sensors in order to minimize human errors, which in turn will support in class learning so it will become more efficient.

1.3 Objectives

- To solve the problem about classroom attendance that may seem like not a big deal but it is actually very important in order to support the learning process.
- To create a multifunction system, which works automatically to count the number of students being present in the classroom at all times and also helps maintain the building security.

1.4 Scopes and Limitations

This final project involves the design a of system that will count the number of persons being present in the classroom automatically and also will maintain the classroom security by notifying the security guards on duty in the event that an unwanted person enters the classroom during a non-class time period.

The final project limitations:

- The project will create a prototype only but not a system that is used in real life situations.
- The attendance counter will not be able to distinguish between one person and another and will only count the number of people present at a certain time in the classroom.

1.5 Outline

The final project report consists of five chapters and is outlined as follows:

Chapter 1 – *Introduction*

This chapter presents an overview of the project itself. It comprises Final Project Background; Problem Statement; Final Project Objectives; Final Project Scopes and Limitations; and Final Project Outline.

Chapter 2 – *Literature Review*

It presents a literature review telling the readers what has been done in relation to the present project and how the present project compares with other people's work in the past. It also shows why the present project has merit and significance.

Chapter 3 – *Design Implementation*

This chapter presents detailed methods, descriptions of the techniques used, the implementation of the design, and analysis. These include calculations that utilize formulas; schematic diagrams, and single line diagram design. Further, this chapter presents data collections, observations, and analysis.

Chapter 4 – *Results and Discussions*

Here the results associated with the project are presented and discussed. The strengths and weaknesses of the technique presented are also discussed.

Chapter 5 – *Conclusions and Future Recommendations*

It presents conclusions pertaining to the current project. Recommendations for future development are stated.

CHAPTER 2

LITERATURE REVIEW AND DESIGN SPECIFICATION

2.1 Literature Review

Attendance is an indicative that a person or number of persons are attending something [2]. There is an increasing need for higher education institutions to monitor student attendance, on the assumption that better attendance leads to higher retention rates, higher grades, and a more satisfying educational experience [7]. In both classroom settings and workplaces, attendance may be mandatory. Poor attendance by a student in a class may affect their grades or other activities. Poor attendance may also reflect a student's personal life situation, and is an indicator that a student is not developing the knowledge and skills needed for later success.

The manual attendance record system is inefficient and more time is required to record as well as calculate the attendance of each student. Hence a system is needed, which will solve the issue of the manual attendance. The existing system largely consists of physical register where the teacher manually inputs the attendance record of all students [1]. While the move towards the digital era is being accelerated, technologies have started to affect people's daily life at each and every instance. The problem with the existing system is that the manual system is time consuming and the advanced technologies are too expensive to be implemented in a large scale in any organization.
Then again, progresses in electronic and information technology innovation have likewise helped in the improvement of solid security frameworks. In this manner, this security framework is expected to keep up the security consistently and efficiently so as to ensure the protection of assets owned. This framework, shields us from any unwanted visitors.

This system is used to monitor the security in a store using an alarm as a warning sign. This security system is made to sense the motion of a human object when the store is not in operation [3]. There are some technologies that also work in the development of a system of traffic light. The author reviews 3 journals that present similar concept and makes comparisons among them as shown in Table 2.1.

Table 2.1: Comparison among sensors utilizing Arduino

	Sensor type.	**Is it a visitor counter?**	**Is it a room security sensor?**	**The type of microcontroller Used.**
[3]	PIR and Fuzzy Logic	NO	YES	Arduino Uno
[4]	IR Sensor	YES	NO	Arduino Uno
[5]	IR Sensor	YES	NO	Arduino Uno
Author	Ultrasonic Sensor	YES	YES	Arduino Mega 2560

Darmawan et. al [3] explained about the Security System using a Motion Sensor and Notification of Short Message Service with an Arduino-Based Fuzzy Logic Algorithm. The difference is it was built using Passive InfraRed Sensors (PIR) while the author use Ultrasonic Sensor. Darmawan et. al [3] system's will detect human movements during non-operating hours, the system will send a text message to the shop owner's mobile number, but this project didn't include visitor counter system.

Prasad K et. al [4] explained how a bidirectional visitor counter in Industrial Automation works. This projects utilize Arduino UNO to count the number of people entering the room but didn't include a security monitor in it.

In another project, Ebanesh et. al [5] discussed about an Automatic Room Monitoring with a Visitor Counter. The persons entering the room through the entrance will be sensed by the Infrared Sensors (abbreviated IR sensors) and the signal sensed is sent to Arduino UNO for processing and controlling of the count in the room. This project only highlights the visitor counter and monitors the lights and fan to show whether the energy is conserve.

2.2 Microcontroller

2.2.1 Arduino Mega 2560

This final project uses Arduino Mega 2560 as microcontroller. The reason for using this microcontroller is because it has enough pins that are needed to build a prototype for the project. Arduino Mega 2560 is easy to find both online and in the physical stores. The picture of Arduino Mega 2560 is shown in Figure 2.1.

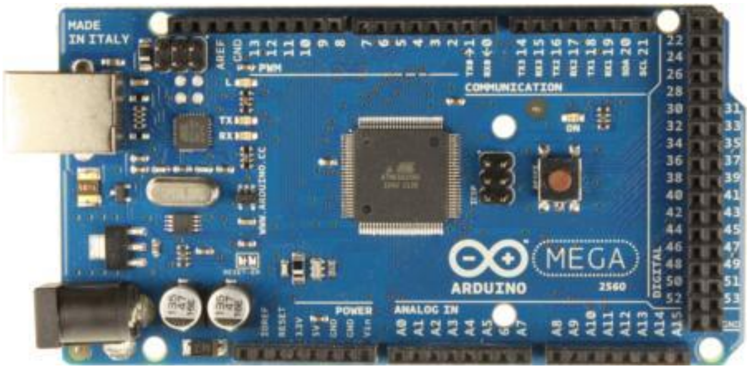

Figure 2.1 Arduino Mega 2560 [6]

The Mega 2560 is compatible with most shields designed for the Uno and the former boards. Arduino is preferred because it has more digital and analog pins and programming is easy to carry out.

Table 2.2: Specifications of Arduino 2560 [6]

Parameters	Specifications
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	54 (of which 14 provide PWM output)
Analog Input Pins	16

Parameters	Specifications
DC Current per I/O Pin	20 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	256KB of which 8KB used by bootloader
SRAM	8kB
EEPROM	4kB
Clock Speed	16 MHz

2.2.2 Arduino IDE

The software used in this final project is Arduino IDE (Integrated Development Environment). The Arduino IDE interface can be seen in the Figure 2.2.

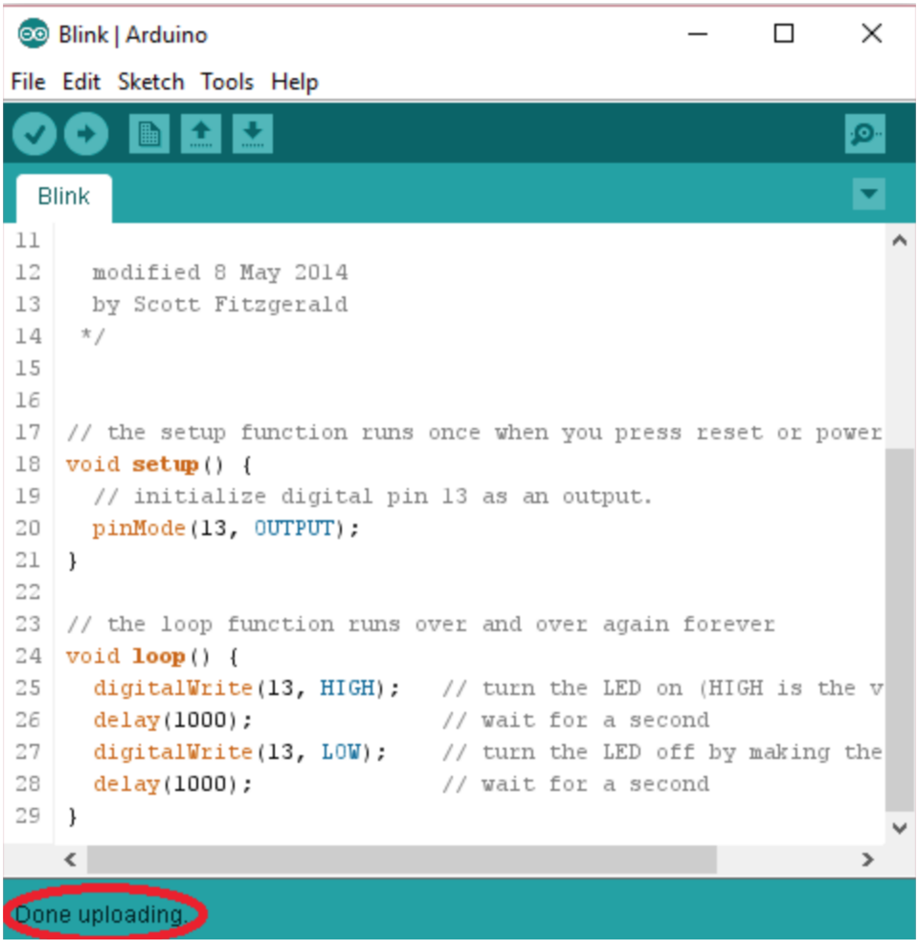

Figure 2.2 Arduino IDE Interface [10]

Arduino IDE is a very sophisticated software, which is written in Java. Arduino IDE consists of an editor program, compiler and uploader. There are several menu options in the Arduino IDE that has the following functions:

Verify: Check for errors and compile code.

