Palestine Polytechnic University

College of IT and Computer Systems Engineering

Graduation Project Report

Multi Parametric Access Control System for Multiple Zones

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Dedication

My parents, thank you for your unconditional support with my studies, I am honored to have you as my parents. Thank you for giving me the chance to prove and improve myself through all these years.

My family, thank you for believing in me and for allowing me to further my studies and dreams. With your support we became who we are today. Please don't stop doing this.

My teachers and staff of faculty of engineering, thank you for being our mentors, friends and our second family. Thank you for guiding us through all of these years and teaching us with all that you can.

Thank you all.

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Acknowledgement

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We acknowledge this project to all Palestinian citizens, inside and outside Palestine, and to martyrs and prisoners in Israel jails.

Abstract

Over the years, access control systems have become more and more sophisticated. Today, the term "access control system" most often refers to a computer-based, electronic card access control system. The electronic card access control system uses a special "access card", rather than a brass key, to permit access into the secured area.

Access control systems are most commonly used to control entry into exterior doors of buildings. In this project the system is designed for the University. This access control system will control the access to the University campus and buildings.

The purpose of an access control system is to provide quick, convenient access to those persons who are authorized, while at the same time, restricting access to unauthorized people. Moreover, this system will provide different levels of authorizations and will allow users to enter only during duty times and days.

The user can use either his/her magnetic card or using Bluetooth enabled device to identify his/her identity.

The system will also have a fire detection feature, an MQ CO_2 gas sensor will be used to detect any fires, if a fire was detected all doors will be opened.

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Chapter One

Introduction

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1.1 Chapter Overview:

In this chapter we will talk and describe the idea of the access control system and the functions that it will perform. We will also explain the reasons and motivations why we choose this particular project.

1.2 Project Idea Description:

Locks and keys have been used to secure facilities for decades. what the keys can't provide is to control when the keys are used, additionally the keys can easily duplicated, this means that there may be keys with people that you don't want to have access[1]. To avoid this risk you should rekey your door locks each time. That’s why we choose this idea, which is to control the access of people electronically by using a special access controller which reads the magnetic card, and based on this card, the system will allow the user to enter or not depending on his/her authorizations.

If the user is allowed to enter this specific place the door will automatically open and will also close after a short period, and a welcoming message will appear on LCD Otherwise, the system will display a message on an LCD to inform the user that he is not allowed to enter.

In case user forgot his/her magnetic card, user can send his/her ID and a special password using enabled Bluetooth device to the controller. Depending on this, the system either opens the door or not.

The system is also capable of opening all the doors and the exits of the building automatically in case of fire emergency. A fire alarm that's connected to the microcontroller will detect any fire, and an alarm will be produced.

1.3 Motivation:

1.3.1General Motivations:

1- To analyze and design an access control system for our university.

2- To implement an access control system for a specific building in our university.

3-To solve the problem of security by allowing people to get in or out based on their security levels and permissions.

4- To protect people and assets by increasing the security, and by managing each action.

1.3.2 Specific Motivations:

1. To analyze and design a complete access system using special microcontroller units and other devices.

2. To implement an access control system for a special building in our university using special microcontroller units and other devices.

3. Design a special software and database, which are mainly designed to serve our system.

4. To full fill the security requirements for each zone.

5. To use different sensors and to connect them to microcontrollers.

6. Learn new technologies such as Bluetooth technology and how to make an interface between it and microcontroller.

7. Learn about new components such as Arduino microcontroller and MQ CO2 sensor**.**

1.4 Project Scope:

1.4.1 Context:

Our project will be integrated with the database of our university.

1.4.2 Functions:

The functions that the access control performs are:

1. Enabling authorized people to get in to the desired place.

1.1 Passing the magnetic card though the access controller.

1.2 The microcontroller units will behave depending on the result, if the person is allowed the door will open and then close after a short period.

1.3 If the person doesn't have his card, he/she can send a specific code using enabled Bluetooth device.

1.4 In case of any error, a message will be displayed on the LCD to notify the user.

2. To control who enters the places depending on their level of authorization.

2.1 Some places in the university have higher security than others, so that not everyone is capable of entering this place.

2.2 Using a database that we will design, we will give permissions to the people depending on their level of authorization.

3. Fires detecting:

3.1 a fire alarm will be connected to the microcontroller, so that if the sensor detects any fire, all doors and exits of the building will be opened automatically.

1.4.3 Input/output information:

Our project asks user to pass his magnetic card or entering a code through enabled Bluetooth device, and then behave accordingly.

There are number of operations that the system performs such as opening and closing door, producing an alarm and to open the doors automatically in case of any fire emergency.

1.5 Description of Later Parts:

Chapter two: theoretical background focuses on theories and materials that are related to the project.

Chapter three: this chapter describes the project objectives in details, introduces the design options and shows the general block diagram.

Chapter four: project analysis this chapter presents project software in more details; it presents design options and tools that used in this project, and the classes that are found in the project.

Chapter five: system design, this chapter presents project design in more details, it makes the design clear and the block diagram is shown in this chapter.

Chapter six: Project Implementation, this chapter is filled with the implementation of the project.

Chapter seven: Testing, this chapter shows all the testing of the project and also shows the results.

Chapter eight: Conclusions, this chapter is filled with all the conclusions of the project.

2

Chapter Two:

Literature Review and Theoretical Background

2.1 Chapter Overview

2.2 Theoretical Background

2.3 Literature Review

2.4 Chapter Summery

2.1 Chapter Overview:

In this chapter we will talk about the theoretical background of access control systems and the concept of the security, we will also consider the related project and papers and compare them with our system.

2.2Theoretical Background:

In this section we will explain the concept of security and the techniques used to build an access control system.

Security is the degree of resistance to, or protection from harm. It applies to any valuable asset, such as a person, community, nation, or organization. Sometimes traditional keys are just not enough, they can easily be duplicated and that will threat the security of the organization. That's why we choose this particular project, which is an access control system that will limit the entry to a specified place based on authorizations.

2.2.1Access control:

Access control system is a function that controls which person has access to which resource. It ensures that only authorized users have access to services and data [2]. Access control is one of the most important elements of security. The object of security is to separate the world into "authorized" and "unauthorized" users. It

follows that you cannot achieve security unless you have a mechanism to perform separation[3].

The importance of access control:

1. It can be difficult to control who is going in and out of the building. Even small offices need to focus on security; an access control system will help you to manage all of this and to ensure that your premises staff, products and data are secure.

2. It can also be used for monitoring staff comings and goings.

3. Provide a high-tech, easy to use, low-cost product, and sophisticated software to use.

Components of an access system: [4]

"Access Control utilizes technology and procedures to manage who's
able to go where and when".

"An Access Control system is composed of:

- input/output devices
- devices to control ingress/egress (doors and related equipment)
- system(s) to manage information regarding identified risks
- System(s) to manage information regarding personnel."

The components are:

1. Entryways: where granting access can be electronically controlled which can be a door, parking gate, elevator, or other physical barrier.

2. Locking devices for the entryways: is a stand-alone electric lock.

3. Devices to identify properly authorized users: The lock is unlocked by an operator with a switch. To automate this, operator intervention is replaced by a reader. The reader could be a keypad where a code is entered, it could be a card reader, or it could be a biometric reader. Readers do not usually make an access decision, but send a card number to the door position a magnetic door switch can be used [5].

Reader:

It's a device which reads information contained in an encrypted sequence on a magnetic strip. Hotels Door locks now commonly have a magnetic card reader attached to replace the old fashioned key, since the cards are so cheap to make, and can be remade even if the original is lost. this reader can read plastic cards embedded with either a barcode, magnetic strip, computer chip or another storage medium Now that it is understood how data is stored on a magnetic card [6].

The magnetic card reader uses a specific component to read –head. The magnetic card reader is a microcontroller-based device. The read heads contain signal amplifiers and line drivers. All modern magnetic read heads contain integrated F/2F bit recovery circuitry and interface with the host controller.

Using good coding techniques, interrupt driven sampling can be used to read and handle the data. Most of the head will read the first and second tracks simultaneously. Some of advanced read heads can read all three tracks simultaneously. Linear conditioning is used for noise reduction and signal conditioning. The reader also contains an oscillator section that provides the clocks for the recovery section and for the enable/disable timers. The enable/disable counters provide initialization for the recovery section. The recovery section locks onto the data rate and recovers the individual data bits from the data stream. [7]

4. Devices to permit exiting from the secure area to the outside: In case exit is also controlled, a second reader is used on the opposite side of the door. In cases where exit is not controlled it's called free exit.

In addition to these components we add other components to the system:

Microcontroller:

A microcontroller is a small computer on single integrated circuit consisting of relatively simple CPU combined with support functions such as crystal oscillator, timers, serial and analog I/O etc, the name PIC was originally an acronym for "Programmable Intelligent Computer".

Microcontroller have long a convenient interface for embedded system, they represent the core of the control system for electronic devices in dedicated applications. Thus , the microprocessors that are used in general purpose applications like personal computers that need high performance, and multitasking

microcontroller contain data and program memory .serial and parallel I/O, timers, external and external interrupt.

Sensors:

A sensor is advice that converts a physical phenomenon into an electrical signal.

2.2.2 Bluetooth:

Bluetooth is a wireless personal area network technology (WPAN for short), a low-range wireless network technology used for linking devices to one another without a hard-wired connection. Bluetooth devices do not need a direct line of sight to communicate, which makes them more flexible in use and allows room-to-room communication in small spaces.

The aim of Bluetooth is to transmit voice or data between devices with low-cost radio circuits, over a range of about ten to just under a hundred meters, using very little power.

Bluetooth technology is designed mainly for linking devices (such as printers, mobile phones, home appliances, wireless headsets, mousses, keyboards, etc.), computers, or PDAs to one another, without using a wired connection. Bluetooth is also becoming more and more commonly used in mobile phones, allowing them to communicate with computers or PDAs, and is especially widespread in hands-free

accessories like Bluetooth headsets. Bluetooth headsets act as advanced earpieces which include remote control features.

Bluetooth is one of today's most exciting technologies. It is a short-range radio wave wireless technology operating in the 2.4GHz frequency spectrum. With an operating of 30 feet (10 meters) and a maximum transmissions rate of 1Mbps, Bluetooth is widely touted as the "cable replacement solution [8].

Bluetooth Applications:

1. Wireless communication between a mobile phone and a headset is possible by way of Bluetooth.

2. Computers can form a wireless network in a limited space and when bandwidth requirement is less.

3. Wireless communication between the input and output devices of a computer is possible by means of Bluetooth technology.

4 .Some game consoles use Bluetooth for their wireless controllers [9].

2.3Literature Review:

The following papers and projects are related to our project:

1. Building Management System: [10]

This project focuses on building flexible and reliable automation system that can be optimized for home layouts and multiple environments needs It has the capability to optimize and properly manage those appliances, and effectively cut the cost of running using monitoring

The main aim of our project is to increase security to people and assets by determining levels of authorizations, and also by protecting the university from cutest catastrophes such as fire.

2. Controlling class room and talking student attendance: [11]

This project used for taking students attendance at the beginning of each lecture. This small system got two parts one of them is attached to each room at the university; the other part will be connected to the main server.

Techniques used in project:

1. The wireless
2. Barcode Reader

This project focuses only on taking attendance and absence in university lectures while our project is to control the entry of students into the university buildings. That's where our project is based on the use of the magnetic card and not a bar code, and our project saves money by using magnetic card instead of bar code.

3. Home Security System: [12]

The Main aim is a Security for building, it detect intruder if the window open or an cutting to the infrared signal in the door, and it detect the motion in the home, if such as intruder cuts the motion detector and if the lights is turned on or off at the home, it will automatically sent notification to the owner of the house if any event of these events happened, it sent him SMS contain what is the event happened, like window opened or door or motion.

However, in our project the system contains a fire alarm, and when a fire happens in the building the system will give warning and open all the doors of the building automatically. We will also provide and determine levels of security. And in addition to the magnetic card the user can use a Bluetooth enabled device to get in or out.

2.4 Chapter Summary:

In this chapter, a background of the access control system is introduced and the main parts of it. In addition to that a literature review is also introduced.

3

Chapter Three:

Project Management Plan

3.1 Chapter Overview:

In this chapter, we are going to define and structure the plan of the project in order to determine all the tasks that we are going to do and divide these tasks on time, also we will determine the deadline, budget depending on the size and the complexity of the software and to determine all cost for each of the hardware and software in addition to determine the risks that we may face during the project and the impact, probability of each one of them. After finishing this chapter, planning stage of the software will be done.

3.2 Project Management Plan:

3.1.1 Project ask set:

1. Communication:

-Identify all the stockholders and the end user of our project, which are the users of the access control system and who will benefit from it.

-Meet the users in order to gather all the needed requirements, also to determine the overall goals of the access control system, and to know exactly how will benefit from this project.

-Determine the scope of our project in order to know in which environment to be in, also to determine all the inputs and outputs of the access control system and all the functions that will perform.

-Final step of communication is modifying the statement of the scope as required, to update the statement of the scope if any change happened.

2. Planning:

- Determine the schedule:

-In this step we will determine all the resources and the components needed for our project**,** in order to determine the budget of the project.

-Determine the process model that we will use in working, we choose the waterfall model because all the work will be done sequentially.

-The deadline will be determined, depending on the budget and functions to be performed.

3. Modeling:

-Analysis: analyze all the requirements in order to design the project correctly, and to make this operation as easy as possible.

-Design: we will design the project in order to achieve the requirements.

4. Construction:

-Coding: we will use macro c language to implement our project, in order to achieve all the requirements.

-Testing: this step will be done to test the correctness of our code.

5. Deployment:

-Operation: the system will be operated in order to be evaluated from the users.

-Maintenance: we will ask from users a feedback, and we will behave based on this feedback.

- **task activity network**

Task	Definition
T1	Identify stockholders and end-users
T2	Meet users
T3	Determine the scope
T4	Modify scope
T5	Determine schedule
T6	Risk management

T7	Analysis
T8	Design
T9	Coding
T10	testing
T11	Operation
T12	maintenance

Table 3.1 Task set

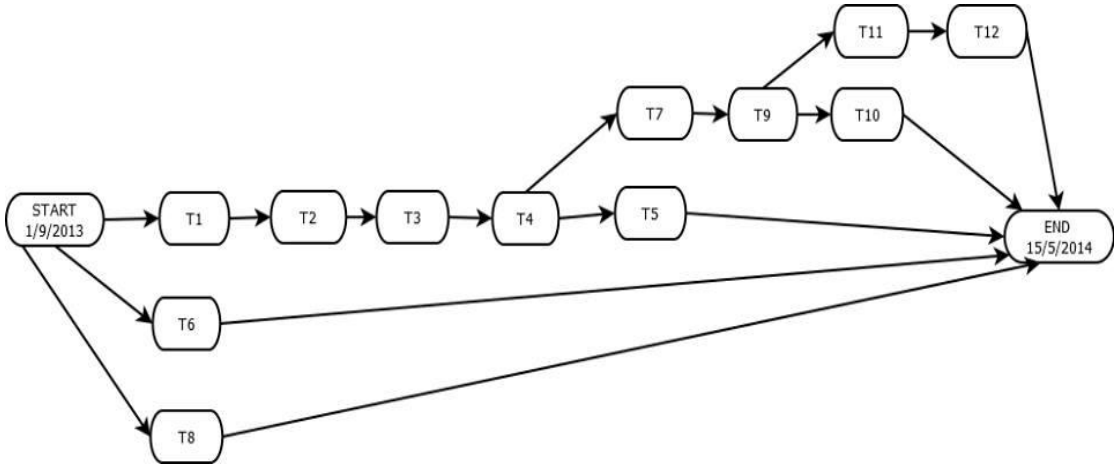


Fig 3.1 Activity network diagram

Task	Dependency
T1	-
T2	T1
T3	T2
T4	T3
T5	T4

T6	-
T7	T4
T8	-
T9	T7
T10	T9
T11	T9
T12	T11

Table 3.2 Task dependencies

Risk Management:

In this chapter we will determine all the risks that may occur during the work, and to determine the impact of each one of them on our project. For each risk we will put a plan to avoid it, but in case the risk happened we have to know how to deal with it and how to reduce its effect and impact as much as possible.

3.2.2 Risks:

Risk is one of the most important factors that must be considered in details and take all the edges of the risk that may occur, in order to avoid them and to ensure a successful project work.

There are different types of risks, each affects the project and each infects team work and some has to do with the installation of the project, and this table will show the risks that may face us in working, also shows the impact and the effect of each one.

Risk ID	Possible Risks	Probability	Effects
R1	Damage of hardware parts (reader, Microcontroller, Sensors)	Moderate	Catastrophic
R2	May not be receiving the hardware device on time	Low	Catastrophic
R3	Lack of full knowledge of how to deal with the tools	Very low	Tolerable
R4	There may be a significant change in requirements more than we expect	low	Serious
R5	Budget is not sufficient	Low	Serious
R6	Code of the software is damaged or deleted suddenly.	Low	Catastrophic
R7	Change the delivery date of the project	Very low	Serious
R8	Sudden illness of one of the team members	Moderate	Serious
R9	The university does not allow us to use their own Doors	Low	Catastrophic
R10	displeasure with some of the students about the idea of being a challenge of their liberty	Moderate	Tolerable

Table 3.3 Risk Probability and Analysis

Risk ID	Management Strategy
R1	Try to solve this damage, if we can't we will provide another one as fast as possible and continue working on other parts and functions.
R2	Contact the providers in order to provide them as fast as possible
R3	Search the web and other references to know how to work with them
R4	Deal with this requirement in a flexible way in order to solve this problem
R5	Take to the supervisor about this, or borrow money
R6	We will always save another copy on flash
R7	Refer to University Regulation
R8	The other member of the team will work doubly
R9	apply it on other place
R10	Meet with them and explain the importance of this project

Table 3.4 Risks management strategies

3.2.3 Project resources and estimated cost:

In this section we will determine resources that we will use in our project:

1. Software resources:

Resource	provider	Price
Microsoft office 2007	PPU	50$
rational rose	PPU	50$
Microsoft visual studio	PPU	50$

MySQL	PPU	50$
Cadence OrCAD 9.2	PPU	50$
Eclips	PPU	50$
Arduino IDE Software	PPU	free
Total cost	300$	

Table 3.5 Software resources cost

All of the software resources are provided by the PPU, so they are considered free.

