Palestine Polytechnic University

College of Engineering and Technology

Electrical Engineering Department

Graduation report

Home Automation System

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كلية الهندسة والتكنولوجيا

دائرة الهندسة الكهربائية

اسم المشروع

Home Automation System

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بناء على نظام كلية الهندسة والتكنولوجيا وإشراف ومتابعة المشرف المباشر على المشروع وموافقة أعضاء اللجنة الممتحنة تم تقديم هذا المشروع إلى دائرة الهندسة الكهربائية وذلك للوفاء بمتطلبات درجة البكالوريوس في الهندسة تخصص أتمتة صناعية

توقيع المشرف

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توقيع اللجنة الممتحنة

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توقيع رئيس الدائرة

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الإهداء

لـمن علمتني أن الحياة نضال

و أن الضيق مهما وجد لأبد

أن يتسع لـ أطفالها و رجالها

لأرض النور و السلام ارضي ..

لمن التصق أسمي باسمه

ليزداد مع الجمال فخراً

لمن سكنت قلبي و أهدتني

الحب بالدعاء لجنة الدنيا

لـ كل من كان معي

و بجانبي أخذ بيد

إلى هنا

هذا حصاد سنوات

لـ الله الفضل و الحمد

و الشكر من قبل و بعد...

Mohammad Hamad Jundi

Ahmad Ibrahim Jawabreh

Mohammad Asad Deriyah

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Ahmad Ibrahim Jawabreh

Mohammad Hamad Jundi

Mohammad Asad Deriyah

Abstract:-

We used arduino(microcontroller) to control many devices(lighting system, socket, and charger), by give commands to microcontroller through smart phone or through human sensor that connect to the microcontroller (the sensor disconnect the lighting system when nobody exist in the house), also give commands from smart phone to socket and charger to connect or disconnect the relay that feeds it.

The project contains smart door lock system that can open it by using fingerprint sensor that connect to the microcontroller, the sensor response only for the fingerprints that defined previously or can open it using normal key.

The project also contains security system by using motion sensor that connect to the microcontroller that works through gives sound using buzzer when anybody enter the house from the entrance of the door.

The project Computes energy consumption through LabVIEW program , also contains protection system that disconnect the electricity from all house when the current more than the desired value that you identified it previously , the program also used to display the current and the voltage and socket state and the door state and the lighting state and the charger state and the human detection state .

الملخص:

عبارة عن نظام يستخدم فيه الاردوينو)متحكم دقيق (للتحكم في العديد من الاجهزه) كإلاضاءة والأباريز والشاحن ,(ويتم إعطاء الأوامر للمتحكم من خلال الهاتف الذكي أو من خلال المجس الخاص بالإنسان المتصل مع المتحكم) حيث يقوم بفصل ووصل الاناره في حال عدم وجود إنسان بالمكان (أو من خلال المفتاح للإنارة أو يتم إعطاء الأوامر من خلال الهاتف الذكي للإبريز والشاحن ونظام قفل للباب يفتح عن طريق قارئ البصمة الموصول مع المتحكم ويوجد كذلك نظام حماية يعمل بدخول احد إلى المكان عن طريق مجس الحركة المتصل بالمتحكم حيث يتم تفعيل الإنذار من قبل صاحب المنزل عن طريق الهاتف الذكي وقت ما شاء ويتم حساب كميه الطاقة المستهلكة من خلال (LabVIEW) ويتم تحديد قيمه التيار القصوى التي يجب سحبها حيث إذا زاد عن هذه القيمة يقوم البرنامج بفصل الطاقة عن المنزل وكذلك يمكن له عرض قيم الجهد والتيار والقدرة وفصل ووصل الكهرباء عن المنزل من خلال البرنامج , وبمكن له أيضا عرض حالة الباب والإضاءة والمقبس والشاحن وكذلك عرض وجود شخص في الغرفة من عدمه .

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1.1 Introduction

While the smart home automation spreading in America, Europe, Japan, and developing countries, it was preoccupied experts, and designers, this application make the life easier, also saving the energy.