Upload: Upload your code to board/controller.

Serial Monitor: Open the monitor serial port to see feedbacks from your board.

2.2.3 Core Syntax of the Arduino Language

A syntax is like the punctuation of a code. It is a code that could run the program when it is written correctly. If we run Arduino IDE, the main code that is shown first on the program will be a void setup () {} and void loop () {}. In addition to these two syntaxes, there is a number of syntaxes that are commonly used in Arduino IDE, such as:

a. void setup () {statements;} void loop () statements;}
b. ; (Semicolon)
c. {} (Curly Braces)
d. () (Parantheses)
e. // (Single Line Comment)
f. /* multi-line comment */
g. #define button 2
h. #include <library.h> or #include "library.h"

2.3 Sensors

2.3.1 Ultrasonic Sensor

The ultrasonic sensor used here is an HC-SR04 type. This sensor emits 2 types of signals: low and high. These signals propagate in the air and bounce back if there are obstacles or obstructing objects along their path. The ultrasonic sensor presented here consists of multi vibrators. A multi vibrator receives sound waves that propagate from the vibrators. A sensor has an emitter. The detector detects a sound wave whose frequency is 40 kHz, which is further sent to Arduino microcontroller in the form of electric signals. Ultrasonic Sensor HC-SR04 type consists of four pins, which are VCC, Trig, Echo and GND. It has +5V DC power supply with 2cm – 400 cm/1″ – 13ft ranging distance. Moreover, HC-SR04 type has <15° effectual angle and 30 degree measuring angle.

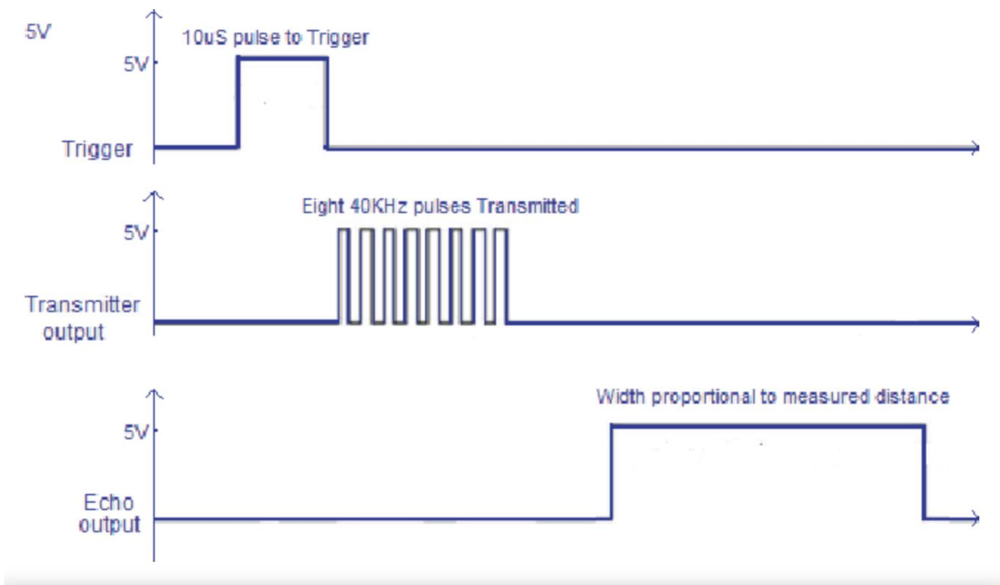

Figure 2.3 HC-SR04 Timing Diagram [11]

To generate the ultrasound wave, the Trig pin should be on High State for 10 µs as depicted in Figure 2.3. This action will send out eight 40Khz pulses transmitted, which will travel at the speed of sound. Such pulses will be received by the Echo Pin. The output of the Echo pin represents the travel time of the sound wave, which is measured in microseconds [11].

Distance Measurement

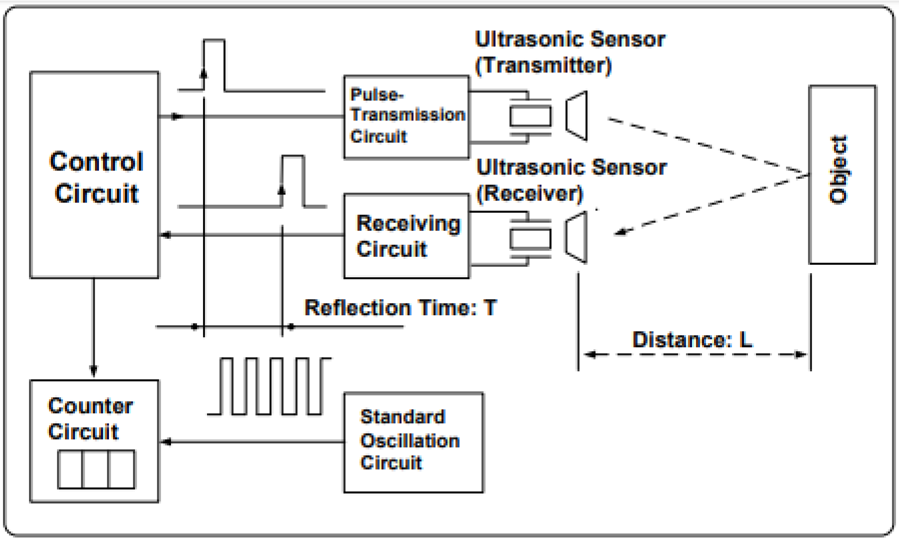

Figure 2.4 The principles of measuring a distance [8]

Figure 2.4 shows the block diagram of a pulse reflection method for distance measurement allowing us to count the number of pulses. This method gives allowance to measure the signal flight time from the transmitter to the object and continues to the receiver. The perpendicular distance from the object to both the transmitter and receiver is one half of the flight time multiplied by the speed of sound. Formula 2.1 and Figure 2.4 of the ultrasonic sensor will be used and applied on chapter 4 of the thesis.

For an object distance equaling 20 cm and using the speed of sound in the air to be 340 m/s, the flight time

$$Flight\ time = 2\left[\frac{distance}{speed\ of\ sound}\right]$$

=1.18 ms

Formula 2.1 Formula of Ultrasonic Sensor working system [8]

2.4 LCD (Liquid Crystal Display): I2C Model

The LCD used in this project is LCD 16x2 with I2C. It means that it only needs 4 pins for the LCD display: VCC, GND, SDA, SCL. It saves at least 4 digital/analog pins on Arduino.

Figure 2.5 LCD [9]

2.5 Buzzer

This project is using a 5-V active buzzer. It's rated power can be directly connected to a continuous sound. This buzzer can be directly controlled by a single-chip microcontroller IO. The pin configuration is VCC, Input and ground. The board size is 22 mm x 12 mm. This buzzer will be used as the primary security notifier.

2.6 RTC

Real time clock (RTC) is an electronic component that is used to get real time clock with speed and accuracy. In DS3231, I2C is used to communicate with the Arduino which in Arduino Mega is connected to the SDA and SCL pin.

CHAPTER 3
DESIGN IMPLEMENTATION

3.1 Introduction

This chapter discusses the hardware and software implementation of the project. It covers the general procedure that is involved in the project, from a start until the stage when the sensor can detect an object. This will be explained in block diagram. A flowchart of the system will be included. The requirement of components, and hardware design are stated. Software implementation, which employs Arduino program coding is included.

3.2. System Design

When a person is present, the Ultrasonic sensor will activate and retrieve data according to the distance. Arduino MEGA will process the information. When someone comes into the room within a distance range of 1 cm to 12 cm or goes out a distance range of 13 cm to 25 cm Arduino MEGA will process the information and send it to the LCD for display. Arduino will count the number of people inside and outside the room. When the room is empty because class is over the Ultrasonic sensor detects movement within 1 cm to 12 cm, which means that there is someone coming into the room. The security system buzzer that serves as an alarm will turn on. The block diagram of the system can be seen in Figure 3.1. The flowchart of the system is depicted in Figure 3.2.