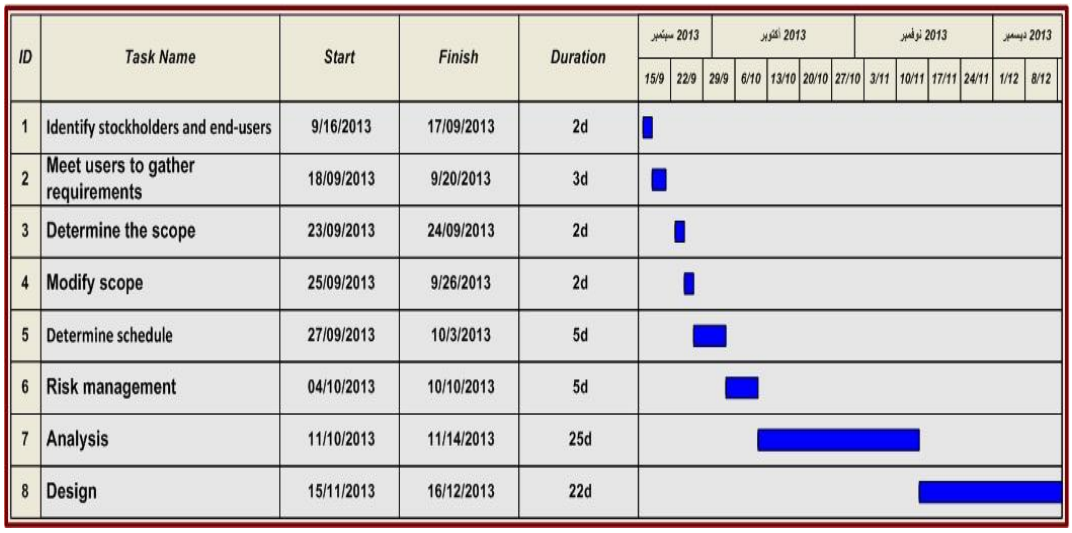
2. Hardware resources:

Hardware component	**Price per one in NIS**	**needed**
Arduino mega	350 NIS	2*350 = 700 NIS
MQ2 detector	120 NIS	1*120 =120 NIS
Magnetic reader	250 NIS	2*250 =500NIS
Bluetooth receiver	250 NIS	1*250 = 250NIS
buzzers	20 NIS	2*20 = 40NIS
Electrical locks	50 NIS	2*50 = 100NIS
LCD	40 NIS	2*40 = 80 NIS
Cards	10 NIS	10*3=30NIS
Total cost	**1820 NIS**	

Table 3.6 Hardware resources cost

3.2.4 Time estimation:

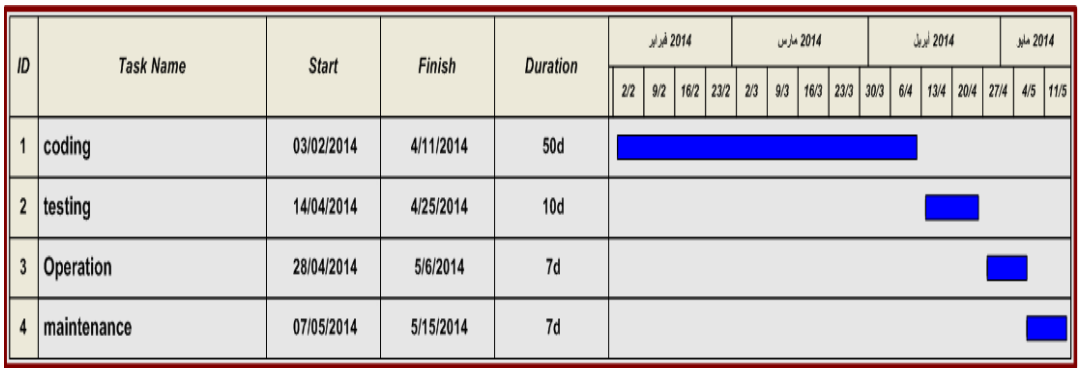
First semester:



ID	Task Name	Start	Finish	Duration
1	Identify stockholders and end-users	9/16/2013	17/09/2013	2d
2	Meet users to gather requirements	18/09/2013	9/20/2013	3d
3	Determine the scope	23/09/2013	24/09/2013	2d
4	Modify scope	25/09/2013	9/26/2013	2d
5	Determine schedule	27/09/2013	10/3/2013	5d
6	Risk management	04/10/2013	10/10/2013	5d
7	Analysis	11/10/2013	11/14/2013	25d
8	Design	15/11/2013	16/12/2013	22d

Fig 3.2 Gantt chart (first semester)

Second semester:



ID	Task Name	Start	Finish	Duration
1	coding	03/02/2014	4/11/2014	50d
2	testing	14/04/2014	4/25/2014	10d
3	Operation	28/04/2014	5/6/2014	7d
4	maintenance	07/05/2014	5/15/2014	7d

Fig 3.3 Gantt chart (second semester)

3.3 Project Methodology:

3.3.1 Options:

Options are a wide world if we want to do anything we must consider all options in order to choose the most suited one.

That's why we considered different options in designing our project, for example in choosing the microcontroller we considered the PIC or the Arduino kit and we choose the Arduino for several reasons that are explained in the next section, exactly the mega Arduino because it has larger numbers of input/output pins than other types of Arduino.

Actually it's Arduino mega ADK not Arduino mega Uno.

Another option was to use the Bluetooth technology or the GSM technology to increase flexibility of the system, as we mentioned previously in this chapter we will use this technology to enable the user to enter to the specific place in case the user forgot his magnetic card. We choose the Bluetooth technology for seasons also explained in next section.

The final option was about the reader, there are different types of the readers, there's reader with a camera for face recognition also there's reader with a control panel, but we choose the reader that only reads a magnetic card because we used the Bluetooth technology instead.

3.3.2 Analysis of each option:

Why we choose the Arduino mega instead of UNO?

We chose The Mega because it's bigger both physically and in terms of available FLASH memory and RAM (256kB FLASH/8kB RAM vs. 32kB FLASH/2kB RAM on the Uno).

The Mega has more hardware serial ports, more timers, and more I/O pins. Some shields do not work on the Mega because the SPI pins and I2C (TWI) pins are not in the same place as on the Uno.

That is the main difference, but there are a few other things different between the Uno and the Mega.
The mega has 8K of RAM vs. 2K (so if you need to store a lot of big variables, use the Mega), as well as more Flash memory (248K usable vs. 31.5K usable) and more non-volatile EEPROM (4K vs. 1K) [13].

Why we choose the Arduino instead of PIC?

The biggest difference is that a PIC is just a chip, while an Arduino is a platform. Yes the Arduino is expensive to have multiples, but it is rather plug and play, the PIC will require some external circuitry. If you are looking for something a little more apples to apples check out the chip that controls the Arduino. It is an Atmel part. The Arduino provides a layer of abstraction from most of the natty gritty aspects of the chip, while there are no any similar programs for the PIC.

The PIC can be programmed in asm or C, the same as the Atmel AVR chips. The Arduino is simpler for quick prototyping. The biggest advantage of the Arduino as a platform is that the system (the shields, the programming environment, and the documentation) allows for fast and simple setups with minimal debugging of the processor circuits, they work. That was rather rambling and I'm sorry but it kind of came out as a stream of consciousness [14].

3.4Project Components:

3.4.1 Hardware Components:

Are components and devices that we will use to build our system:

1-Arduino Mega 2560:

"The Arduino Mega 2560 is a microcontroller board based on the ATmega2560 .It has 54 digital input/output pins (of which 15 can be used as PWM outputs), 16 analog inputs, 4 UARTs (hardware serial ports), a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It 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 Mega is compatible with most shields designed for the Arduino. "[15]

Properties:

Microcontroller	ATmega2560
Operating Voltage	5V

Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	54 (of which 15 provide PWM output)
Analog Input Pins	16
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	256 KB of which 8 KB used by bootloader
SRAM	8 KB
EEPROM	4 KB
Clock Speed	16MHz

Table 3.7 Properties of Arduino

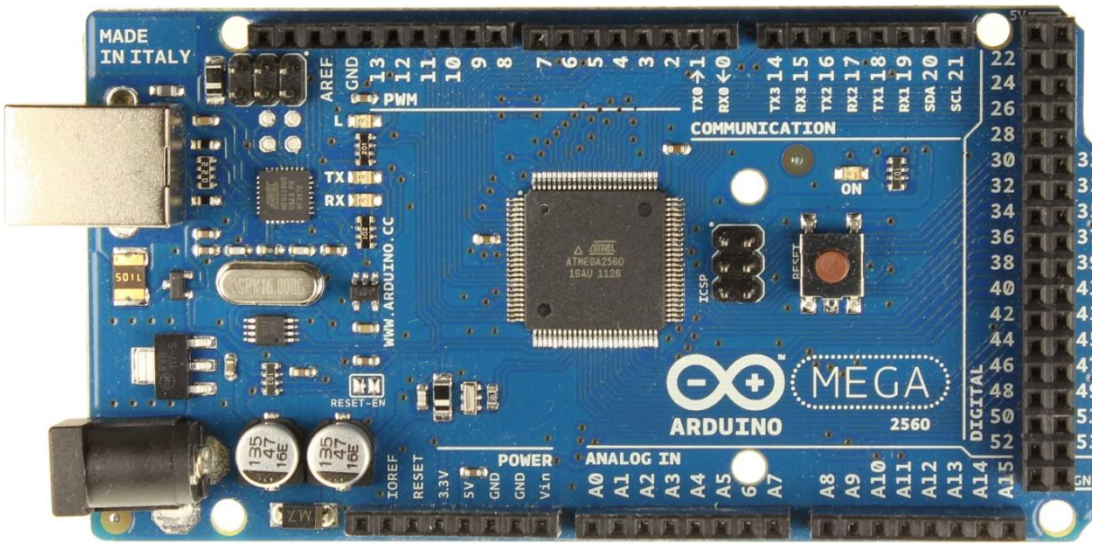


Fig 3.4 Arduino microcontroller

In our system we will use the Arduino as a microcontroller for our system; we will connect it with other components and devices to achieve all the requirements. It will be connected with the reader, it will receive a signal from the reader and based on this signal the Arduino will behave whether to open the door or not, or to enable the buzzer.

2-MQ2 Gas sensors:

The MQ series of gas sensors use a small heater inside with an electro-chemical sensor. They are sensitive for a range of gasses and are used indoors at room temperature, this sensor detect the CO_2 gas.

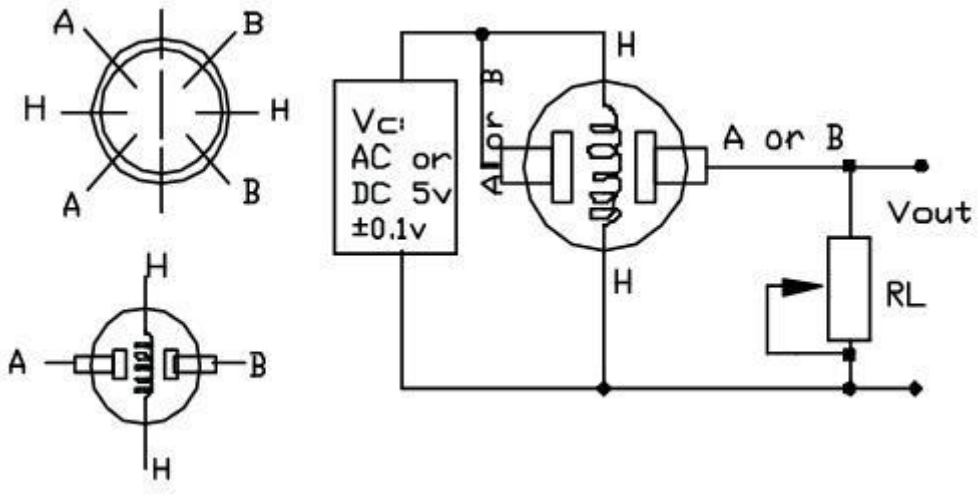


Fig3.5 MQ CO_2 GAS sensor

In the picture, the heater is for +5V and is connected to both 'A' pins. This is only possible if the heater needs a fixed +5V voltage.

The variable resistor in the picture is the load-resistor and it can be used to determine a good value. A fixed resistor for the load-resistor is used in most cases.

The Vout is connected to an analog input of the Arduino. [16].

Application:

1. Gas leak detection for houses, workshops, commercial building, Fire, Safety detection system.
2. Coal gas, CO etc gas detection for houses/workshops/commercial building
3. Gas leak alarm, Gas detector.

Feature:

1. High sensitivity.
2. Fast response.
3. Wide detection range.
4. Stable performance and long life.
5. Simple drive circuit. [17].

3. Magnetic card reader:

Every student of our university has a magnetic card to prove his identity to this

university, and our system is based on this card, the card contains a Student ID. " A magnetic card is a rectangular plastic object that contains either a magnetic object embedded within the card or a magnetic stripe on the card's exterior. A magnetic card can store any form of digital data." [18].

As we mentioned previously, this reader will be connected to the microcontroller, when the user passes his card the reader will send a signal to the microcontroller, the reader will check the identity of the user and check his security level. Based on that the door will open or not.

3-RDIF Reader ID-20LA:

"RFID (radio-frequency identification) is the wireless non-contact use of radio-frequency electromagnetic fields, for the purposes of identifying and tracking tags attached to objects. This is the ID-20LA, a very simple to use RFID reader module from ID Innovations. With a built in antenna, the only holdup is the 2mm pin spacing (breakout board available below). Power the module, hold up a 125 kHz card, and get a serial string output containing the unique ID of the card.

The new ID-20LA is essentially the same as the older ID-20, but has a lower input voltage."

Features:

- 2.8 - 5V supply.
- 125kHz read frequency.
- EM4001 64-bit RFID tag compatible.
- 9600bps TTL and RS232 output.
- Magnetic stripe emulation output.
- Read range of 180mm [19].

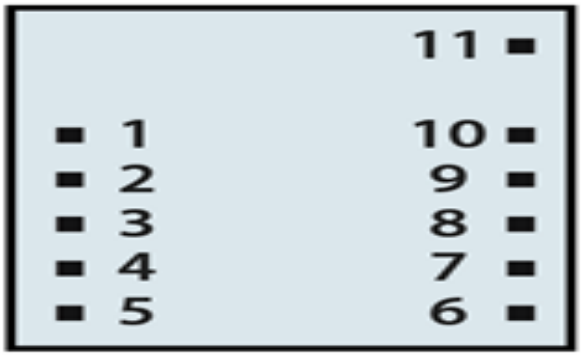


Fig 3.6 Pins of ID20-LA

1.	GND	5.	CP	9.	D0 (Data|)
2.	RES(Reset)	6.	Tag in Range	10.	Read (LED /Beeper)
3.	NC	7.	Format Selector	11.	+2.8V thru +5.0V
4.	NC	8.	D1 (Data Pin 1)		

Table 3.8 RDIF Reader ID-20LA pins

4. Bluetooth Receiver Mate Silver:

We choose this specific technology, in case the user has forgotten his magnetic card, he/she can send a specific code using an enabled Bluetooth device.
A Bluetooth receiver will be used and connected with the Arduino mega, to increase the flexibility of the system.

Features:

- Designed to work directly with Arduino Pro's and LilyPad main boards
- Low power consumption : 25mA avg
- Encrypted connection
- Frequency: 2.4~2.524 GHz
- Operating Voltage: 3.3V-6V
- Serial communications: 2400-115200bps
- Operating Temperature: -40 ~ +70C
- Built-in antenna [20].

5. Buzzers:

Buzzer is an alarm that will be used to notify the users that there is a fire emergency.

3.4.2 Software Components:

Software components that we will use in our project are as following:

1. Microsoft office 2007: we will use it to document and edit all the work and to write chapters.

2. Rational rose: this software will be used to draw all the diagrams needed such as class diagram and activity network diagram.

3. Microsoft visual studio: this will be used to writ the code and to compile it to see if there are any programming errors.

4. ORCAD: will be used to draw all the block diagrams and circuits needed.

3.5 Summary:

In this chapter we specified all the tasks to be done to complete this project. We determined the resources and components to be used and the dead line. We also determined the budget for hardware and software resources.

4

Chapter Four:

System Analysis and Requirement Specification.

4.1 Overview

4.2 Problem Description and Requirements Definition

4.3 Requirement Description

4.4 CRC Modeling

4.5 Class Hierarchies and Relationships

4.6 Summary

4.1 Overview:

In this chapter we will describe and analyze the system by determining all actors and by writing specific and detailed scenarios. We will also determine classes; draw the class diagrams and CRC tables.

.

4.2 Problem Description and Requirements Identification:

In this section we will describe and explain the system in details. This access control system will provide a high level of security by determining and limiting the entry to the university except for students, instructors and anyone who works in the university.

This will be done by determining levels of authorizations for each person depending on his position in the university, the student doesn't have the same level of authorizations like the instructor, and the instructor doesn't have the same level of authorization like the dean. In this way authorizations will be determined and also depending on the place or building in university, as everybody know that not every building or every room has the same level of security. So by this access control system and by determining level of authorization the security concept will be achieved in the university.

An access controller will be used to control the entry to buildings and offices of the university. To access throw this access controller you must have your magnetic card

of this university that has your ID, password and your level of authorization. The user will pass his/her magnetic card through the reader and the microcontroller will compare the serial number and level of authorization with the data existed in the database, if he is allowed to enter the door will open, then after a period of time, and a message on the LCD will be displayed.

If the user is not allowed to enter a message on the LCD will be displayed to notify the user that he is not allowed to enter, the user can retry to pass the magnetic card.

To increase the flexibility of the access control system the user can use a Bluetooth enabled device such as his/her phone to send ID and password to identify his identity and level of authorization, the user will have an application installed on his/her phone that enable him/her to enter his ID and password then to send it, the Bluetooth receiver will receive this ID and password and pass it to the microcontroller which is going to compare the ID, password and level of authorization with the data existed in the database. If the user is allowed to enter the door will be opened and a message on LCD will be displayed.

Another feature in this system is the fire detection; a fire detector is used to detect any fire emergency. This detector is connected with the microcontroller, if the fire detector detects any fire; it will send a signal to the microcontroller informing it that there is a fire. The microcontroller will open all doors automatically and enable a buzzer, so that everyone knows that there is a fire emergency.

.

This access control system must accomplish all these requirements and objectives:

1- Doors must open or close based on the signals and information from the microcontroller.

2- The software must be able to accomplish the operation of distinguishing levels of authorizations.

3- The software must be able to process data taken from the hardware, and convert it into suitable understandable data.

4- Keeping University safe and secure from fire emergencies.

5- The buzzer must be enabled in a case of any fire emergencies.

6- The system must interface Bluetooth in mobile.

7- Implement Bluetooth functionality with mobile.

8- Provide a high level of security in the university.

9- The software must be able to accomplish the operation of distinguishing levels of authorizations.

10- The software must be able to communicate with the microcontroller.

11- The system must provide ports for future expansion.

4.3 Requirement Description:

Use case: is a notation for modeling user interactions with an existing or envisioned system, the description details the interaction using a sequence of events, use cases and scenarios are used synonymously**.**

Scenario: It's comprised of sequence of events that describe the possible ways for user to interact with the system.

Actors: are users who use this system such as students, instructors and everyone who works in the university.

The following are the scenarios of the system:

Use case	Enabling authorized users to get into the University or the desired building
Primary actor	User
Goal in context	To control entering of users to the university and university buildings depending on authorization level.
Precondition	The user must be a student or instructor or anyone who works in the university, also must have the magnetic card containing the ID and password and level of authorization and must be registered in the system database.

Trigger	User decided to enter a specific place in the university.
Scenario	1. User passes the magnetic card throw the reader. 2. The user's serial number and level of authorization is compared with the database. 3. If the user is allowed to enter depending on his level of authorization the door will open automatically, and door will close automatically after a period of time. 4. A welcoming message will be displayed on the LCD. 5. If the person is not allowed to enter the door will not open and the message will be displayed on the LCD in order to inform the user that he/she is not allowed to enter.
Exceptions	1. If the user is not allowed to enter: the door will not open and the message will be displayed on the LCD in order to inform the user that he/she is not allowed to enter.

Table 4.1 Use case for enabling entrance for authorized people

Use case	Using Bluetooth technology
Primary actor	User
Goal in context	To increase flexibility of the system by allowing the user to access the system using mobile.
Precondition	User must have Bluetooth enabled device to use it to enter

	the code and a mobile application installed on it
Trigger	User decided to use the Bluetooth instead of the magnetic card or forgets the magnetic card and uses this technology instead.
Scenario	1. In case the user wants to enter from the main gate of the university without getting out of his car; he can use this technology by sending a specific code to the microcontroller. 2. If the user forgets his card, he uses a Bluetooth enabled device to send the code to identify his identity.
Exceptions	1. If the microcontroller denies the code: the user will reenter the code. 2. If the user doesn't have a Bluetooth device: call security of the university and allow him to access if possible.

Table 4.2 Use case for using Bluetooth technology

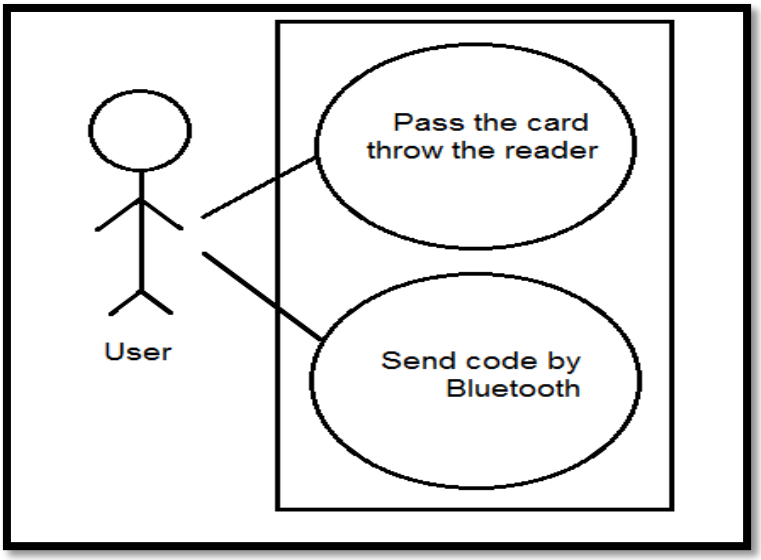


Fig 4.1 Use case diagram for the user

Use case	Fire detection.
Primary actor	System.
Goal in context	Increasing the safety by detecting fires, and facilities the exit of the users from the building safely.
Precondition	A fire detector must be connected with the microcontroller in order to open all doors automatically.
Trigger	Fire accident happens.
Scenario	1. Fire accident happens. 2. Fire detector detects the fire and sends a signal to the microcontroller indicating that there is a fire. 3. System will order microcontroller to open all doors automatically. 4. Alarm of level 3 will be produced.
Exceptions	1. Fire detector breakdown: multi fire detectors can be installed.