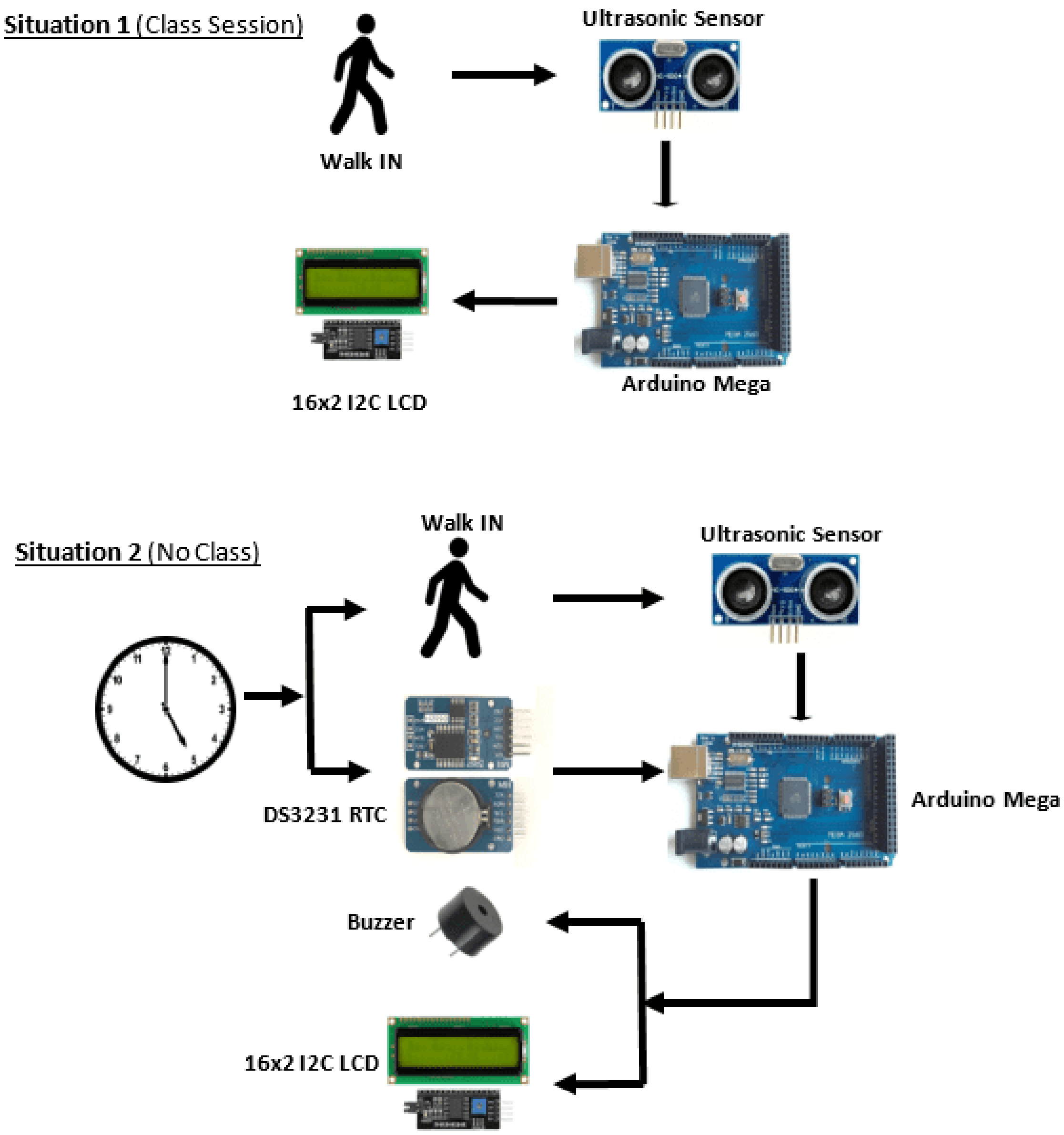

Figure 3. 1 The block diagram of

Attendance Counter and Room Security Sensors

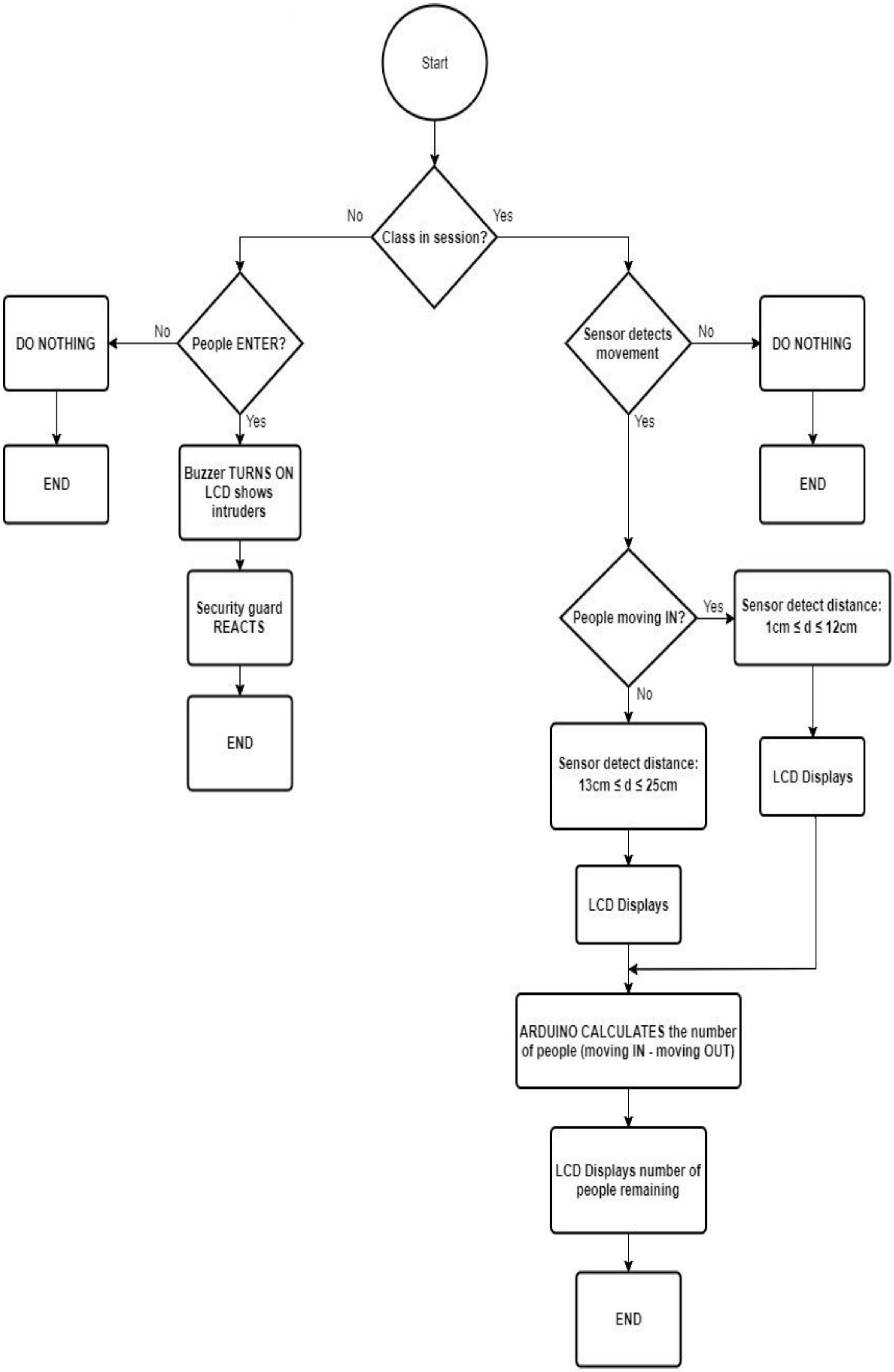

Figure 3. 2 A flowchart of the prototype.

3.3 Hardware

This section shows what the prototype consists of. The hardware components are:

- Cardboard as the wall and floor of the room, cork as the foundation of the miniature, origami papers to make a table, chairs and whiteboard inside the room.
- 1 Arduino Mega 2560 as the microcontroller device.
- HC-SR04 Ultrasonic Sensor as the main input and output measurement of microcontroller.
- DS3231 I2C RTC Module for real time clock function to determine the usage of when to use and not to use the security alarm.
- LCD 16x2 with I2C adapter as display to show data of people going in, going out and total inside of the room.
- Active 5V Buzzer for security alarm as another output measurement of microcontroller.

3.3.1 Ultrasonic Sensor

This sensor is used to detect movements. Data received from the sensor will be transferred to Arduino MEGA 2560, which is a microcontroller.