Table 4.3 Use case for fire detection

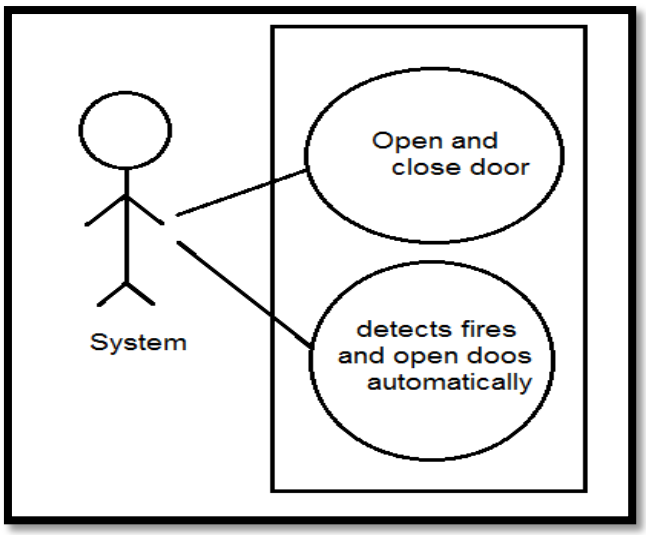


Fig 4.2 Use case diagram for the system

4.4 CRC Modeling:

A Class Responsibility Collaborator (CRC) model is a collection of standard index cards that have been divided into three sections. A class represents a collection of similar objects, a responsibility is something that a class knows or does, and a collaborator is another class that a class interacts with its responsibilities.

In this section we will divide the system to class, and identify the responsibility for each class, and the collaboration with other class.

Class : Access control system	
Responsibility:	**Collaborator :**
Identify the access control systems name/ID/Zone	
Disable the system	
Enable the system	

Table 4.4 CRC model index for access control system class

Class : Door	
Responsibility:	**Collaborator:**
Identify the doors number	

Lock the door	
Open the door	
Incorporates with access control system	Access control system

Table 4.5 CRC model index for door class

Class : Buzzer	
Responsibility:	**Collaborator :**
Identify the buzzers number/ level of sound	
Disable buzzer	
Enable buzzer	
Incorporates with access control system	Access control system

Table 4.6 CRC model index for Buzzer class

Class : Fire detector	
Responsibility:	**Collaborator :**
Identify fire detectors number/statues	

Enable fire detector	
Disable fire detector	
Incorporates with access control system	Access control system

Table 4.7 CRC model index for fire detector class

Class : Identification	
Responsibility:	**Collaborator :**
Identify number/id/level of authorization/ type of identification	
Identify code	
Incorporates with access control system	Access control system
Incorporates with User	User

Table 4.8 CRC model index for Identification class

Class : User	
Responsibility:	**Collaborator :**

Identify user's name/ID/ level of authorization	
Incorporates with identification	Identification

Table 4.9 CRC model index for user class

Class : Bluetooth	
Responsibility:	**Collaborator :**
Lock the door	
Unlock the door	
Incorporates with identification	Identification

Table 4.10 CRC model index for Bluetooth class

Class : Magnetic card	
Responsibility:	**Collaborator :**
Incorporates with identification	Identification

Table 4.11 CRC model index for magnetic card class

Class : Database	
Responsibility:	**Collaborator :**
Get data from database	
Insert data to database	
Update data of database	
Delete data from database	
Incorporates with access control system	Access control system

Table 4.12 CRC model index for Database class

4.5 Class Hierarchies and Relationship:

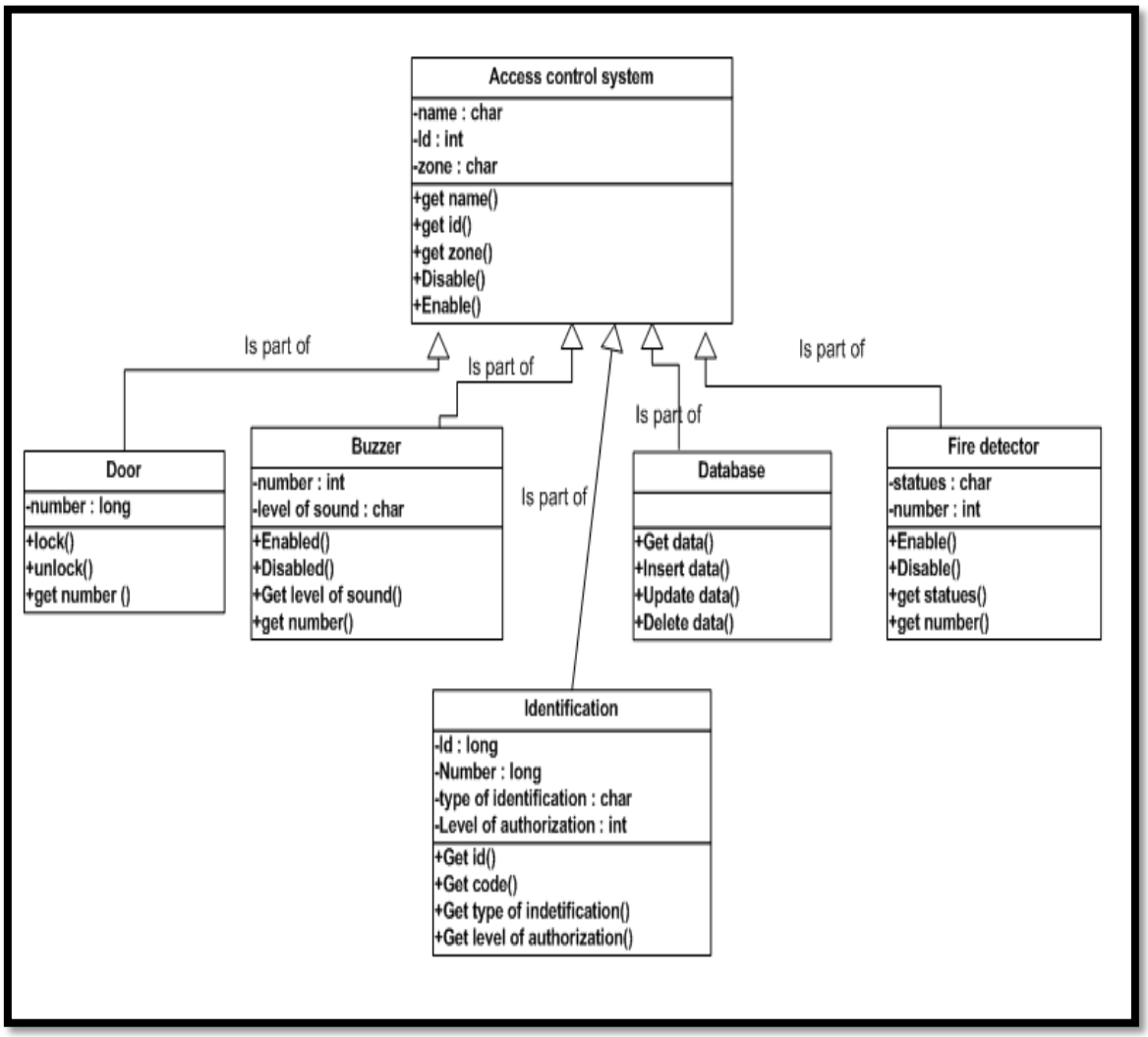


Fig 4.3 Relationship between access controller and other classes

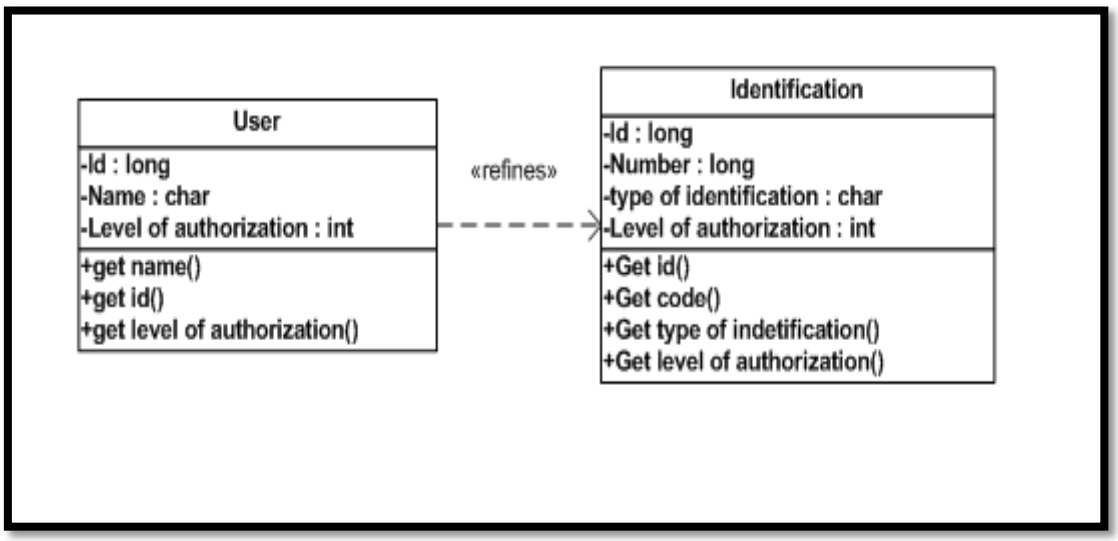


Fig 4.4 Dependency relationship between user class and identification class

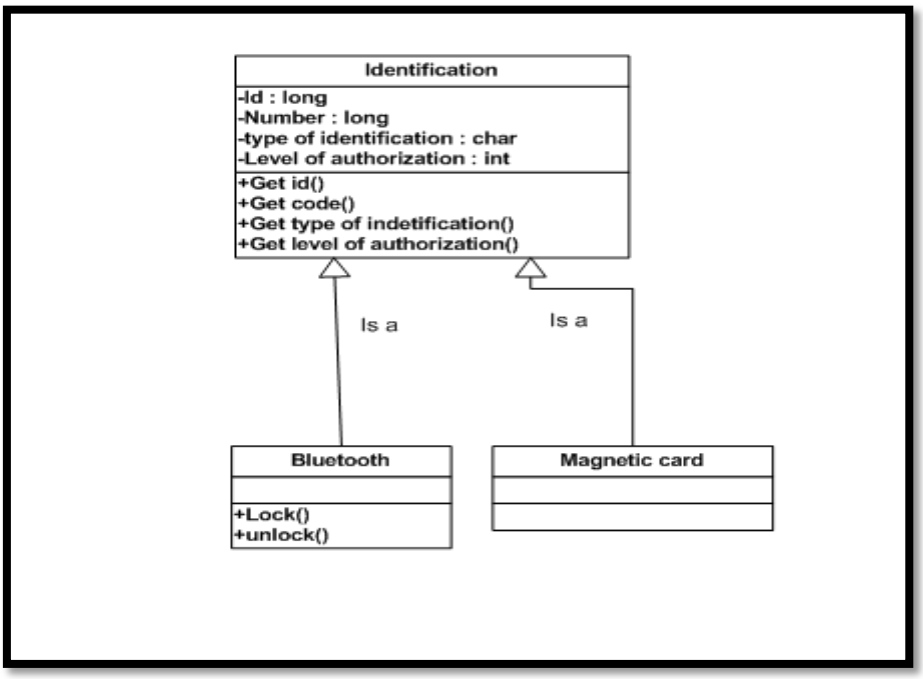


Fig 4.5 Relationship between identification class and other classes

4.6 Summery:

In the end of this chapter we should have an analyzed system that will enable us to design the system as best as possible, by describing the system requirements using the scenarios and user case. We also determined the classes for this system.

5

Chapter Five:

System Design.

5.1 Chapter Overview

5.2 Object Relational Model

5.3 State Behavioral Modeling

5.4 Subsystem Design

5.5 Class and Object Design

5.6 Object Interfacing

5.7 Hardware Interface Design

5.8 Summery

5.1 Chapter Overview:

In this chapter we will define the components, modules, interfaces, and data for the system to satisfy specified requirements.

The following diagram shows the Basic system abstraction diagram, and how components are connected together:

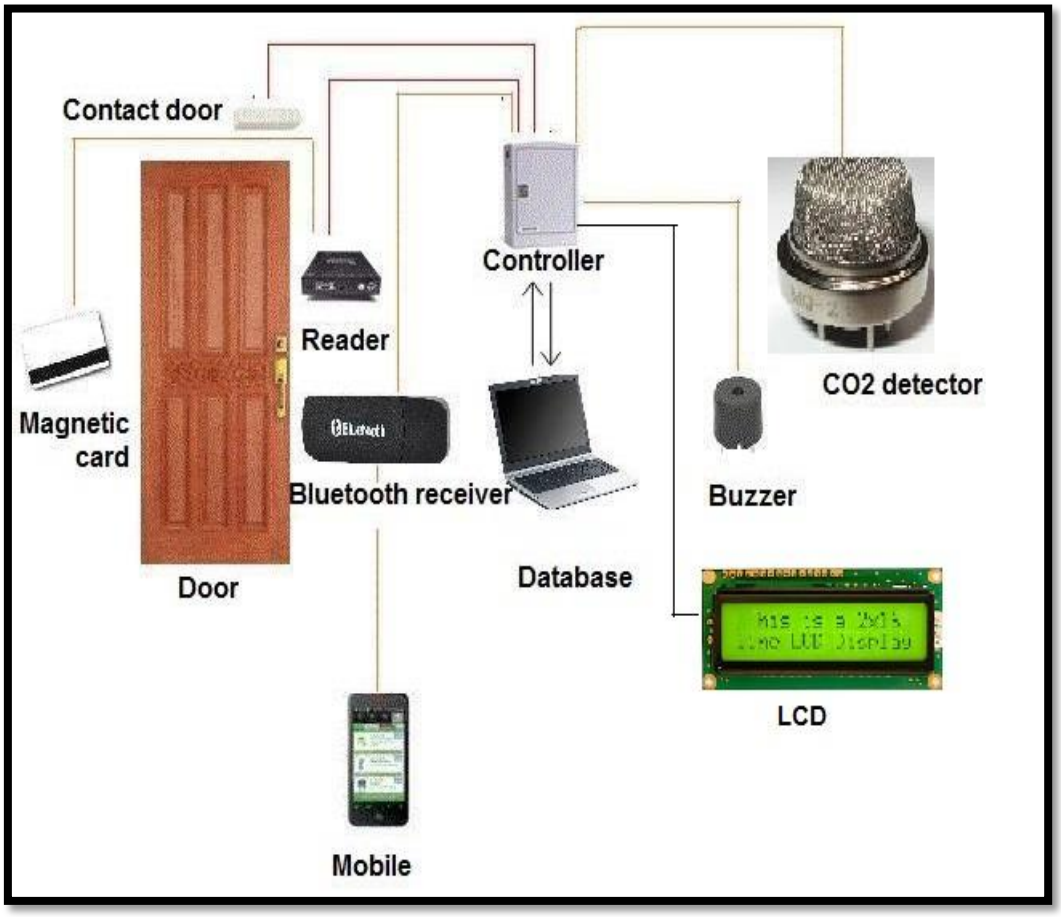


Fig 5.1 Basic system abstraction

5.2 Object Relational Model:

Is a database management system (DBMS) similar to a relational database, but with an object-oriented database model: objects, classes and inheritance are directly supported in database schemas and in the query language. In addition, just as with pure relational systems, it supports extension of the data model with custom data-types and methods. [21]

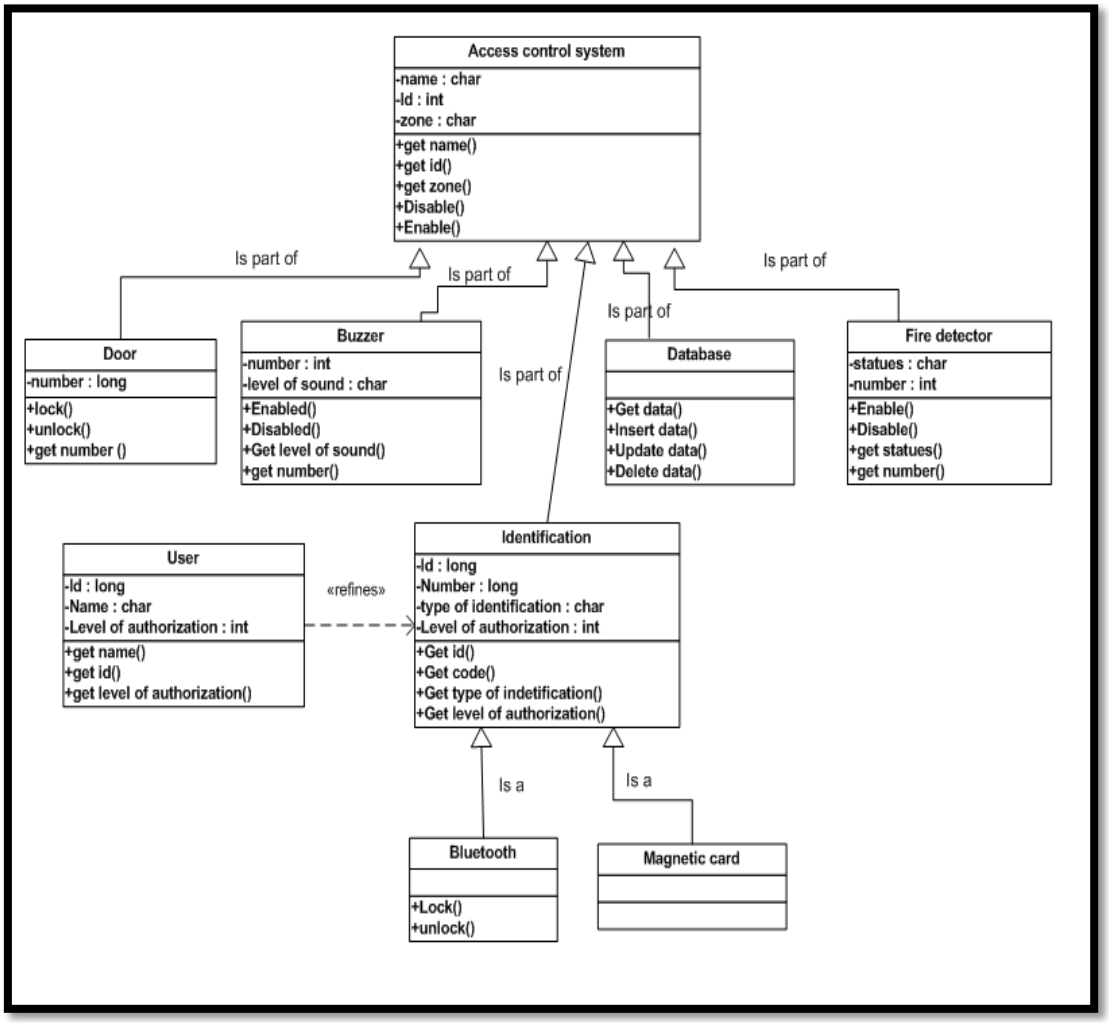


Fig 5.2 Class diagram

5.3 State Behavioral Modeling:

5.3.1 Control Flow:

The following Diagrams are the data flow diagrams for the access control system:

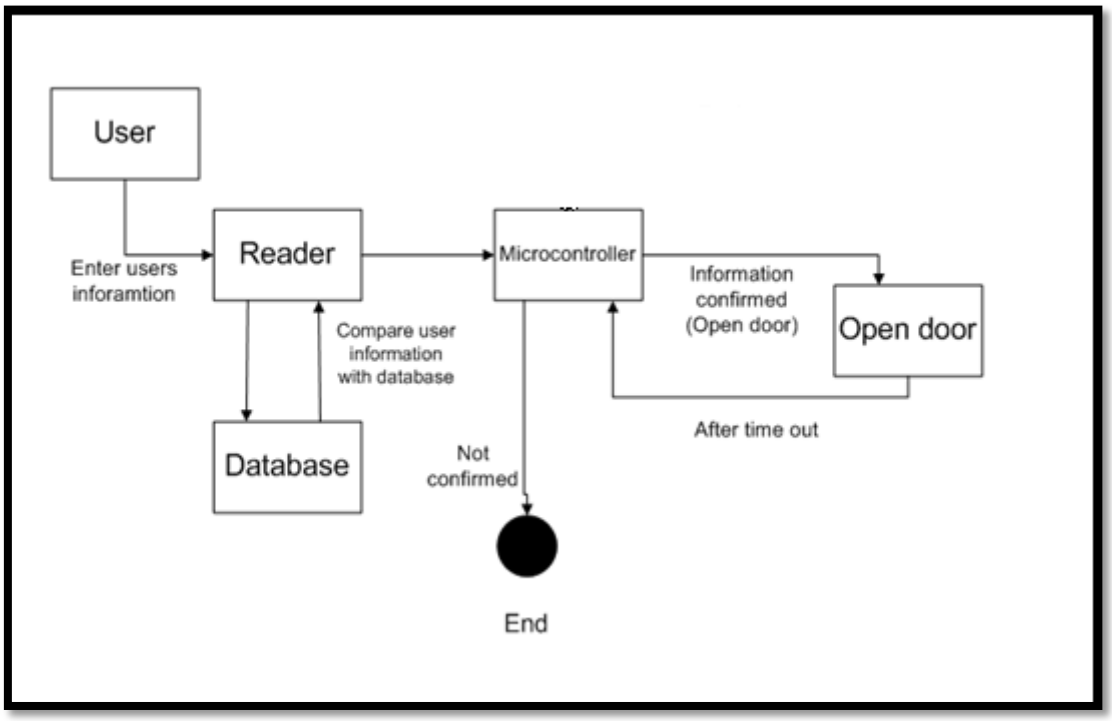


Fig 5.3 Control flow diagram for enabling entrance

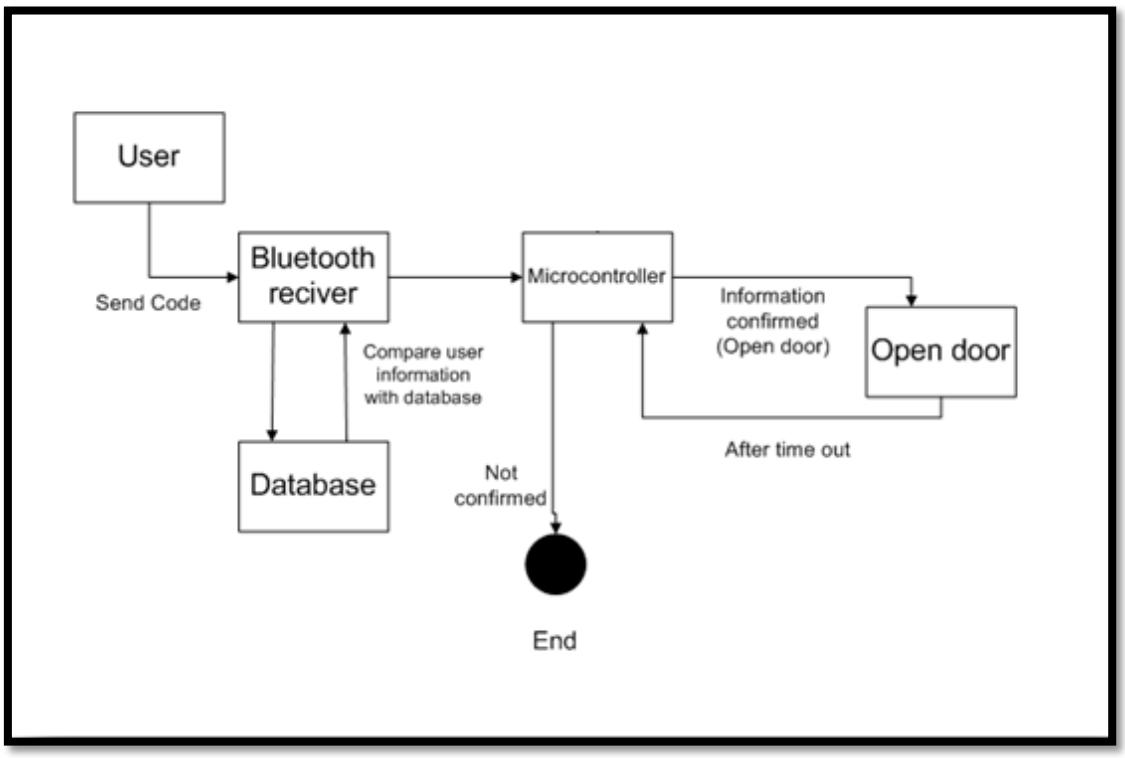


Fig 5.4 Control flow diagram for enabling entrance using Bluetooth technology

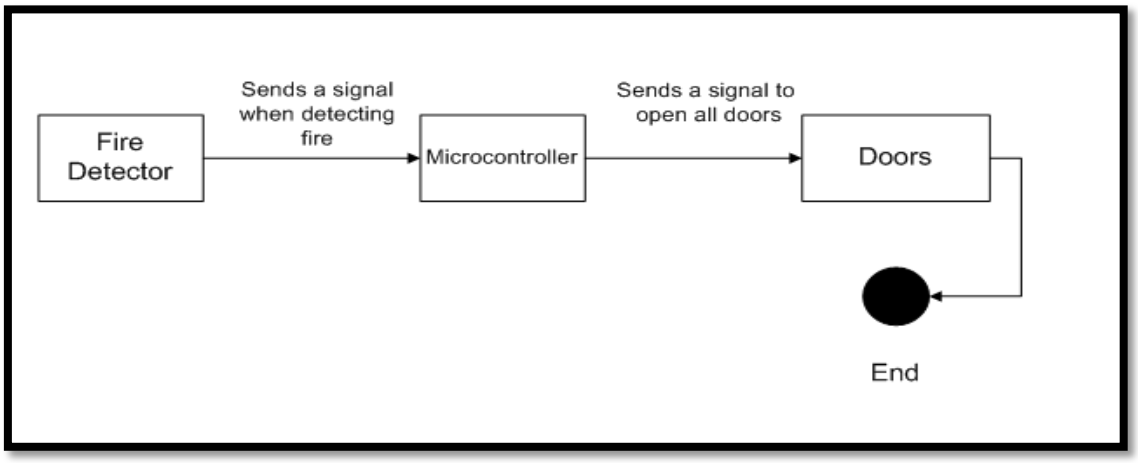


Fig 5.5 Control flow diagram for detecting fires

5.3.2 Date flow:

Data flow is the movement of data between the entity, the process and the data store. It portrays the interface between the components.

The following Diagrams are the data flow diagrams for the access control system:

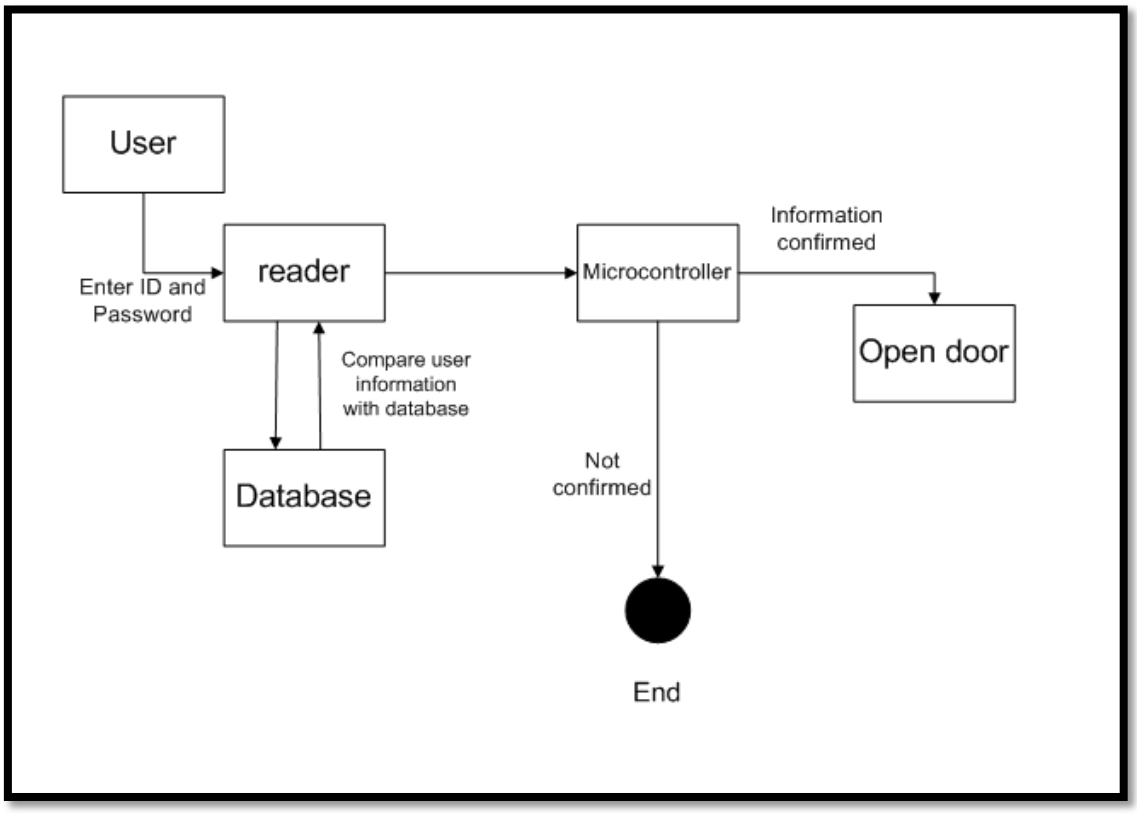


Fig 5.6 Data flow diagram for opening door using magnetic card

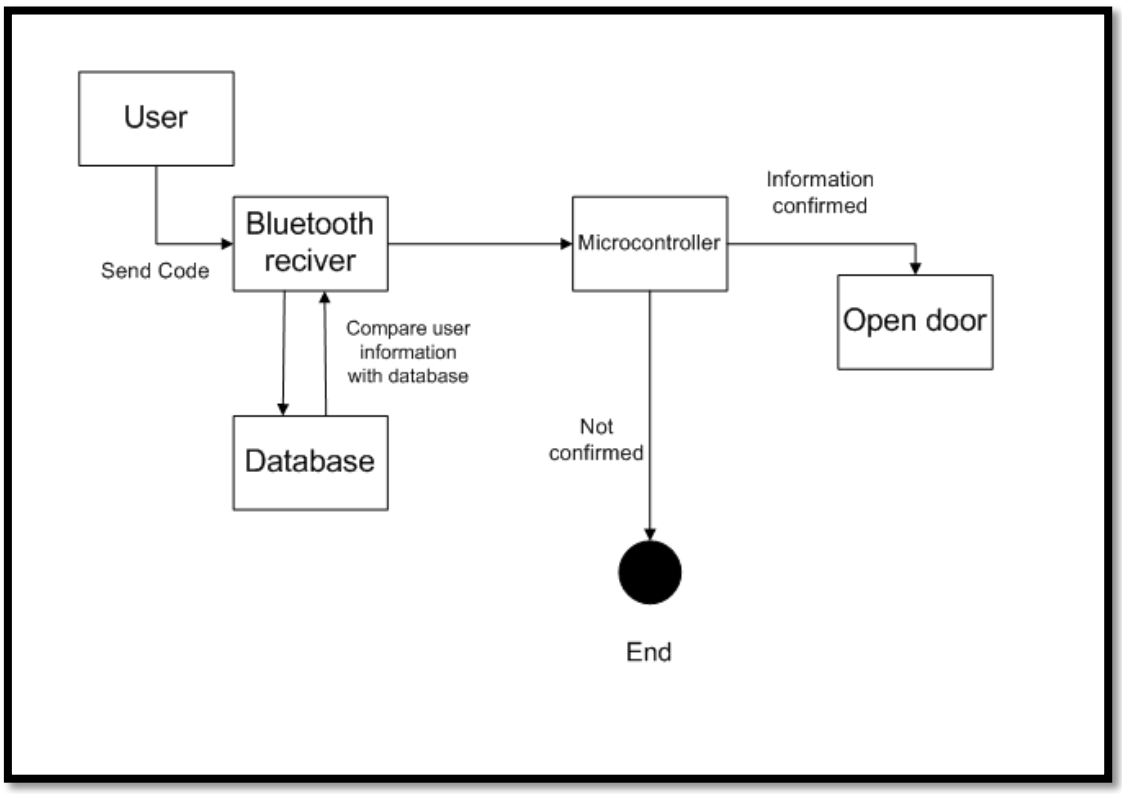


Fig 5.7 Data flow diagram for opening door using Bluetooth

5.3.5 State flow:

State flow is a powerful graphical design and development tool for complex control and logic problems**.**

The following Diagrams are the state diagrams for the access control system:

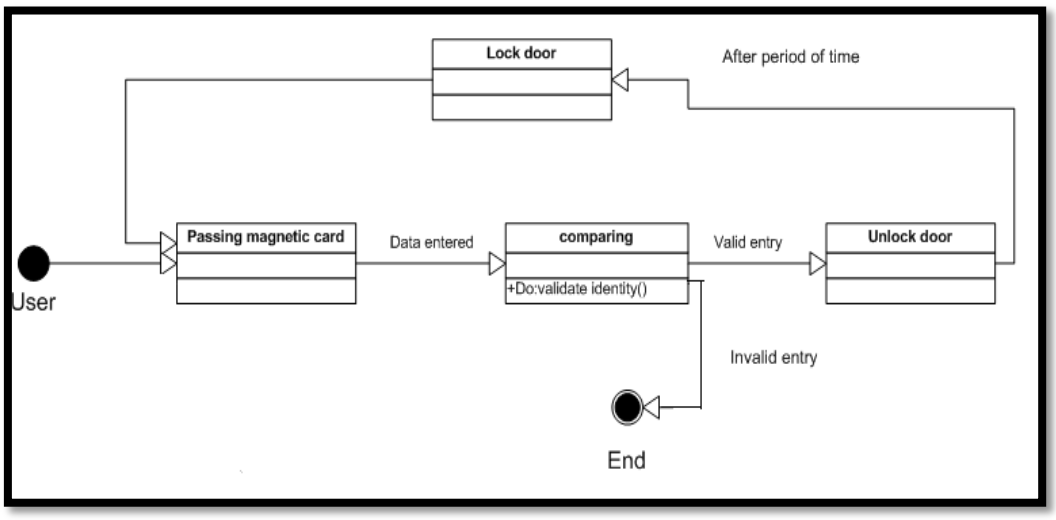


Fig 5.8 State flow diagram for opening door using magnetic card

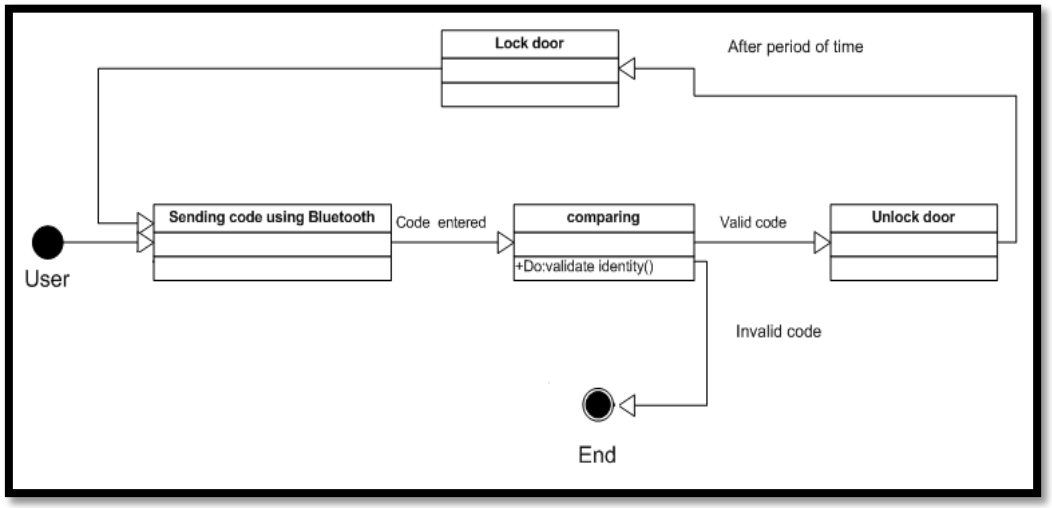


Fig 5.9 State flow diagram for using Bluetooth technology

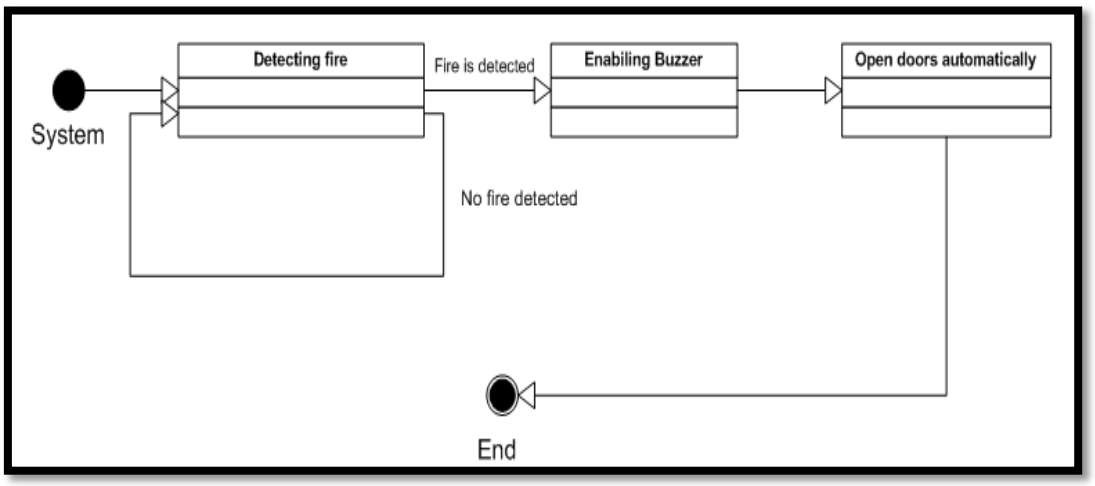


Fig 5.10 State flow diagram for fire detection

5.4 Subsystem Design:

This access control system can be divided into subsystems as following:

1. Access controlling and enabling entrance:

In this subsystem the user enters magnetic valuable card to the reader where it take the information from the reader and store it and then compare it with the information stored in advance valuable Data base so it determines whether this person is allowed to enter this place based on his level of authorizations, and if the information is identical and has the right to Access to this region, the Microcontroller will send a Signal to the door where the door opens for a period of time, but if the information is not identical, the door does not open.

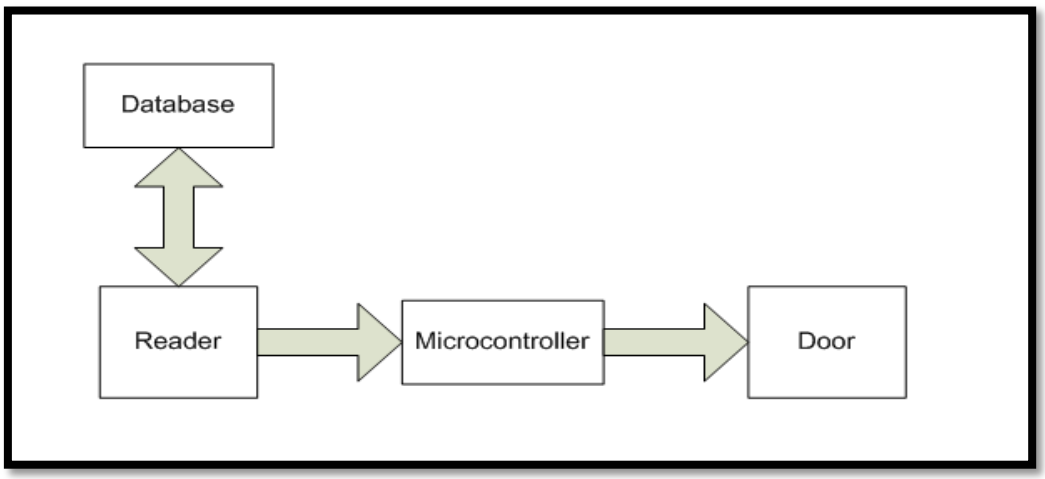


Fig 5.11 Access controlling and enabling entrance subsystem

2. Bluetooth technology:

The second subsystem is the Bluetooth technology, the user will enter the ID and password by Bluetooth using enabled Bluetooth device like mobile, the Bluetooth receiver will receive this ID and password and pass it to the microcontroller which is going to compare the ID, password and level of authorization with the data existed on database. If he is allowed he can choose to open the door and to close it after he enters.