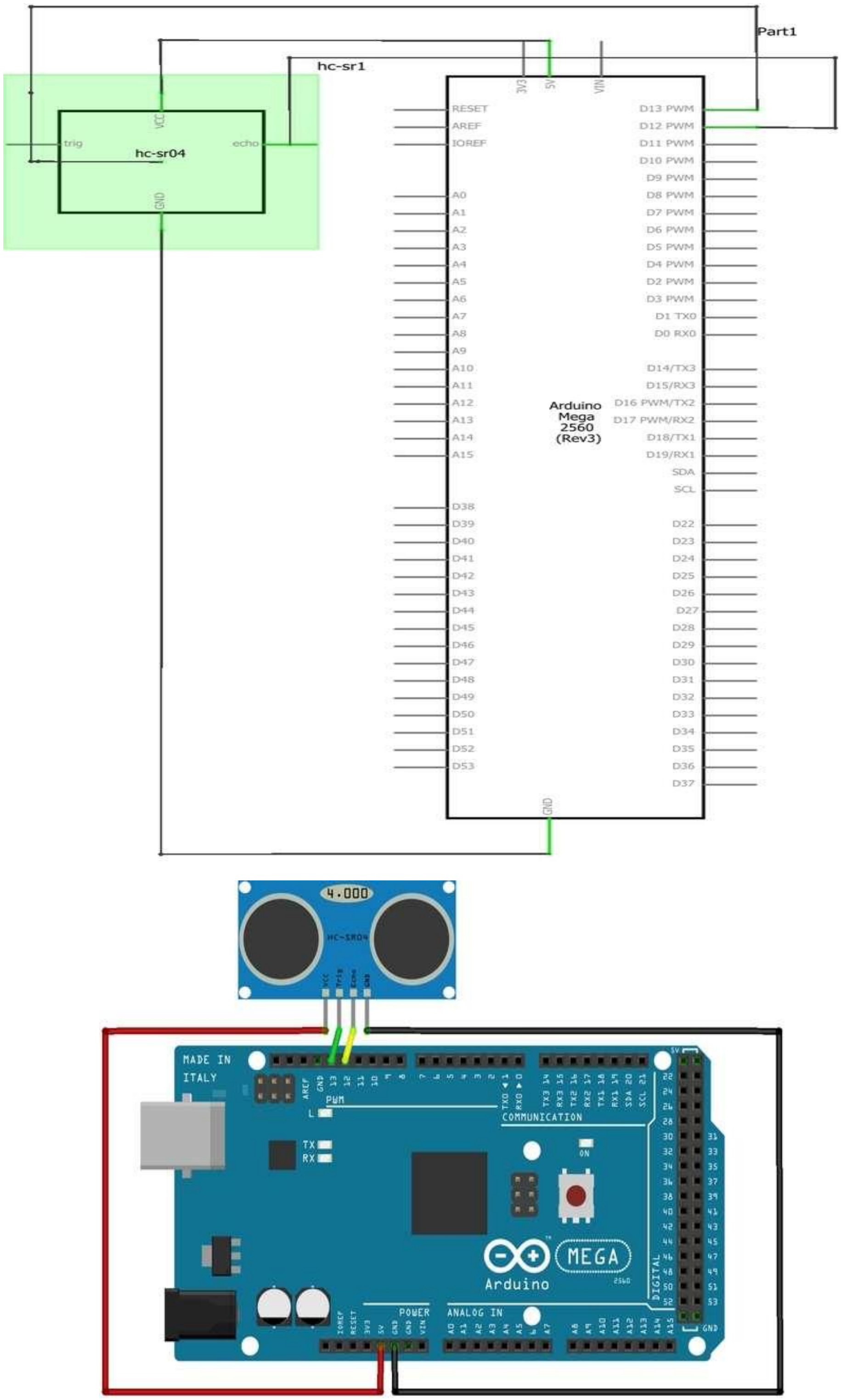

Figure 3. 3 Ultrasonic sensor schematic and wiring diagram

3.3.2 DS3231 I2C RTC (a real time clock)

This module is used to determine the exact and real time of a time zone or any random time given to it through the microcontroller. The author uses this module to later decide when to enable and when to disable the security system of the room. This depends on whether or not there is a session in the room.

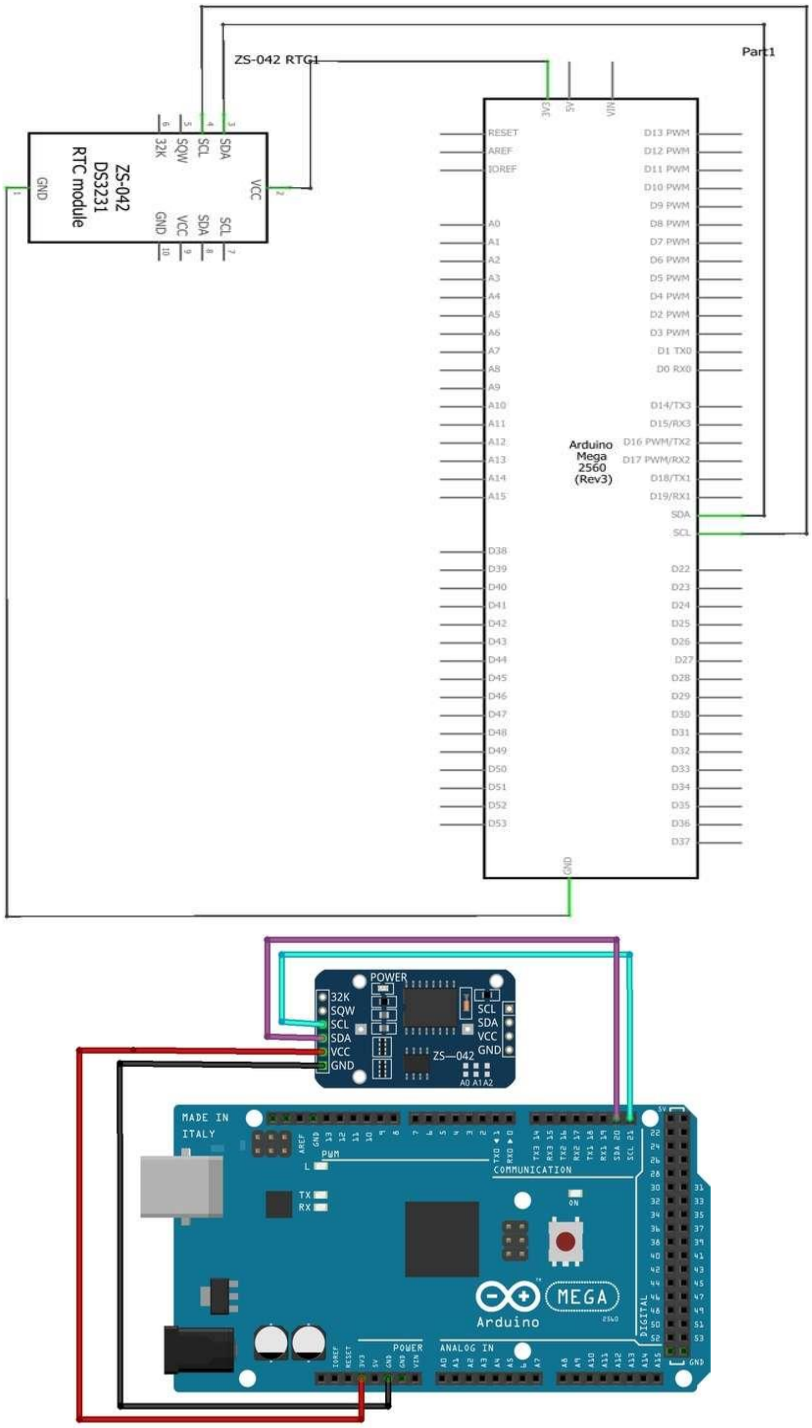

Figure 3. 4 DS3231 RTC: A schematic and wiring diagram

3.3.3 LCD 16x2 with I2C Module

The I2C module, also known as Inter Integrated Circuit, is a standard of communication of two directions that uses 2 channel. Such a module is designed to transmit or receive data. The advantage of using this bus is, that it has two required bus lines only. It eliminates the need for a cable in the circuit. It’s used to display the information about the number of people who is entering and leaving the room and the number of people inside the room.

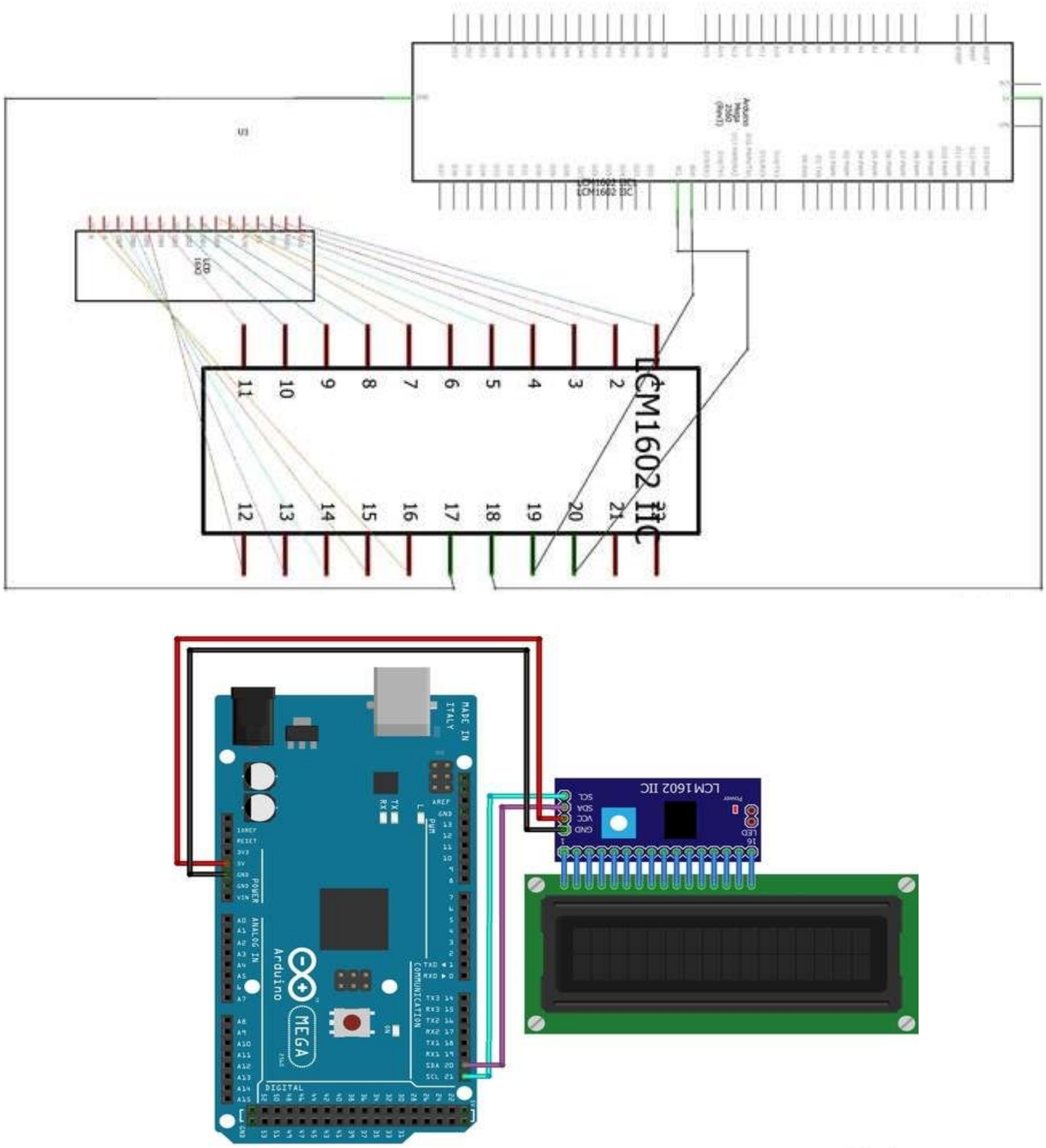

Figure 3. 5 LCD 16x2 with I2C module: A schematic and wiring diagram

3.3.4 Active Buzzer

A buzzer **is** a small yet efficient component to add sound features to our project/system. It is very small, compact, 2-pin structure, which can be easily used in a breadboard. This buzzer will be used as the security alarm during specific time when the room should be empty. The buzzer will turn on when someone tries to come inside the room.

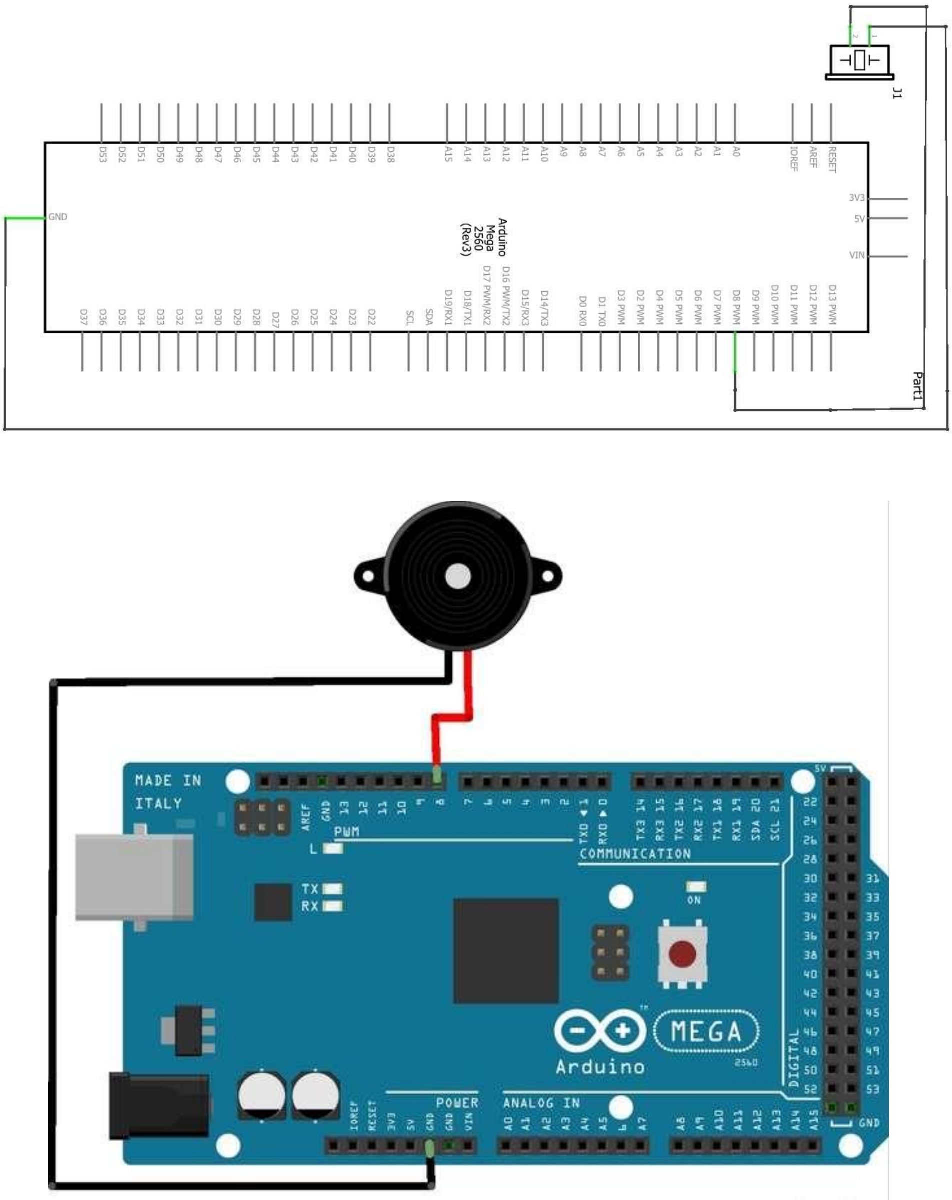

Figure 3. 6 Active Buzzer: A schematic and wiring diagram

3.4 Full Component Wiring Diagram

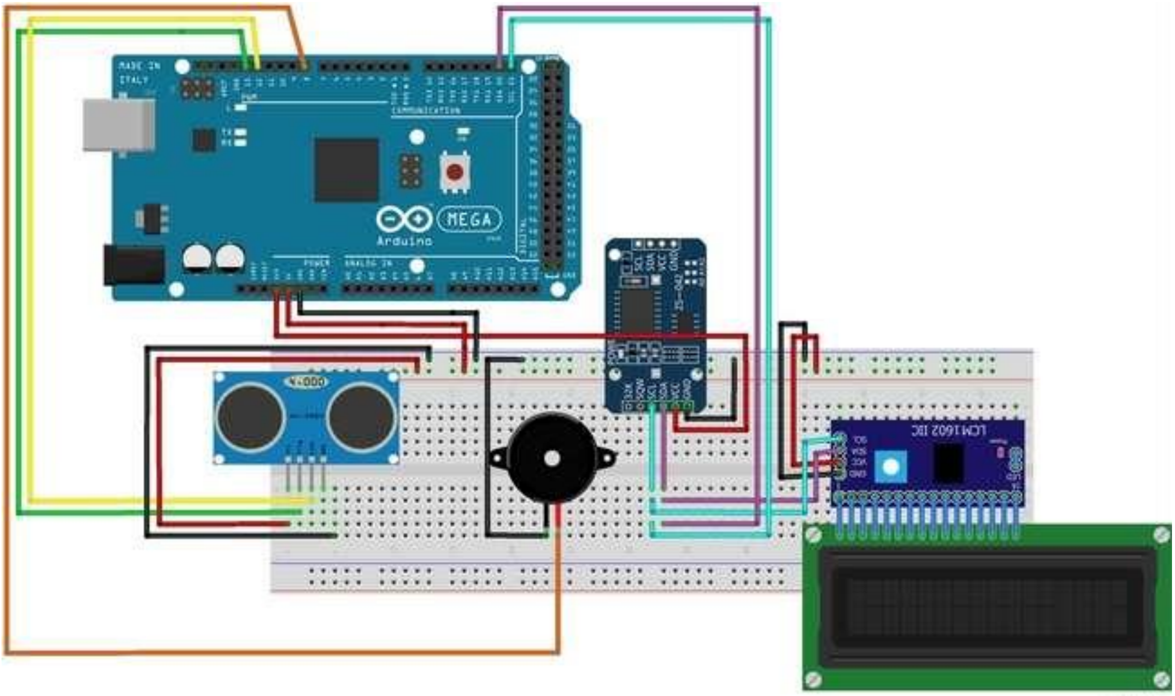

Figure 3. 7 Full component wiring diagram

Figure 3.7 shows a final diagram of this project. It shows the wiring of every component to different pins excluding the GND & VCC line. The only exception is with the LCD and RTC that uses I2C, resulting in both going to the same SDA & SCL pin (for I2C configuration).

3.5 Software

In order to implement the program in the microcontroller, the author uses Arduino IDE 1.8.12. The program consists of detection of a subject, room data display on LCD, RTC time implementation (time setting for activating buzzer) and serial communication. The full sketch of the program can be seen in Appendix.