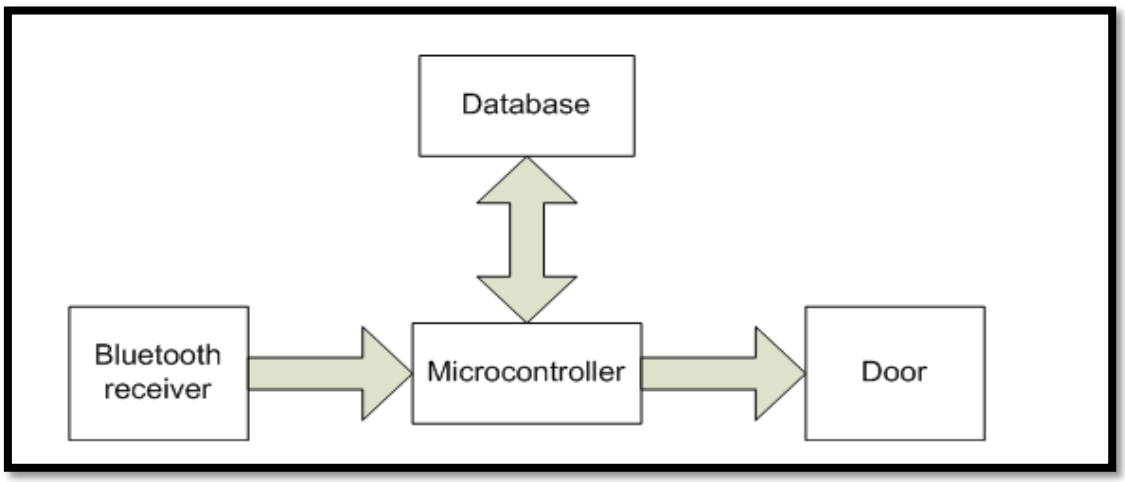


Fig 5.12 Access controlling using Bluetooth technology subsystem

3. Fire detection:

The third subsystem is fire detection, if the fire detector detects any fire, it will send a signal to the microcontroller informing it that there is a fire. The microcontroller will open all doors automatically, and a buzzer of level three will be produced in order to inform people that there is a fire in the building.

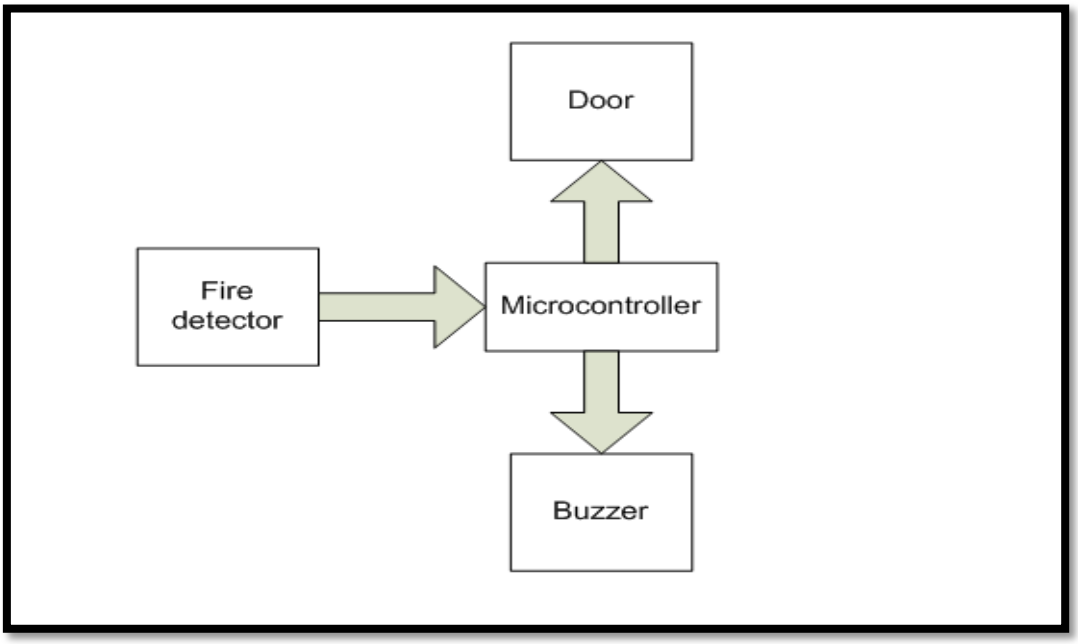


Fig 5.13 Fire detection subsystem

5.5 Class and Object Design:

This section gives more implementation details about each class and operations.

Class name: access control system

The access control system class shows the attributes and the operations of the access control. And the access control makes control of system.

Attributes:

-name: char: this system is designed for multiple zones, and we have many access controllers, each one have name depends on the place or buildings name.

-Id: int: id of an access control identification number of type positive integer. And this number is unique.

-Zone: char: to specify which zone.

Functions:

+get name (): name is a public function which returns a value of type char. And return the name of access control.

+get id (): is a public function which returns a value of type int. And return the number of access control in the system.

+get zone (): is a public function which returns a value of type char. And return the name of zone.

+Disable (): is a public function which does not return any value. When this function is called, this function will disable the system when needed.

+Enable (): is a public function which does not return any value. When this function is called, this function will enable the system when needed.

Class name: access control system
-Name. -ID -Zone.

+Get name.
+Get ID
+Get zone
+Disable
+ Enable

Class name: Door

The Door class shows the attributes and the operations for the door, and our system contains many doors.

Attributes:

-number: long: number of the door in the building, identification number of type positive long.

Function:

+Lock (): this function lock the door after a period time.

+Unlock (): this function unlock door when the id and password correct, and when there is a fire emergency.

Class name: Door
-Number
+Lock +Unlock

Class name: buzzer

The buzzer class shows the attributes and operations of the buzzer. In our system we will use the different levels of buzzer.

Attributes:

-Number: long: number of the buzzer in the buildings, identification number of type positive long.

-Level of sound: char: level of sound is a name that identifies the level of sound of type char. It is a public attribute. There will be 3 levels and they are high, middle and low.

Functions:

+Enabled (): is a public function which does not return any value. When this function is called the buzzer will be enabled.

+Disabled (): is a public function which does not return any value. When this function is called the buzzer will be disabled.

+Get level of sound (): is a public function which returns a value level of sound. When this function is called, the value of level of sound store in level if sound attributes.

+Get number (): is a public function which returns number of the buzzer. When this function is called, the value of number store in number attributes.

Class name: Buzzer
-Number -Level of sound
+Enable +Disable +Get level of sound +Get number

Class name: Fire detector

The fire detector class shows the attributes and the operations of fire detector, the system contains many fire detectors.

Attributes:

-Statues: char: is a name that identifies the statues of the fire detector.

-Number: long: number of the fire detectors in buildings in system.

Functions:

+Enable (): is a public function which does not return any value. When this function is called it will enable fire detector.

+Disable (): is a public function which does not return any value. When this function is called it will disable fire detector when needed.

+Get statues (): is a public function which returns the statues of the fire detector.

+Get number (): is a public function which returns number of the fire detector. When this function is called it returns number of the fire detector.

Class name: Fire detector
-Number -Statues
+Enable

+Disable +Get Statues +Get number

Class name: user

The user class shows the attributes and the operations for user, the system depend on the user and cannot be complete without user.

Attributes:

-Name: char: it's a name that identifies the name of user. It is public attribute.

-ID: int: user ID is a user identification number of type positive integer. It is a private attribute.

-Level of authorization: int: this attribute will identify the level of authorization for each user.

Functions:

+Get Name (): is a public function which returns a value of type char. And return the name of user.

+Get ID (): is a public function which returns a value of type int. And return the ID of the user to identify his identity in the system.

+Get Level of authorization: is a public function which returns the level of authorization of the user.

Class name: User
-Name -ID -Level of authorization
+Get level of authorization +Get ID +Get name

Class name: **Identification:**

This class shows the attributes and operations of the identification class, identification which identify the user in the system.

Attributes:

-ID: int: identification ID is an identification of the type that user use, whether he uses magnetic card or Bluetooth. It is a private attribute.

-Type of identification: char: identifies which type the user will use whether he uses magnetic card or Bluetooth.

-Level of authorization: int**:** identifies the level of authorization of user.

Functions:

+Get ID (): is a public function which returns value. When this function is called, it returns the value id stored in id attribute.

+Get Number (): is a public function which returns value. When this function is called, it returns the value of number stored in number attribute.

+Get Type of Identification (): is a public function which returns value. When this function is called, the value stored in the type of identification attribute is returned.

+Get level of authorization (): is a public function which returns value. When this function is called, the value stored in the level of authorization attribute is returned.

Class name: Identification
-Number -ID -Level of authorization -Type of identification
+Get level of authorization +Get ID +Get number +Get Type of identification

Class name: Magnetic card

This class inherits identification class and has the same operations and attributes of identification class.

Class name: Bluetooth

The Bluetooth class shows the attribute and the operation of the Bluetooth, and this class inherits identification class and has extra operation like lock and unlock.

Functions:

+Lock () this function lock the door when the user want to lock the door using Bluetooth.

+Unlock (): this function unlock door when the Id and password correct, and when the user choose to open the door.

Class name: Bluetooth
+Lock +Unlock

Class name: Database

This class shows the functions of the database, this database is connected with the system.

Functions:

+Get data (): this function is used to get data from the database.

+Update data (): this function is used to update data in the database.

+Insert data (): this function is used to insert data into the database.

+Delete data (): this function is used to delete data from the database.

Class name: Database
+Get data +Update data +Insert data +Delete data

5.6 Object Interfacing:

5.6.1 Software Interface Design:

This section will be explained using sequence diagrams.

The following diagrams are the sequence diagrams for the access control system:

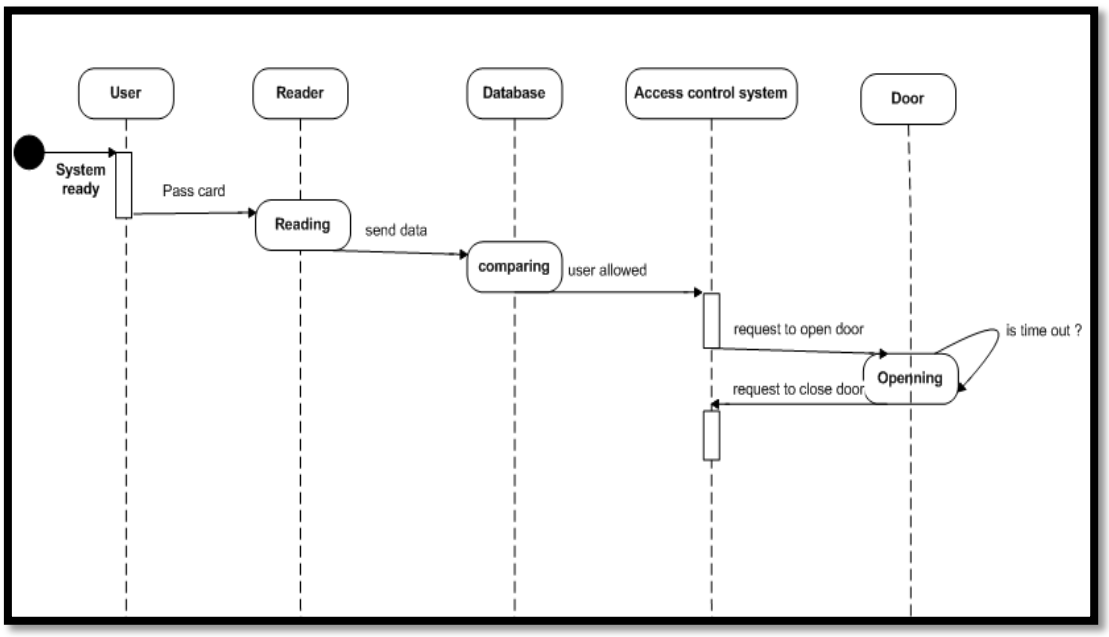


Fig 5.14 Sequence diagram for opening door using magnetic card

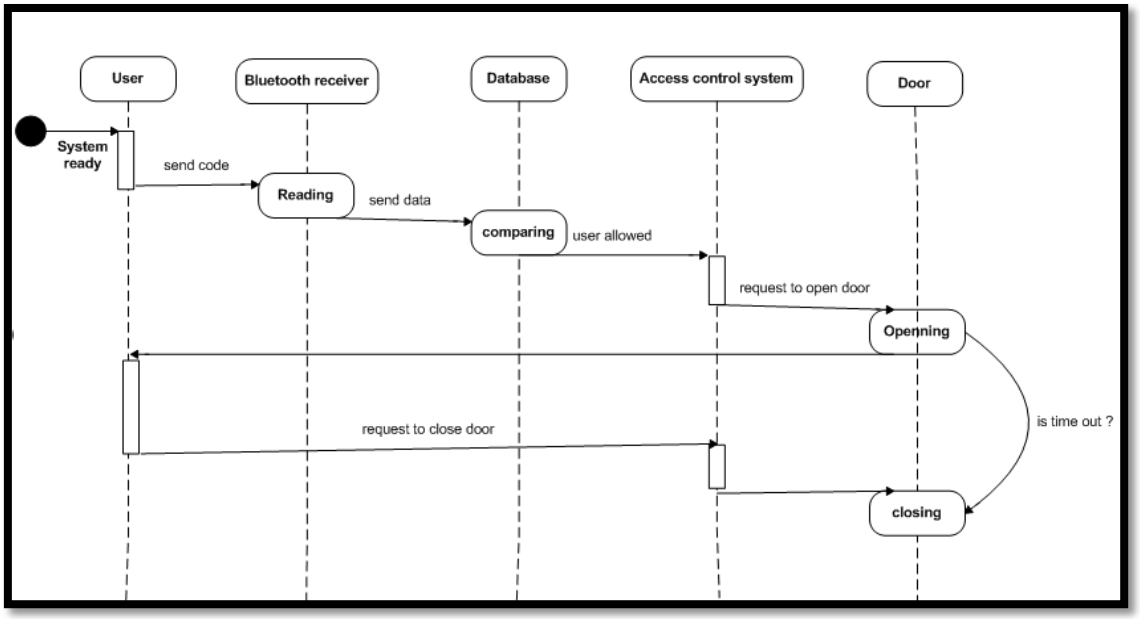


Fig 5.15 sequence diagram for Bluetooth technology

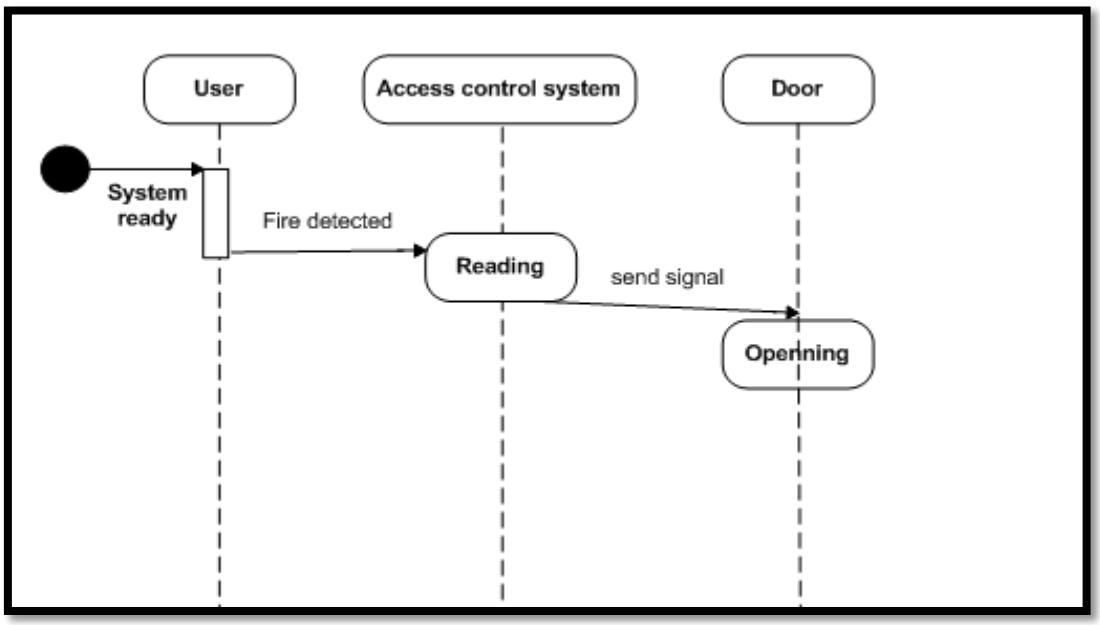


Fig 5.16 sequence diagram for fire detection

5.6.2 User Interface:

The interfaces that will be implemented in this project are as following: In case the user want to access using the Bluetooth, he must have an application installed on his Bluetooth enabled device, and will be asked to enter his ID and password as shown in the following figure.