3.6 The Prototype Design

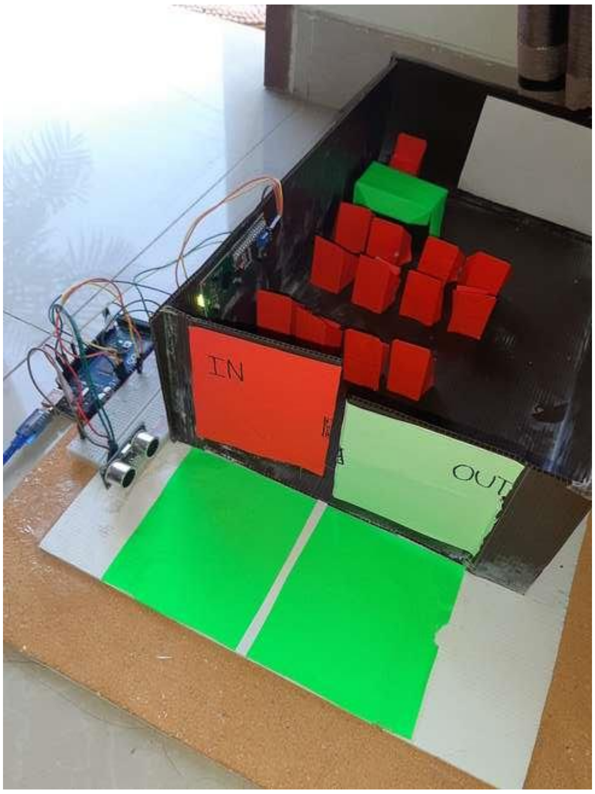

Figure 3.8 The top view of the prototype

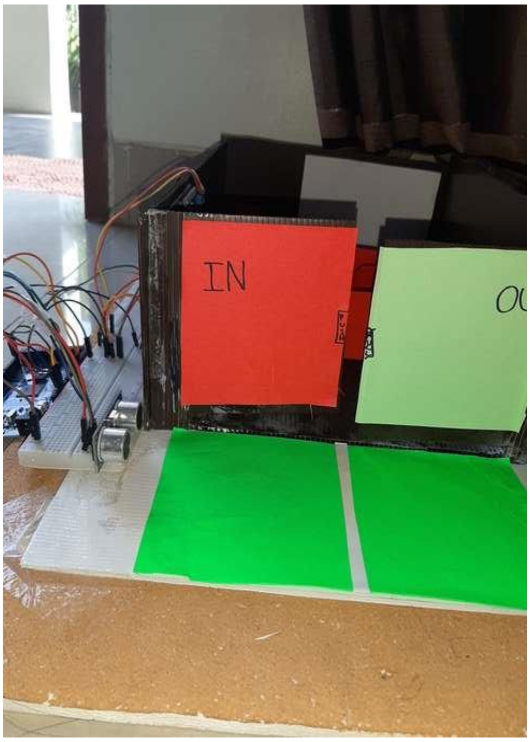

Figure 3.9 Entrance & Exit view of the prototype

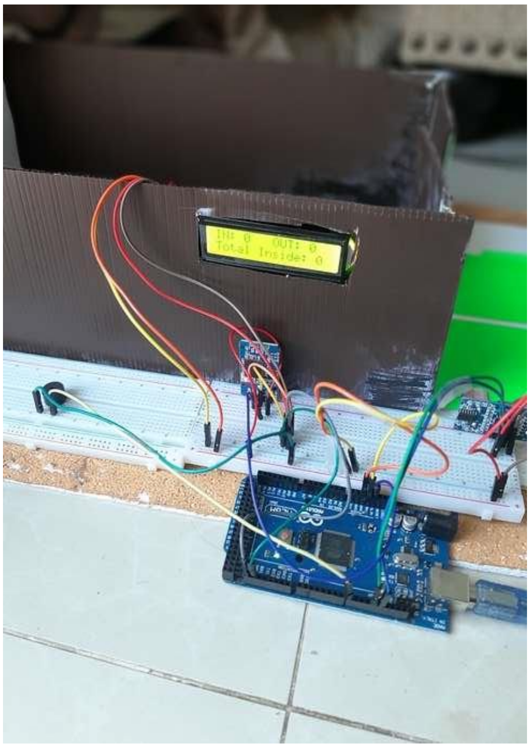

Figure 3.10 Microcontroller & LCD view of the prototype

CHAPTER 4

DATA COLLECTION, OBSERVATIONS, RESULT, ANALYSIS AND DISCUSSIONS

4.1 Data Collection & Observation

Data collection and observations are to be presented here. Two tests were done in order to check the accuracy and versatility of the sensor.

4.1.1 Ultrasonic Sensor and LCD Counter testing

Tests were done for different object to sensor distances. The first test is done to determine which validating time best suits the sensor in an actual situation. Starting with Table 4.1 for counting people who are going IN and continue to test Table 4.2 for counting people who are going OUT.

Some terminologies:

Trial : Number of test(s) done.

Sensor to object distance : The distance between the object and the sensor.

Sensor validating time : Time setting of sensor to detect an object along its path (programmed in Arduino IDE).

LCD Count result : A number shown on the LCD display every time the sensor detects an object along its path.

Attendance Counter (IN)

Table 4.1 Attendance Counter IN experiment

Trial	Sensor to object distance [cm]	Sensor validating time [s]	LCD count result	Trial	Sensor to object distance [cm]	Sensor validating time [s]	LCD count result
1	1	1	+2	19	7	1	+2
2		2	+1	20		2	+1
3		3	+1	21		3	+1
4	2	1	+2	22	8	1	+2
5		2	+1	23		2	+1
6		3	+1	24		3	+1
7	3	1	+1	25	9	1	+1
8		2	+1	26		2	+1
9		3	+1	27		3	+1
10	4	1	+1	28	10	1	+1
11		2	+1	29		2	+1
12		3	+1	30		3	+1
13	5	1	+1	31	11	1	+1
14		2	+1	32		2	+1
15		3	+1	33		3	+1
16	6	1	+1	34	12	1	+1
17		2	+1	35		2	+1
18		3	+1	36		3	+1

Table 4.1 shows three experiment trials for each sensor to object distance within the range: 1cm-12cm. The numbers “+1” and “+2” in the LCD Count signify the number of people going into the room for every test. The different results: “+1” and “+2” are attained because of the sensor validating time. When the setting time for the sensor to detect is too quick (in this case 1 second), the sensor may detect “+2” instead, if the object is still along its path after the validating time period is done.

Attendance Counter (OUT)

Table 4.2 Attendance Counter OUT experiment.

Trial	Sensor to object distance [cm]	Sensor validating time [s]	LCD Count result	Trial	Sensor to object distance [cm]	Sensor validating time [s]	LCD Count result
1	13	1	-2	19	19	1	-1
2		2	-1	20		2	-1
3		3	-1	21		3	-1
4	14	1	-1	22	20	1	-1
5		2	-1	23		2	-1
6		3	-1	24		3	-1
7	15	1	-2	25	21	1	-1
8		2	-1	26		2	-1
9		3	-1	27		3	-1
10	16	1	-1	28	22	1	-1
11		2	-1	29		2	-1
12		3	-1	30		3	-1
13	17	1	-1	31	23	1	-1
14		2	-1	32		2	-1
15		3	-1	33		3	-1
16	18	1	-2	34	24	1	-1
17		2	-1	35		2	-1
18		3	-1	36		3	-1

Table 4.2 shows three experiment trials for each sensor to object distance within the range: 13 cm-25. The presence of the numbers “-1” and “-2” in the LCD Count can be explained in the manner it was explained for Table 4.1. The different results: “-1” and “-2” in Table 4.2 also can be explained in the manner it was explained for its Table 4.1 counterpart. The only difference is that Table 4.2 shows the number of people going out.

The main purpose of this data collection is to determine the best sensor validating time for the project. From this test we can see different results. Based on different distances between a subject and the sensor and the sensor validating time, on both Attendance Counter IN and Attendance Counter OUT. The ideal condition for Table 4.1 (Attendance Counter IN) is to get "+1" while that of Table 4.2 (Attendance Counter OUT) is to get "-1". Getting the ideal condition means getting the actual result.

4.1.2 Ultrasonic Sensor and Buzzer reaction testing

The second test is carried out in order to find out the reaction of the buzzer for different object to sensor distances. Data associated with this buzzer reaction is used to determine the role of the buzzer in security notification as shown in Table 4.3.

The Security Sensors

Table 4.3 Security Sensor experiment.

Trial	Sensor to object distance [cm]	Buzzer Reaction
1	1	HIGH
2		HIGH
3		HIGH
4	2	HIGH
5		HIGH
6		HIGH
7	3	HIGH
8		HIGH
9		HIGH
10	4	HIGH
11		HIGH
12		HIGH
13	5	HIGH
14		HIGH
15		HIGH
16	6	HIGH
17		HIGH
18		HIGH

Trial	Sensor to object distance [cm]	Buzzer Reaction
19	7	HIGH
20		HIGH
21		HIGH
22	8	HIGH
23		HIGH
24		HIGH
25	9	HIGH
26		HIGH
27		HIGH
28	10	HIGH
29		HIGH
30		HIGH
31	11	HIGH
32		HIGH
33		HIGH
34	12	HIGH
35		HIGH
36		HIGH

In Table 4.3, "HIGH" means that the buzzer's output is high or the buzzer turns on. The case when the buzzer's output is "LOW", the buzzer is not being used.

Based on this test, the buzzer/security notifier is always in a “HIGH” state.

4.1.3 Ultrasonic Sensor reaction testing

The third test is carried out in order to see the reaction of the ultrasonic sensor in case there are 2 people entering and exiting the room at the same time. The test is shown in Table 4.4.

Table 4.4 Entering and Exiting simultaneously experiment.

Experiment Number	Distance (cm)		LCD Count
	Object 1 (Enter)	Object 2 (Exit)	
1	1	13	1
2			1
3			1
4	5	17	1
5			1
6			1
7	9	21	1
8			1
9			1
10	12	25	1
11			1
12			1

Table 4.4 shows three experiment trials for each sensor to object distance, with “1”, “5”,” 9” and “12” being the distance of “Object 1” to the sensor (in cm), while “13”, “17”, “21” and “25” being the distance of “Object 2” to the sensor. “Object 1” and “Object 2” indicates the object entering and exiting the room at the same time respectively.

Based on this test, the LCD count will only count 1 person, which is the person entering the room. Due to the position of a person entering the room being the nearest to the sensor.

4.1.4 Ultrasonic Sensor accuracy testing

The last test is carried out in order to check the accuracy of the ultrasonic sensor. This test is crucial for the usage of this project to not get wrong results.