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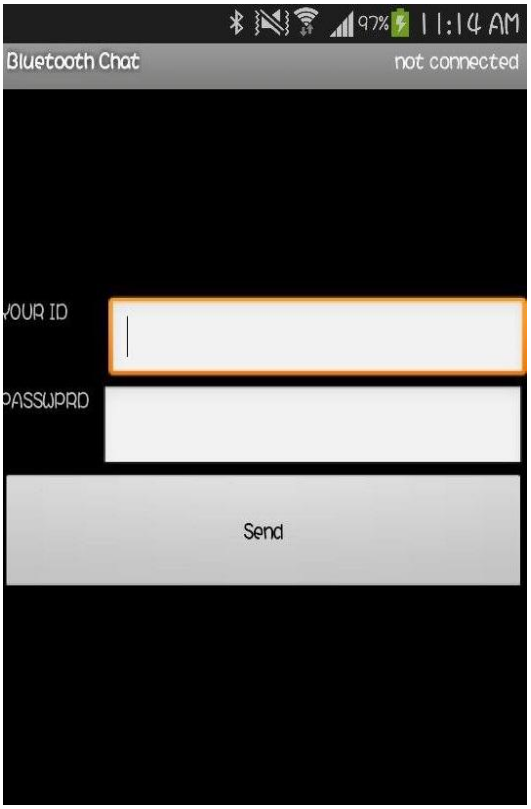


Fig 5.17 Interface for entering user's information

5.7 Hardware Interface Design:

The following diagram shows the general block diagram and how the components are connected together:

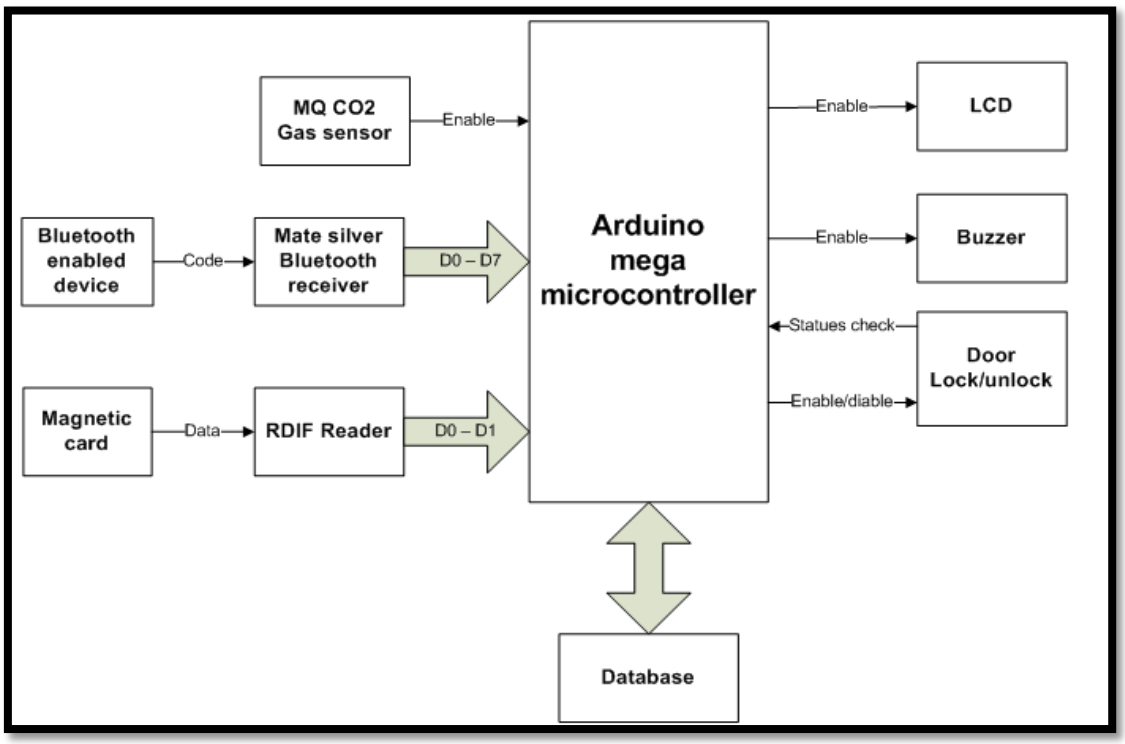
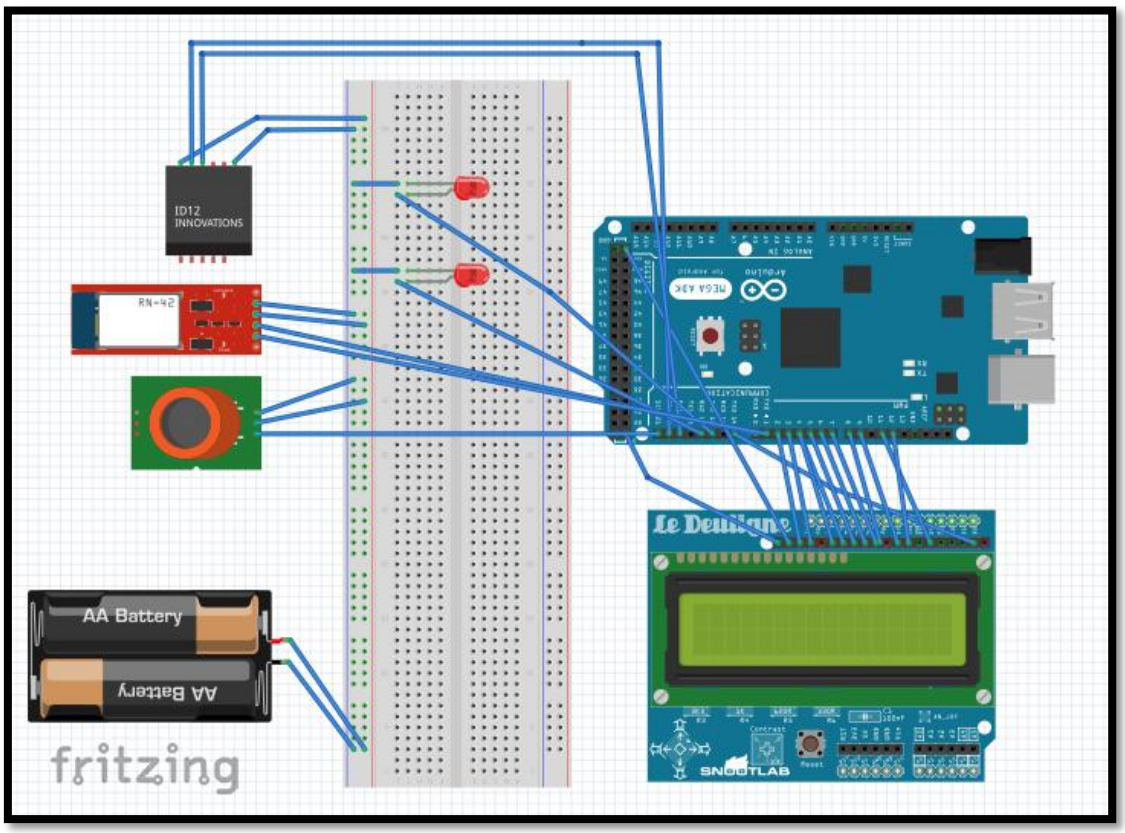


Fig 5.18 General block diagram



5.19 Detailed block diagram

5.8 Summery:

In this chapter we defined the components, modules, interfaces, and data for the system to satisfy specified requirements. We also have drawn control, data, state diagrams and block diagram. In addition to that we have drawn the design of the access control system in order to use it to implement the system.

6

Chapter Six

System Implementation

6.1 Overview

6.2 System Implementation

6.3 Integrated System Implementation

6.4 Summary

6.1 Chapter Overview:

In this chapter we will show and explain the implementation of the system in addition to explain each stage in preparing and executing the project.

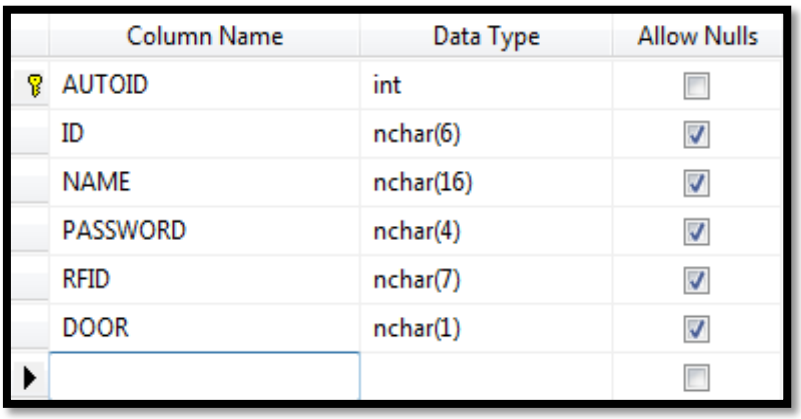
6.2 System Implementation:

In this section we will divide all of the work into number of stages.

6.2.1 Database:

First stage of the project is to build the database; we build it using C# language on Microsoft visual studio2010.

The database consists of one table which contains 6 attributes as shown in the figure bellow.



Column Name	Data Type	Allow Nulls
AUTOID	int	☐
ID	nchar(6)	☑
NAME	nchar(16)	☑
PASSWORD	nchar(4)	☑
RFID	nchar(7)	☑
DOOR	nchar(1)	☑
		☐

Fig 6.1 Database attributes

The AUTOID attribute is the primary key for the table; it will be incremented automatically to give each user a number. Then we have the ID which contains the user ID. The NAME attribute contains user full name, the serial number which the reader will read is stored in the RFID attribute, the final attribute is the DOOR attribute, and this one will determine the authorization for each user. For example in the model we built there are 2 doors, value "1" gives you the ability to enter through door1, value "2" gives you the ability to enter through door2, but the value "3" gives you permission for both doors.

The final interface of the database is shown below.

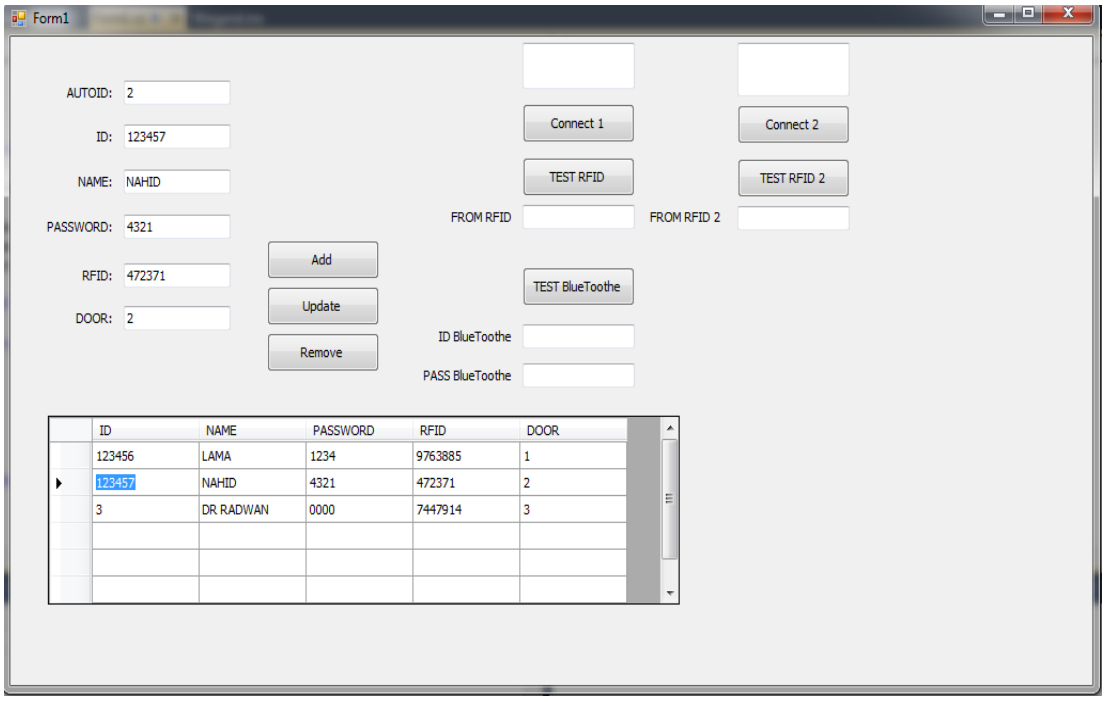


Fig 6.2 Database interface

In the designed model we used 2 doors each one containing a microcontroller in addition to a reader, connect 1 is for door1 and connect 2 is for door 2. As you can

see in the figure, in connect 1 there is a TEST BLUETOOTH button, this one only exist on the connect 1 because only the first door contains a Bluetooth receiver connected to the microcontroller.

6.2.2 Reader Implementation:

The second stage is implementing the RFID reader and connecting it with the microcontroller, In order to enable the functionality of identifying identity using magnetic card.

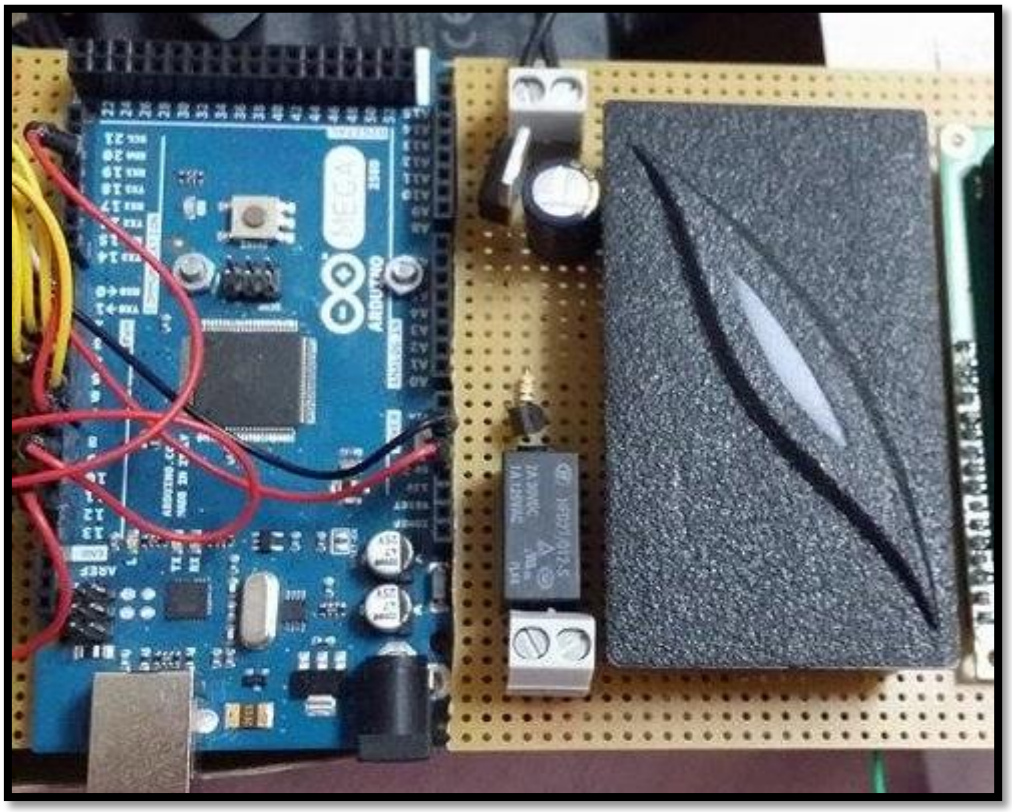


Fig 6.3 RFID reader connected with microcontroller

As shown above the Arduino is connected with the RFID reader and the LEDs only for testing, they are used as indicators for allowed or not allowed user.

The code for implementing the Arduino with the RFID is as shown below, it was connected with LEDs at first for testing and the code is shown in figure 6.4, the results will be shown in chapter 7.

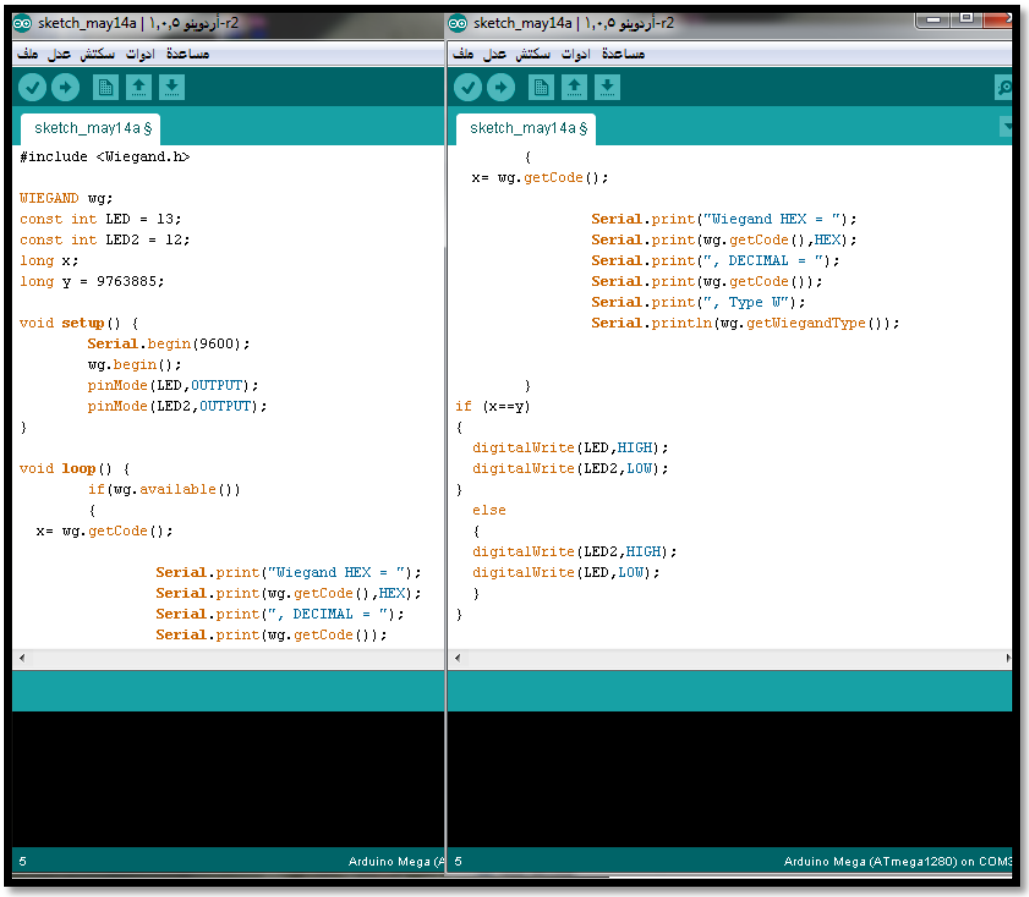


Fig 6.4 Implementation of RFID reader

6.2.3 LCD Implementation:

In this section we will elaborate about the LCD connection with the Arduino microcontroller. The next figure shows the final connection between the Arduino and LCD.

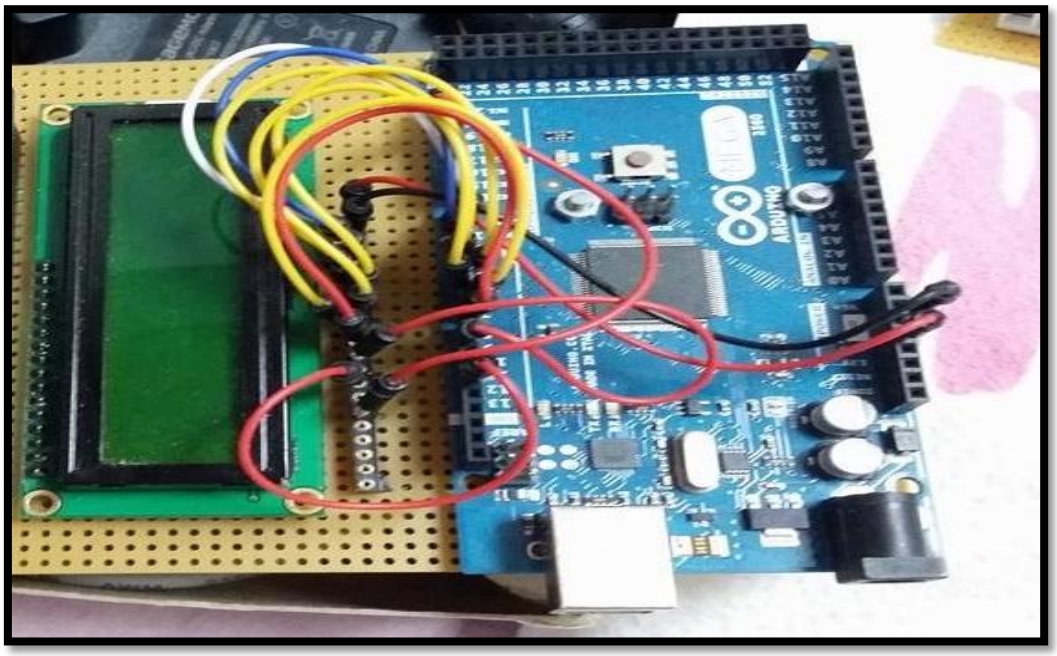


Fig 6.5 LCD and microcontroller connection

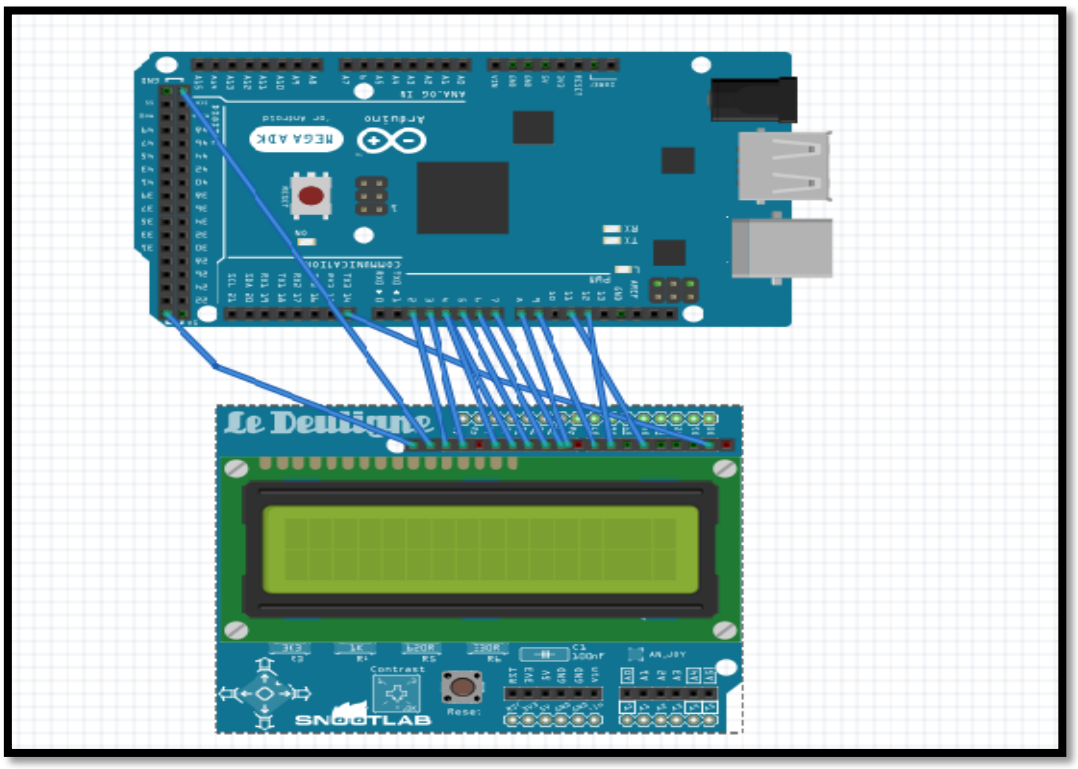


Fig 6.6 LCD and microcontroller connection

The following figure shows the implementation of the LCD with the Arduino.

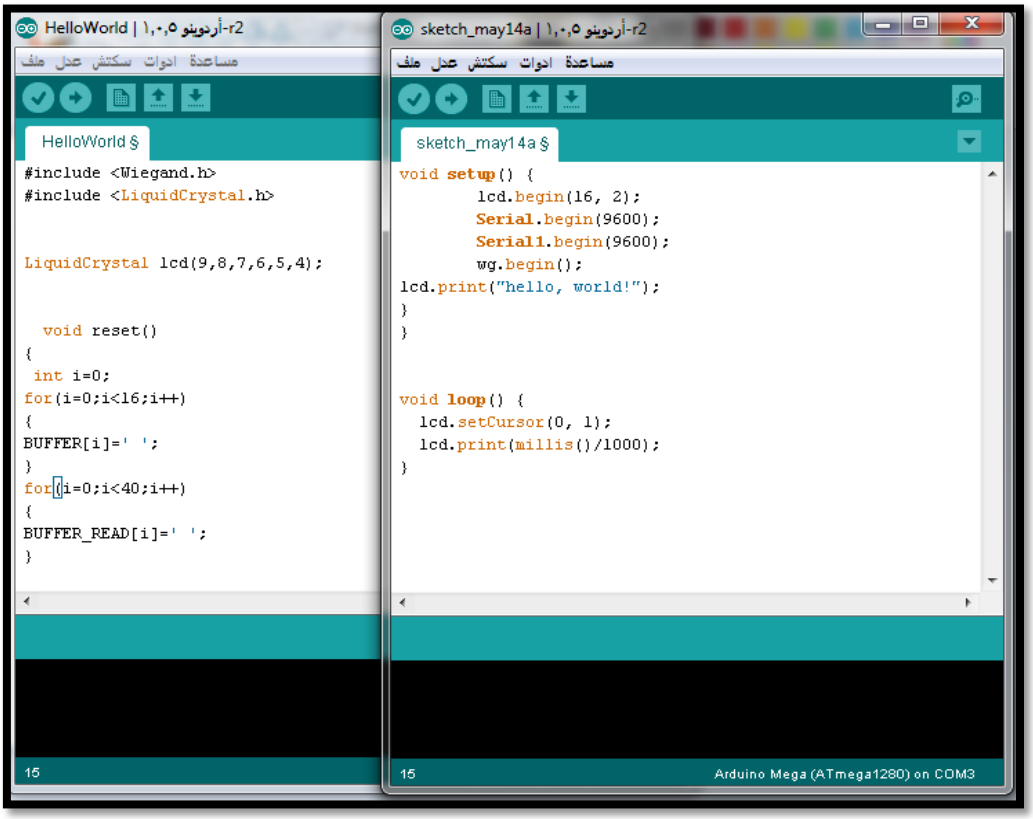


Fig 6.7 LCD Implementation

6.2.4 Implementing MQ2 Sensor:

In this stage we implemented the MQ2 sensor and connected it with the microcontroller. The figure shown below shows the MQ2 sensor in the project.

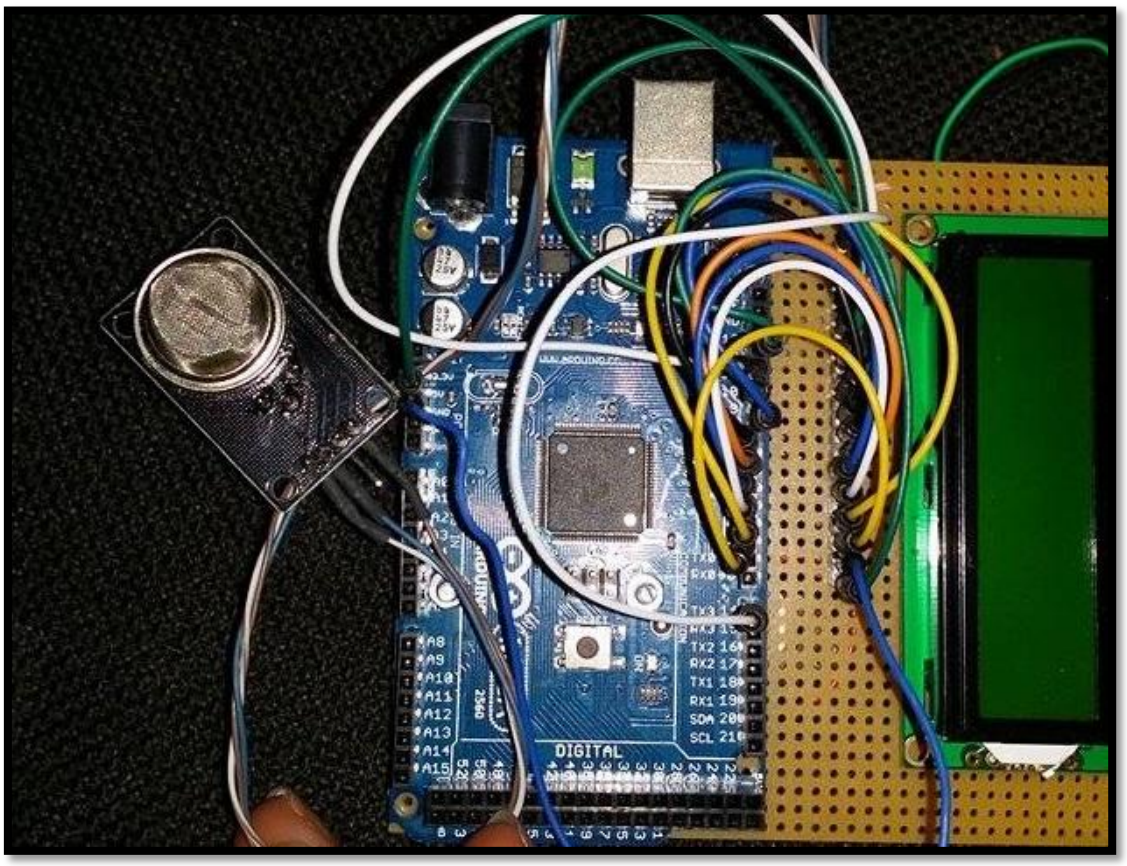


Fig 6.8 MQ2 sensor

The MQ2 has 4 ports which are DO for digital output and AO for analog output and Vcc and ground ports. There is also a potentiometer resistance to adjust the sensitivity. We connected DO Vcc and ground to the microcontroller.

In Figure 6.9 the code for implementing this sensor.

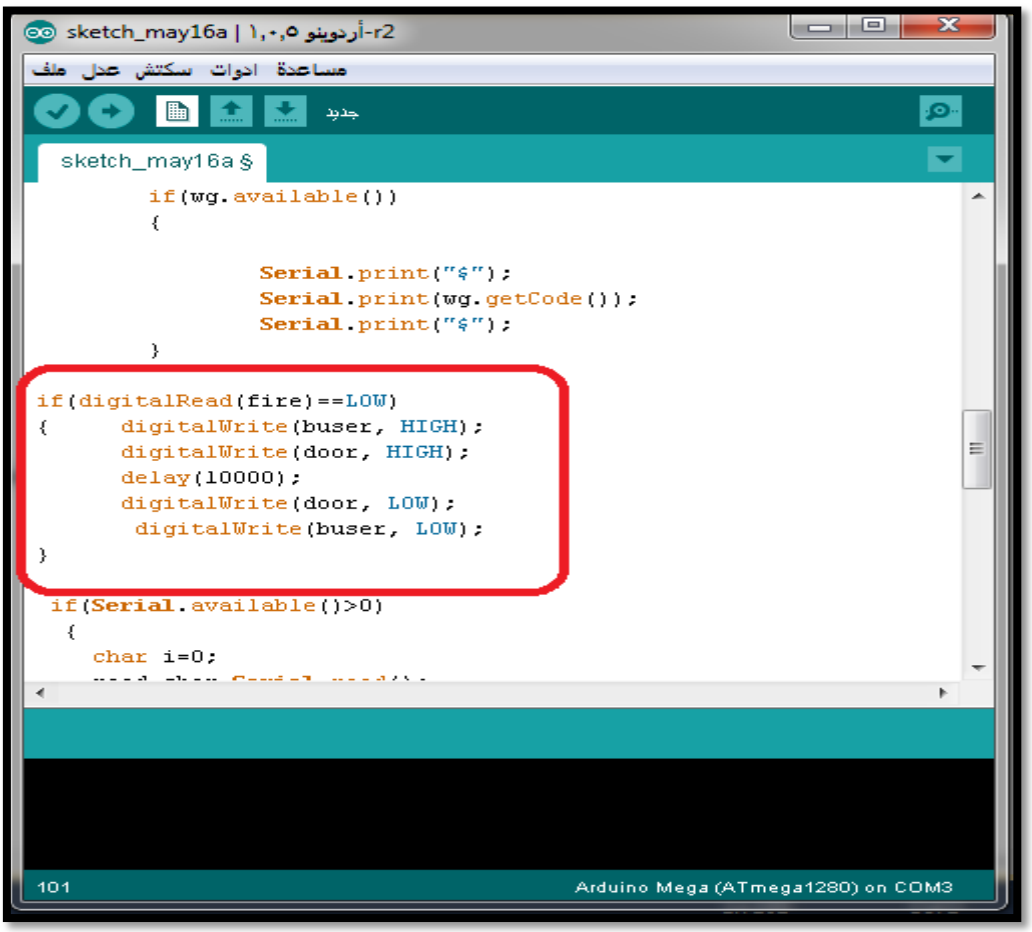


Fig 6.9 MQ2 implementation

6.2.5 Implementing Bluetooth Receiver and Mobile Application:

In this stage we implemented the Bluetooth receiver and connected it with the microcontroller in addition to the mobile application.

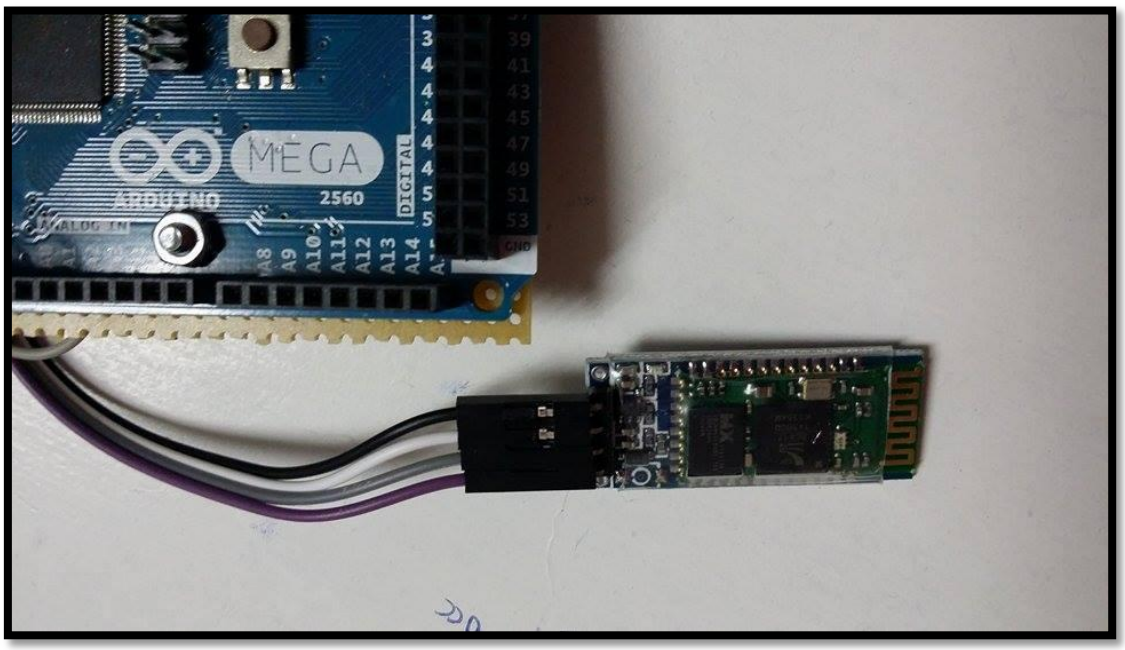


Fig 6.10 Bluetooth receiver connection

As we mentioned in previous chapters, there is an addition option for identifying your identity using mobile application which allows you to send your ID number and password. Figure 6.11 shows the interface of the mobile application and shows the fields in it.

This mobile application had been implemented using eclipse software, using Android environment. The application contains 2 fields and a button, the first field for entering your ID and the second for entering your password. Then you send it to Bluetooth receiver by clicking on SEND.

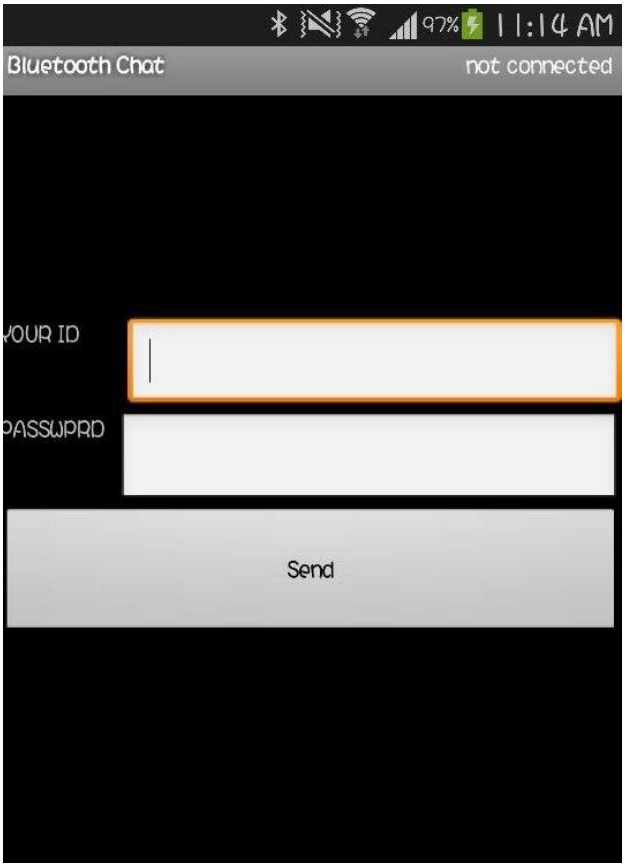


Fig 6.11 Mobile application

6.3 Integrated System Implementation:

The final stage is to connect all the previous subsystems together to get the final circuit. The whole system implemented together as shown in the diagram.

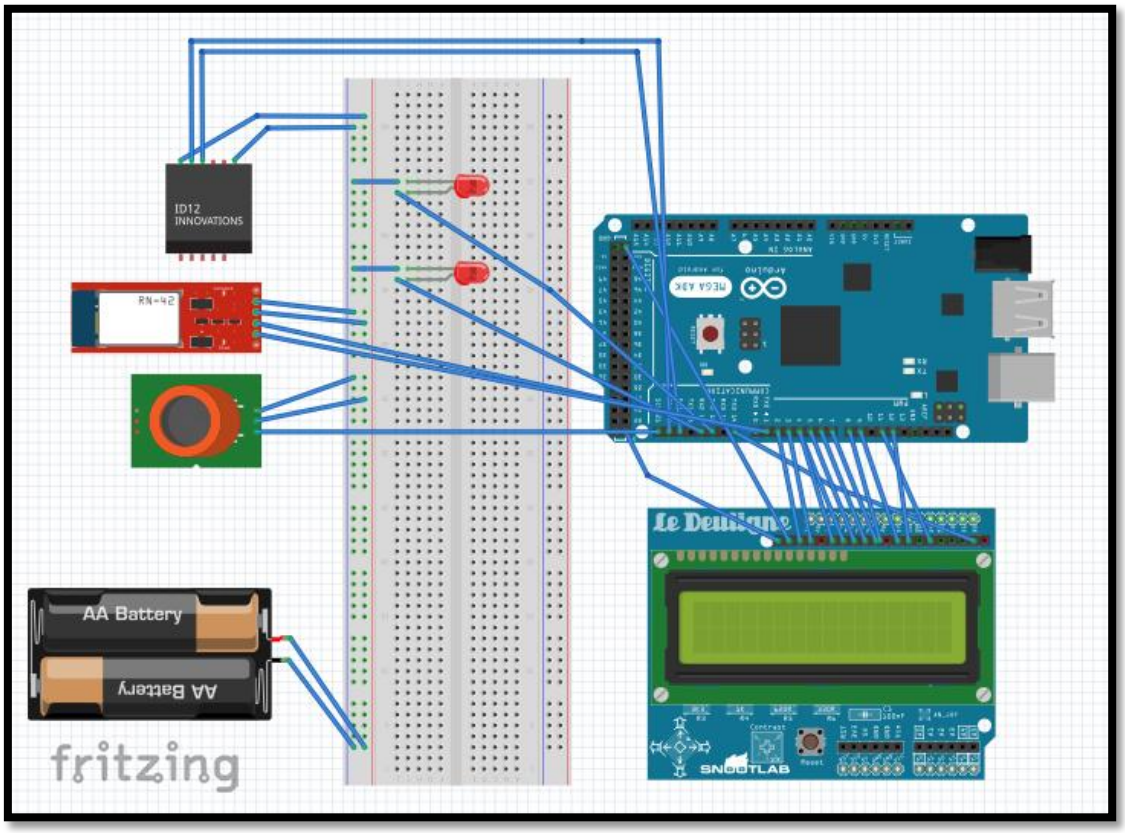


Fig 6.12 The final system

6.4 Chapter Summary:

In this chapter we explained all the work in details, in addition to figures and tables that shows all steps of the project work. Each stage had been explained individually and in next chapter's results of this work is documented.

7

Chapter Seven

System Testing

7.1 Overview

7.2 System Testing

7.3 Summary

7.1 Chapter Overview:

In this chapter Project implementation was done step by step, each step was tested directly and results were recorded. Results of each hardware design and software codes will be presented. Each subsystem will be tested alone and results will be documented, then the whole integrated system together. Figures and tables will be provided in the testing chapter.

7.2 System Testing:

At the beginning we tested each component alone with the microcontroller. This section will provide the testing and all results that accrued during the testing process.

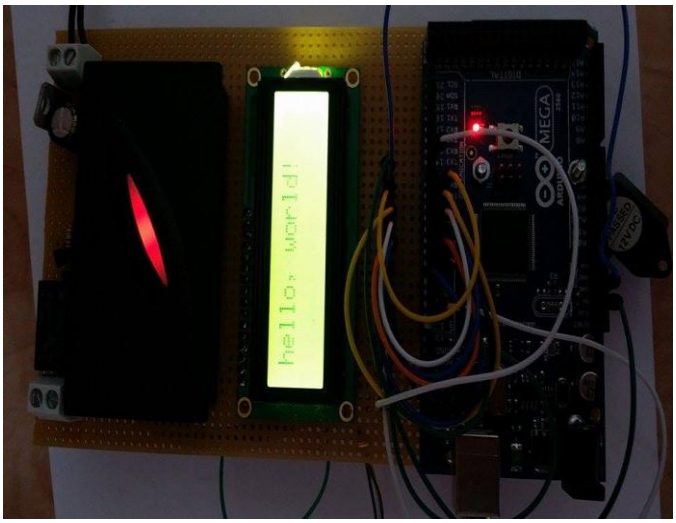


Fig 7.1 Starting the system

In the system there is 2 bored, the first one "con1" contains RFID reader, LCD and the Bluetooth receiver, the second one "con2" contains RFID reader, LCD and the

MQ2 sensor. Both of them are connected to electrical locks to open and close the door.