Table 4.5 Ultrasonic Sensor accuracy experiment.

Experiment Number	**Measurement with Ultrasonic (cm)**	**Measurement with Ruler (cm)**	**Error**
1	1	1	**NO**
2	6	6	**NO**
3	12	12	**NO**
4	13	13	**NO**
5	19	19	**NO**
6	25	25	**NO**

Table 4.5 shows 6 tests done to determine the accuracy of the sensor using a ruler as comparison. “NO” means that there are no errors between the results. Based on this test, the ultrasonic sensor is working properly in terms of accuracy.

4.2 Result

The prototype is finished as planned. The prototype and supporting devices have been tested and are running smoothly. This project, which is based on the ultrasonic module sensor, is completed as the author has expected. The system is depicted in Figures 4.1-4.3. To prove that all units are working as expected and the project has been running smoothly, the author will show how the prototype performs in the form of video presentation during the defense session.

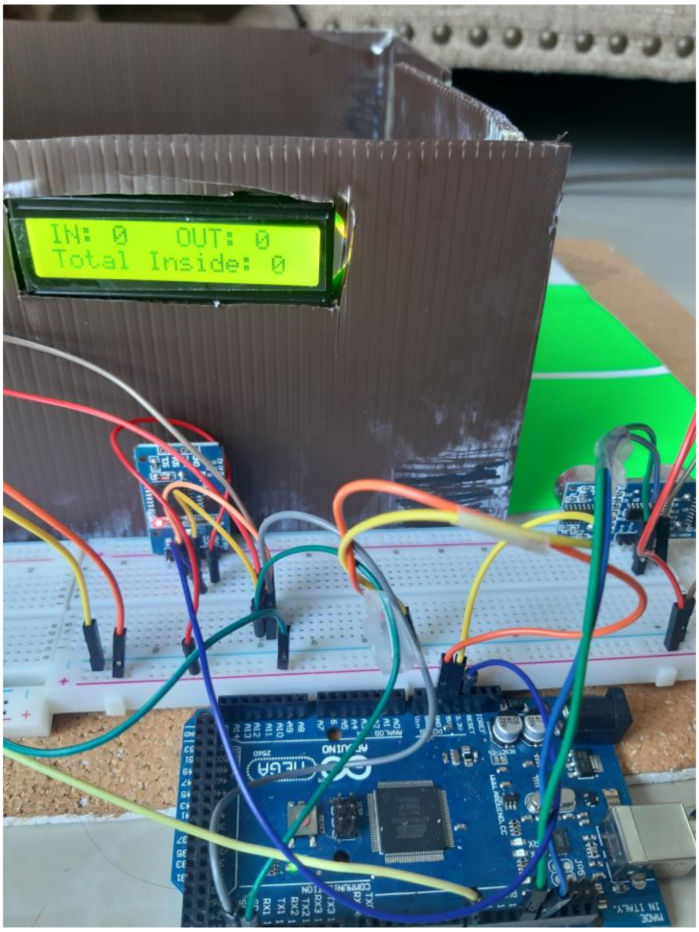

Figure 4.1 An initial project display

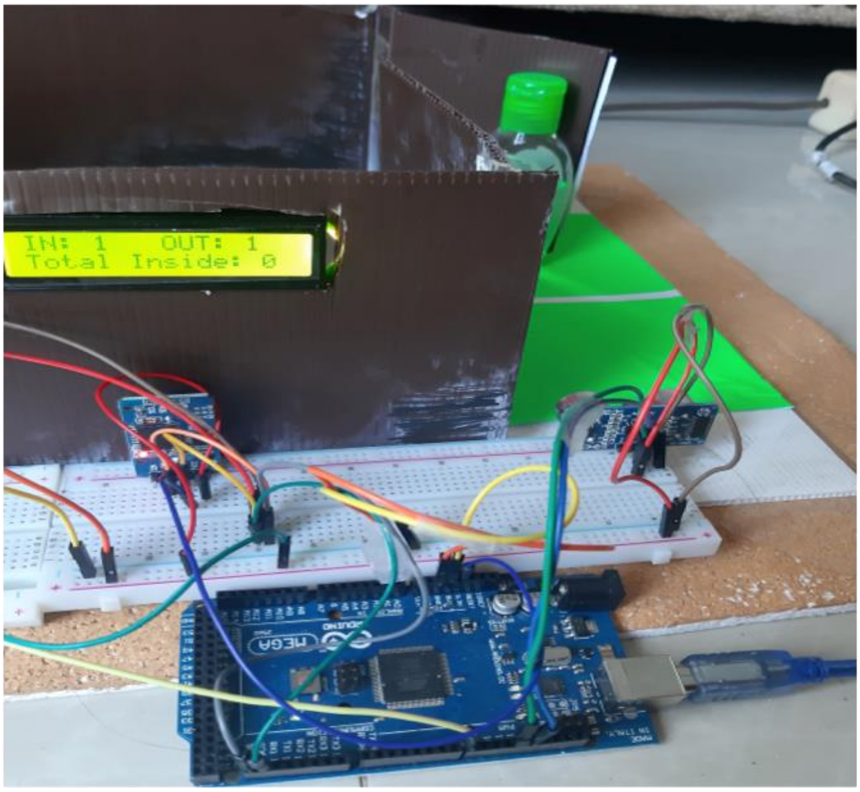

Figure 4.2 An LCD display showing a subject entering the room

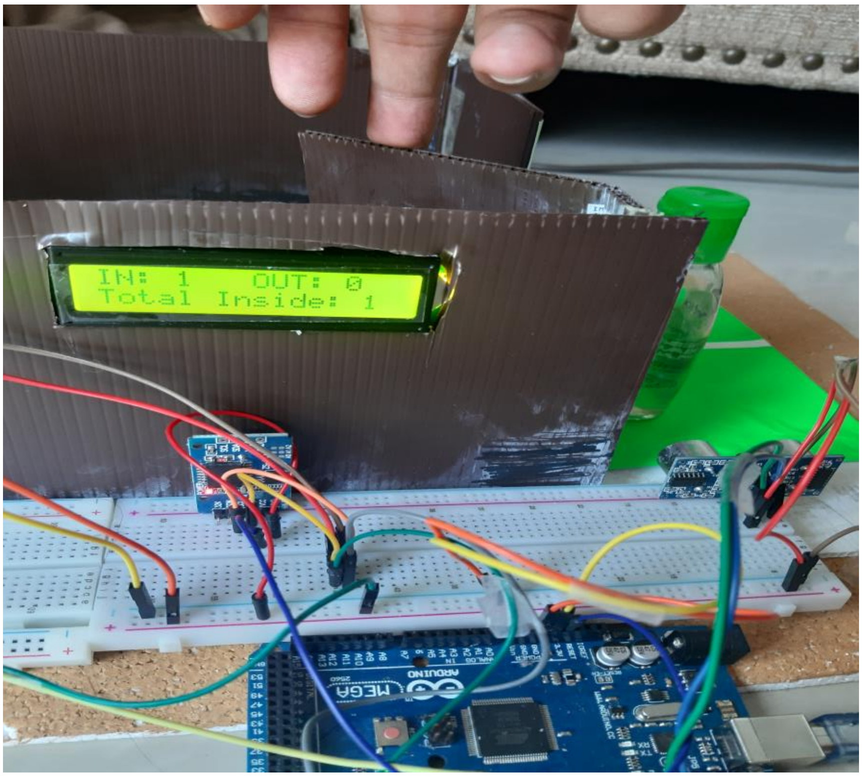

Figure 4.3 An LCD display showing a subject exiting the room.

4.3 Analysis & Discussion

Several trials in the experiment were carried out in order to get the best result. The main purpose of this project is to get the actual number of subjects going in and out of a room by displaying it on the LCD.

4.3.1 Ultrasonic Sensor and LCD

The prototype relies heavily on the codes that are programmed on Arduino IDE. In order to attain the best result by using only 1 ultrasonic sensor, the author implements the system of distance. To attain the number of people who are entering the room, the counting is done by using the first door (IN) at a distance range: 1cm-12 cm. To attain the number of people who are leaving the room, the counting is done by using the second door (OUT) at a distance range: 13cm-25cm. A visualization is provided in Figure 4.4.