7.2.1 Con 2 testing:

RFID reader testing:

First, the RFID reader with the microcontroller, We connected them together in addition to LEDs, the LEDs were a substitute of the door, we used them only to test the RFID, if the first LED is ON that means access is granted if the other LED is ON it means access denied. The following figure shows the connection.

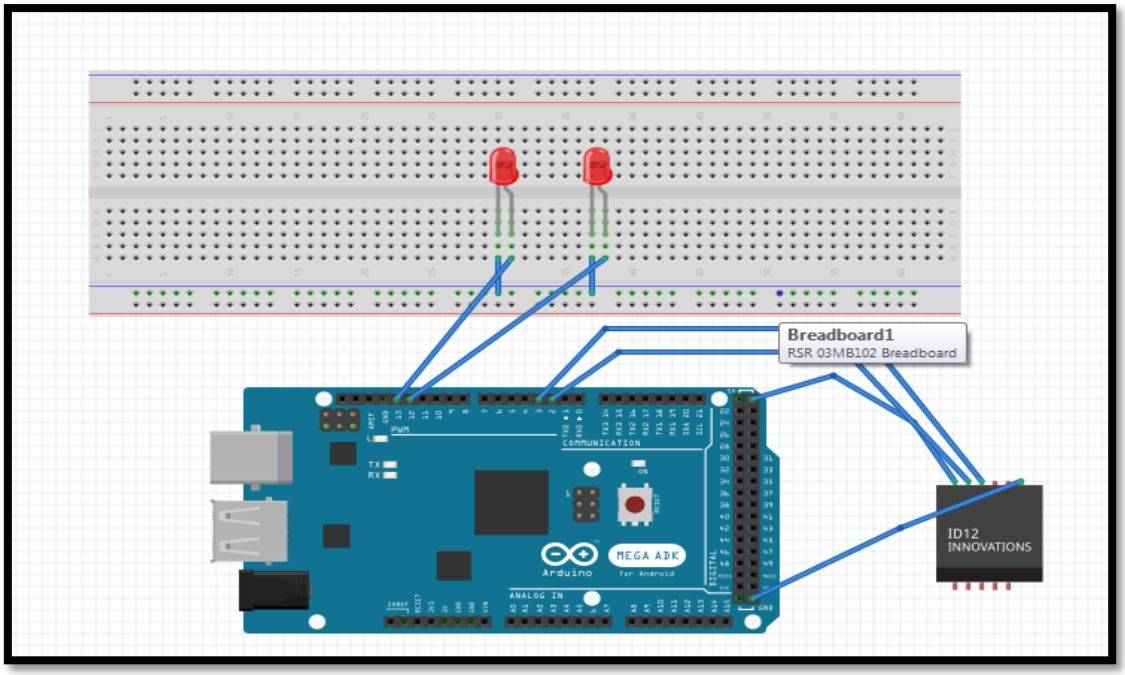


Fig 7.2 RFID primary connection

After we developed the system we re-did the testing again and toke the following images.

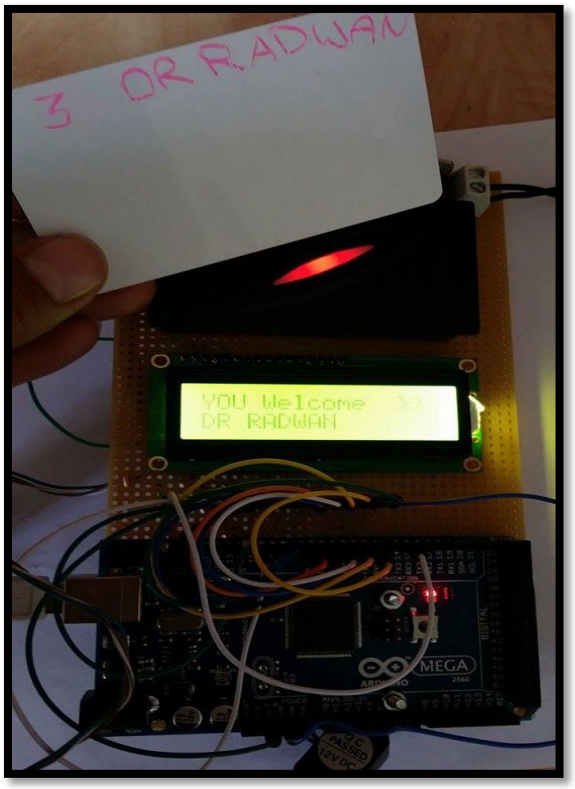


Fig 7.3 RFID testing

This testing process was done by passing the magnetic card through the RFID, the user has the authorization on this door so the LCD displayed "you're welcome DR RADWAN" massage, and the door will open then it will close after 5 seconds.

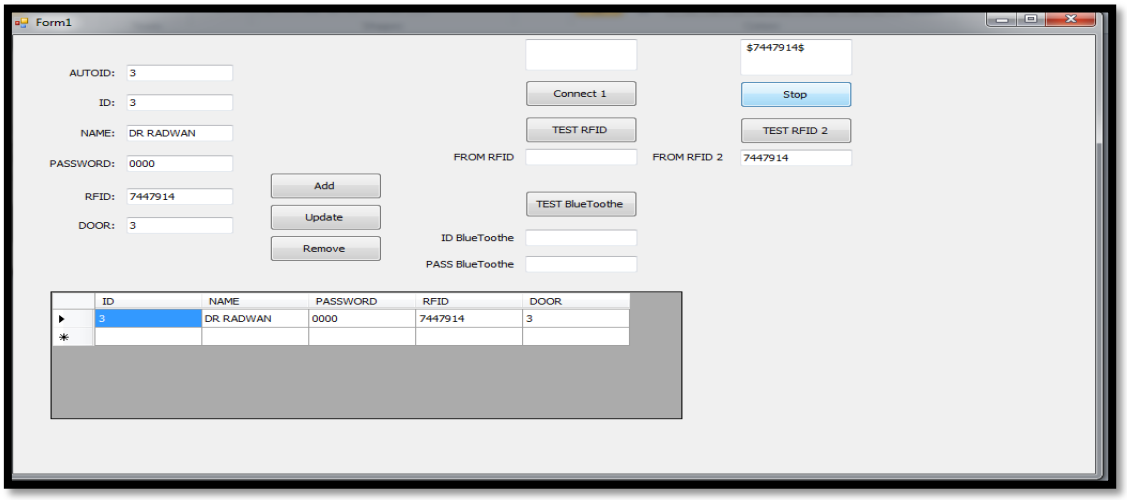
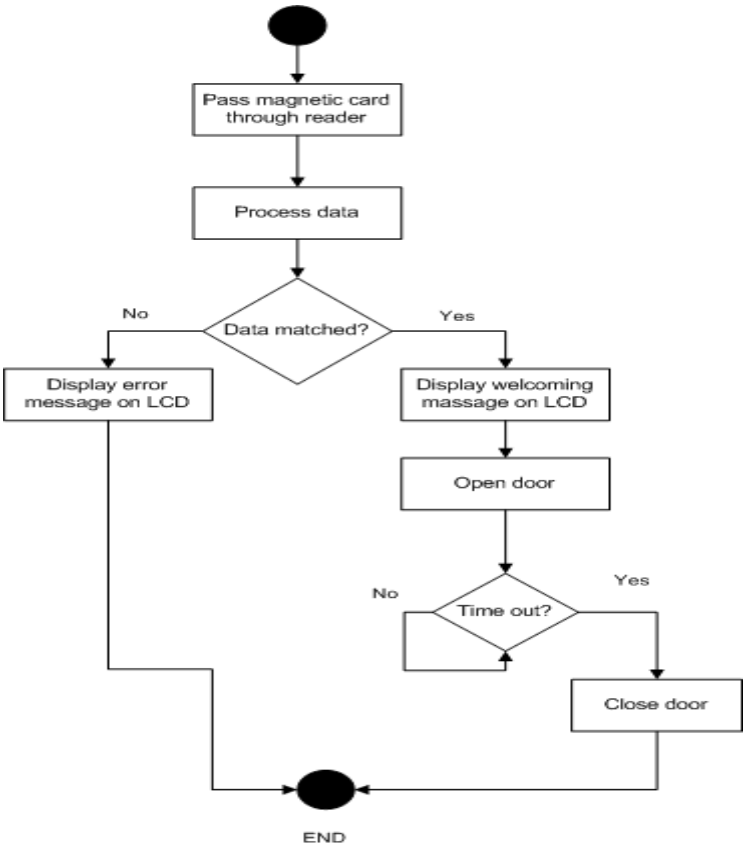


Fig 7.4 Database interface "RFID testing"



7.5 Flow chart for magnetic card reading process

MQ2 Testing:

The MQ2 sensor testing was done also at first using a LED as an indication if there is any fire or not. The following diagram shows the primary connection.

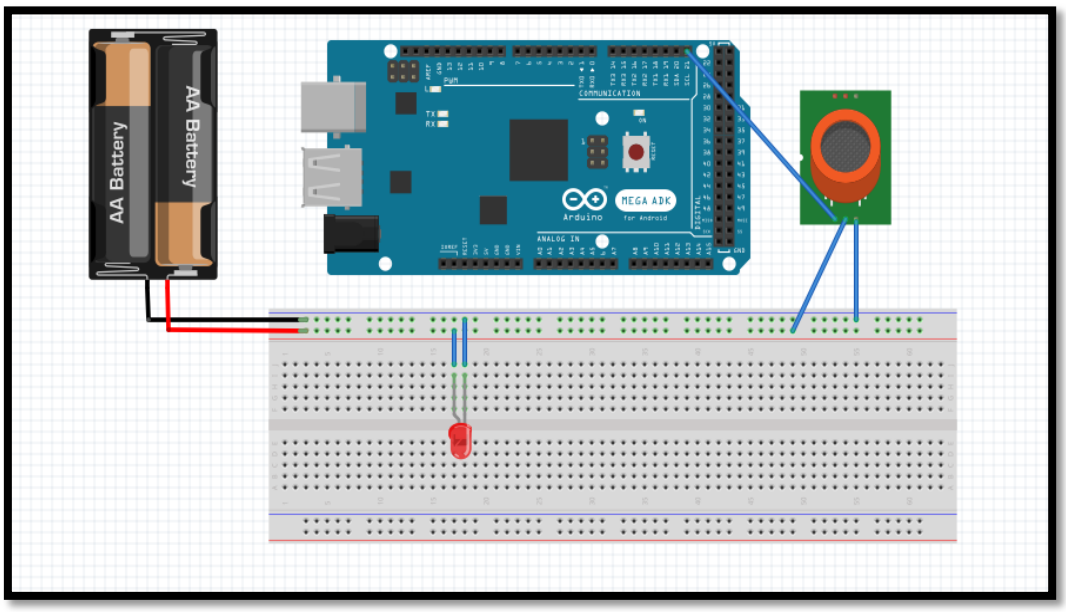


Fig 7.6 MQ2 primary connection. Look at Fig3.5 for schematic design

In case of any fire detected, the LED will be on, if not the LED will be off. In the actual testing process in case of any fire doors will open.

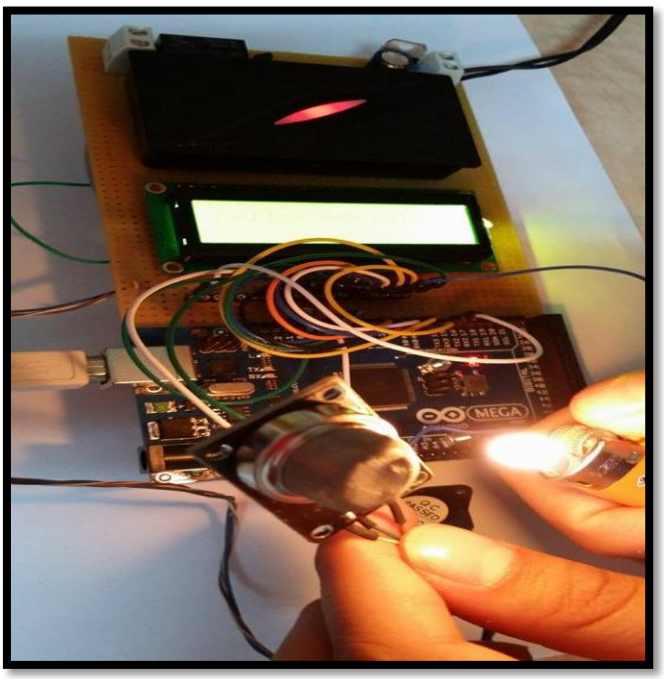


Fig 7.6 MQ2 testing

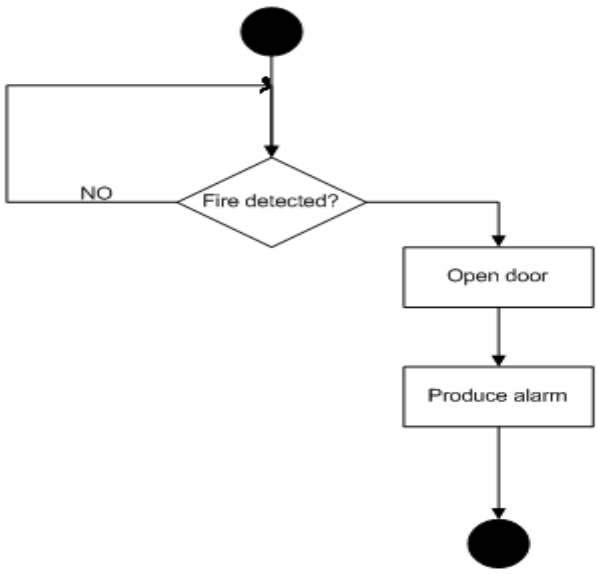


Fig 7.8 Flow chart for fire detecting process

The previous figure shows the fire detecting process works, and what may happen in each case.

7.2.2 Con1 Testing:

The con1 also contains the RFID reader and it has been shown previously.

Bluetooth Testing:

This phase includes testing the Bluetooth receiver and testing the mobile application. The following figures and images are the testing process and results.

The Bluetooth was tested with an unauthorized user and the access was denied as the following figure.

Fig 7.9 Bluetooth testing

As shown the LCD displayed "Access denies EROOR" message, and that means that this user doesn't have the authorization to enter, so the door will not open. The code was sent by the mobile as shown in figure 7.8

Fig 7.10 Mobile interface

During the testing process the database will show the values that the Bluetooth received from the mobile. The next figure shows it.

As shown this statement accrue #123457^4321 this means that 123457 is the ID for the user and 4321 is the password.

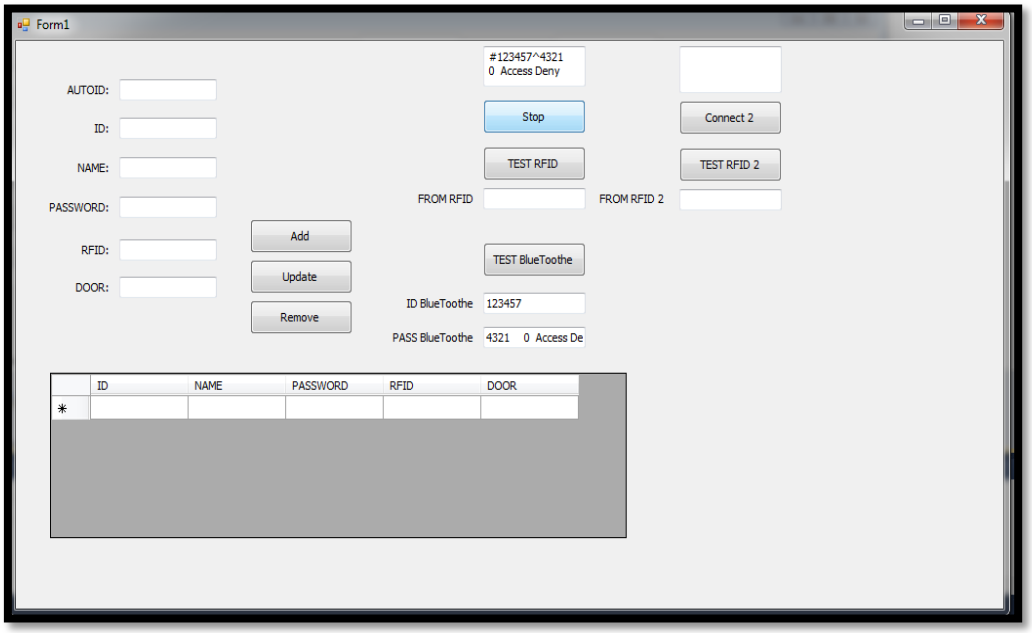


Fig 7.11 Database interface "Bluetooth testing"

The following figure shows how Bluetooth testing process works.

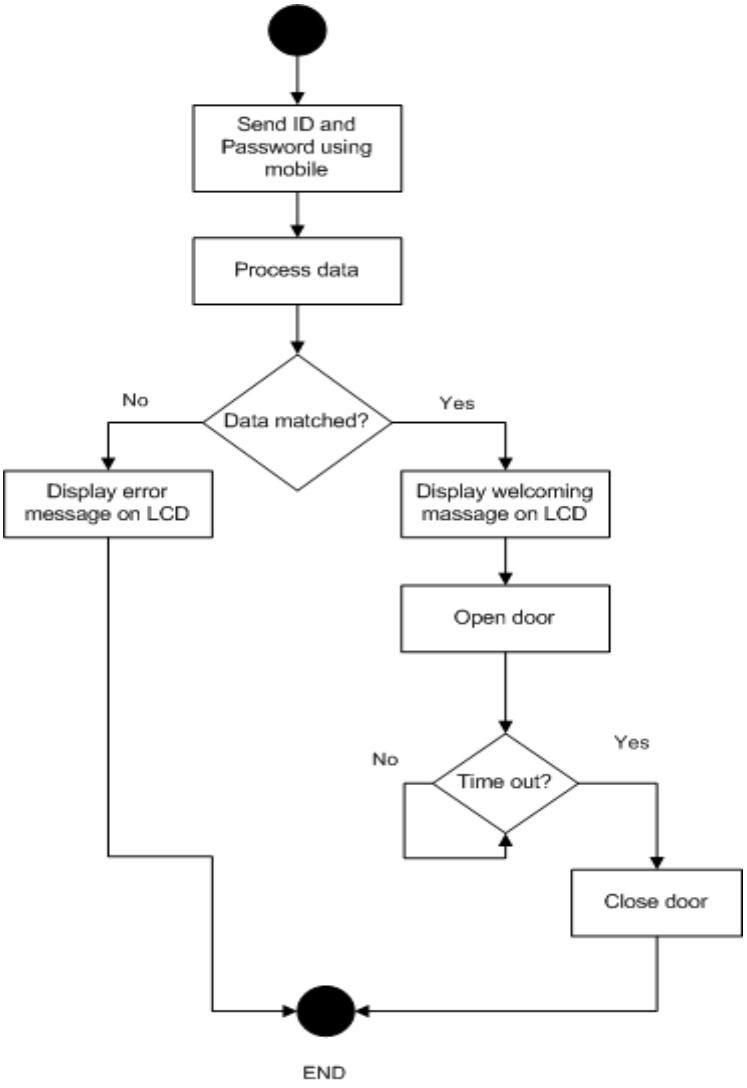


Fig 7.12 Flow chart for Bluetooth testing

7.3 Chapter Summary:

In this chapter we tested the system showing all the results by figures. Each part is examined as individual part, and at the end the whole system is tested as one part.

8

Chapter Eight

Conclusions and Future Work

8.1 Overview

8.2 Conclusions

8.3 Future Work

8.1 Chapter Overview:

In this chapter we will consider all conclusions of the projects, in addition to future work of the project.

8.2 Conclusions:

After working on this system many conclusions were concluded and this section contains a description of these conclusions will be pointed:

1. Working on this project increases the knowledge of projects managements.
2. Working on this project increases the knowledge of the access controlling and increasing security.
3. Working on this project increases the knowledge of Arduino programming and how to deal with it.
4. This system able to recognizes signs from any signer because training data from different signers.
5. Adding new features to access controller such as fire detection and different levels of authorizations.

8.3 Future Work:

In this section, the future work will be explained in order to be the guide for any expansion.

1. This system could be expanded; it may be developed to become a system for taking students attendance and many other things.
2. This system could use different strategies for identifying your identity such as the stain figure or voice recognition.
3. This system could be improved and developed for other facilities such as Banks or any other organization.

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