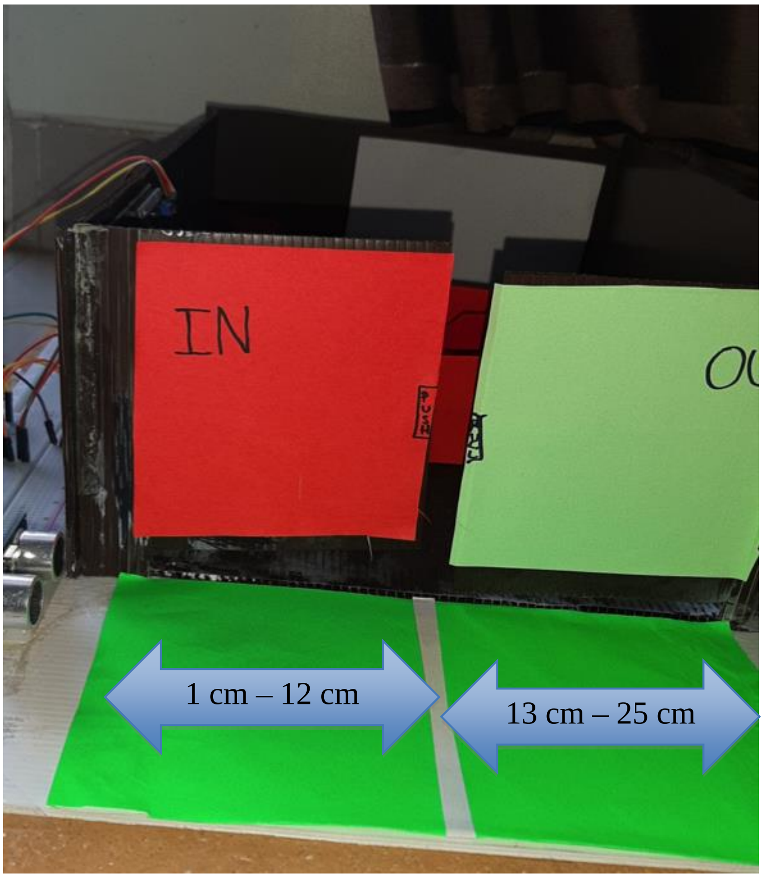

Figure 4.4 First door (IN) and second door (OUT)

The validating time of the sensor is a crucial element that should be considered. Choosing the wrong validating time for the sensor in the program coding may result in less accurate actual result or even a wrong result. As shown in section 4.1.1 the best validating time of the sensor to match an actual result is 2 seconds, because it gives the most ideal result, which is "+1" and "-1", respectively, for Counter IN and Counter OUT. Whereas making the sensor validating time equal to 1 second can sometimes make the count of an object entering and leaving to be "+2" and "-2", respectively. This happens because during the period of 1 second the sensor detects the subject twice, in other words the sensor validating time is too quick for 1 object to go through the sensor's path in a normal motion/step. While making the sensor validating time equal to 3 seconds also gives the ideal result. However, setting the validating time to 3 seconds is too long in the case when there are more people behind the first person (in real applications) going into the room or exiting the room. This whole project is also made based on the condition that people go in and out of the room one at a time (with manners), but not by swarming. Aside from counting the number of people entering and leaving the room, this program also consists of codes, which can show the total number people who are present inside the room by calculating the number of people going in minus that going outside. All of this is done to get the actual number of people who remain inside the room.

4.3.2 Buzzer

The buzzer used in this project is also very important due to its role as the main notifier for the security sensor. It works as expected at the specified times (no class session) through a series of codes to determine its on and off period. This buzzer works only at the specified time and only when there are people going into the room (through the first/IN door) along the sensor's path. Other than that the buzzer also is quite loud making it efficient to notify the security staff who is on duty.

The results that are shown in Section 4.2 show that the prototype works properly. This is possible through the use of the codes that are programmed on Arduino IDE, which is based on all the testing and measurements that were done before.

4.4 Strengths and Weaknesses

After the completion of this final project, it is concluded that the project has some strengths and weaknesses.

4.4.1 The Strengths

The prototype project can count the number of people going in and out of a room and is also capable of knowing the total number of people remaining inside the room by seeing through the LCD. The ultrasonic sensor works properly when counting the number of people going in and out of a room based on the distance that has been determined. The system is very simple, yet very useful, because everything works automatically. Through the use of the RTC module, the prototype always works in a real time (GMT +7), even when the RTC module is not being used. The application of the security system is also very simple, yet effective, because the buzzer is loud enough to notify the security staff.

4.4.2 The Weaknesses

As it is still in the form of a prototype the object that is being sensed is not human. Some adjustments are needed for the sensor validating time in order to attain real life situation results. This project works only based on the condition that people must enter and leave the room one at a time and not by swarming through the door. Since the project is only using 1 ultrasonic sensor, the detection of subject going in and out of the room is based on two doors (IN and OUT doors).

CHAPTER 5

CONCLUSIONS AND RECOMMENDATION

5.1 Conclusions

To recapitulate the results and discussion, it can be concluded that the author has successfully create a multifunction system, which works automatically to count the number of students being present in the classroom at all times and also helps maintain the building security. During class, if sensor detects movement within 1cm-12 cm or goes out in a range of 13 cm-25 cm Arduino MEGA will process the information and send it to the LCD for display. During non-class session, if sensor detects movement within 1 cm-12 cm (someone coming in). The buzzer that serves as the alarm turns on. The utilization of the RTC module allows the prototype to perform its tasks in real time (GMT +7).

5.2 Future Development

There are several possibilities that can be improved in the prototype in order to obtain better performance. The first one is regarding the room security sensor. We can't be sure that the security officers will be the first to notice when the buzzer rings. It is recommended to use an SMS notification feature, which will convey the message directly to the security officer cellphone number. In addition, as it is still in the form of a prototype, the object that is being sensed is not human. Some adjustments are needed to be made for the sensor validating time and distance range of the sensor setting for actual real life situation.

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APPENDIX

ARDUINO CODE FOR ATTENDANCE COUNTER AND SECURIY SENSOR

#include <Wire.h> #include <LiquidCrystal_I2C.h> #include <DS3231.h>	Includes and define library for LCD 16x2 with I2C and RTC Module
#define trigPin 13 #define echoPin 12	Define Ultrasonic sensor pins to digital pin 13 and 12 for trig and echo respectively
int buzzerPin = 8;	Set integer for buzzer at Pin 8

DS3231 rtc(SDA, SCL);
Time t;
const int OnHour = 10;
const int OnMin = 30;
const int OffHour = 14;
const int OffMin = 29;
	Define pin SDA & SCL of Arduino to DS3231 RTC module.
	Define and include “t” as Time
	Set time from DS3231 RTC, for buzzer on and off time (in this case after morning 10.30 class until before afternoon 14.30 class)

LiquidCrystal_I2C lcd(0x27, 16, 2); **int counter = 0;** **int currentState1 = 0;** **int previousState1 = 0;** **int currentState2 = 0;** **int previousState2 = 0;** **int inside = 0;** **int outside = 0;**	LCD address for I2C Set the integer for each **states of LCD**

void setup()
{
pinMode(trigPin, OUTPUT);
pinMode(echoPin, INPUT);
pinMode(buzzerPin, OUTPUT);
rtc.begin();
 	
lcd.begin();
}
	Setup the pinMode of output and input of the program.
	
	Initialize DS3231 RTC
	
	Initialize 16x2 LCD with I2c

void loop() {	Controls the execution of the program, repeated continuously

t = rtc.getTime();
lcd.setCursor(0, 0);
lcd.print("IN: ");
lcd.setCursor(8, 0);
lcd.print("OUT: ");
lcd.setCursor(0, 1);
lcd.print("Total Inside: ");
	Get time from RTC
	Set the cursor to print on LCD

long duration, distance;
 	
digitalWrite(trigPin, LOW);
 	
delayMicroseconds(2);
digitalWrite(trigPin, HIGH);
	Settings for Ultrasonic sensor, “LOW” means on standby or not active. “HIGH” means it sends a ping

delayMicroseconds(10);
digitalWrite(trigPin, LOW);
 	
duration = pulseIn(echoPin, HIGH);
 	
distance = (duration/2) / 29.1;
	Echo Pin receives the ping
	
	This equation is divided by two because it goes out and back so the time would be double that of a one-way travel. The 29.1 is the speed of sound (which is 343.5 m/s => 1 / 0.03435 = 29.1).

if (distance > 0 && distance <= 12){
 	
currentState1 = 1;
}
else {
currentState1 = 0;
}
 	
delay(2000);
 	
if(currentState1 != previousState1){
if(currentState1 == 1){
 	
counter = counter + 1;
 	
if ((t.hour >= OnHour && t.hour<= OffHour) && (t.min >= OnMin && t.min <= OffMin)){
digitalWrite(buzzerPin, HIGH);
delay(5000);
digitalWrite(buzzerPin, LOW);
 	
}else{
digitalWrite(buzzerPin, LOW);
}
}
lcd.setCursor(14, 1);
lcd.print(counter);
inside = inside +1;}
lcd.setCursor(4, 0);
lcd.print(inside);
	Setting the state if distance above 1 cm (which is 1) and is below or equals 12 cm for LCD Display. The situation of each states are as the table above void setup. LCD Counter Total Inside +1
	
	Set the sensor validating time to 2 seconds
	
	Set the state for LCD
	
	Set on and off hour for the security sensor
	
	During “OnHour” the buzzer turns on for 5 seconds when the “counter = counter + 1”
	
	LCD Display setting.

<table>
<tr>
<td>if (distance > 12 && distance <= 25){

currentState2 = 1;
}
else {
currentState2 = 0;
}
delay(2000);

if(currentState2 != previousState2){
if(currentState2 == 1){
counter = counter - 1;}
lcd.setCursor(14, 1);
lcd.print(counter);
outside = outside +1;}
lcd.setCursor(13, 0);
lcd.print(outside);
lcd.setCursor(14, 1);
lcd.print(counter);</td>
<td>Setting the state if distance is above 12 cm to below or equals 25 cm for LCD Display. The situation of each states are as the table above void setup. LCD Counter Total Inside -1

Set the sensor validating time to 2 seconds

Set the state for LCD</td>
</tr>
<tr>
<td>if (counter > 12 || counter < 0){
lcd.setCursor(14, 1);
lcd.print(counter);
delay(100);
lcd.clear();
}

}</td>
<td>Settings for the LCD number display

LCD blank</td>
</tr>
</table>