Smart home automation knows that the house that contains a developed control devices, a touch-screen wall fixed or mobile, such as the iPad and iPhone،and it can control the electrical lighting, air-condition, TV ,audio system, cameras, and electric doors

1.2 Overview

The design of our smart home system is cheaper cost and easier ways to reach the desired goals without complexity.

This system contains four parts:

- Home control via smart phone system.
- Energy-saving system.
- Security and Alarms System.
- System display.

Each part can be explained separately as following:-

1. Home control via smart phone system:-

This system allows the user to control the device by mart phone using application such as (Roboremo). Like, control of lighting (turn off, turn on and control the intensity of lighting) can be done using these applications or done by practical switches(Hardware) that you can select the way from selector switch. On the other hand, the application can control the sockets and the external phone charger.

2. Energy-saving system:-

This system prevents energy consumption. For example the system turns off all lighting automatically by using human sensor when there is nobody in the room or when it is empty. So, there will be no need for lighting or air condition or television, as we will show later.

3. Security and Alarms system:-

In this system, the user can open the door from the outside using fingerprints that are added to the system previously or using normal key. While opening the door from the inside just done using key. The system also contains alarm that can active it from the phone, it scan the movement at the entrance of the house door if any movement at the entrance the system automatically running alarm.

4. System display:-

Use LabVIEW to calculate (current, voltage and power) and to display it on user interface(screen in LabVIEW program), and if the current raise above the set value the system cut electricity, and return electricity by send commands from smart phone after the user checking the devices and correct the error.
It also display the state of the door (open or close), the state of alarms (active or inactive), the state of lighting (on or off), the state of charger and socket (active or inactive), and that very useful for the user to saving time and effort.

1.3 Project motivations

In fact, our country needs such technology to facilitate our lives, and increase the entertainment, as well as savings energy consumption especially if we do not have enough energy sources. We have noted that there is neglect in energy use especially in public places such as hospitals and universities.

Smart home automation technologies are very expensive and the simple Palestinian citizen can't buy it. Also, the economic feasibility is not good from these system. For example, if the home automation systems cost ten thousand dollars, and there is alternative system with low cost less than half of its price, of course, this system attracts the user and encourages them to try it.

From this point, we decide to design a smart home system that is very little cost compared with other systems that used in about 60%.

1.4 Project goals

Design smart home automation system to be able to control the home component using arduino connected to the smart phone . The home automation can be used in many things like lock the door using fingerprint sensor in addition to normal key, control of the

lighting system using smart phone, interface and implement a remote control mechanism with a wireless/bluetooth remote control device , provide an external socket and charger from arduino to control it by smart phone, and we also build security system by using motion sensor.

1.5 Home automation definition

1.5.1 Energy Management

Maintain comfort while saving energy. Automate lighting, temperatures, pumps, fountains, water heaters, irrigation, and other energy-consuming devices based on schedules or events **[1].**

1.5.2 Lighting

To enhance your property, improve safety, and contribute to saving on energy bills. Automate CFL, LED and conventional lighting **[1]**.

1.5.3 Security

Whether checking an event log from a smart phone, watching video surveillance on an iPad, or restricting access to a secure area **[1]**.

1.5.4 Automation Interfaces(application)

To Control your home and business from anywhere in the world by a single touching or use your smart phone or tablet **[1]**.

1.6 Literature Review

The first study is building management system project:-

Previous project has been done at the college of engineering and technology at PPU in 2012. The project is based on manage a building using Wireless technology by using wireless sensor network (WSN),also design the process to gather data and send it to the computer. In this project the user can talk with the computer and giving voice commands to control many devices and the lighting. Also to know the current power consumption of the grid and know the amount of water being consumption and view data and interface on LCD screen. However, the project has some disadvantages**[2]**:

- The depend on voice to send command to control the device and this system doesn't work with a new user, and also if the user voice is effective from any disease, the system doesn't recognize him, It is also sometimes need to send commands more than once until response and this uncomfortable. It should be a quiet place to analysis sound and to respond in order to execute the command, so in our project we used the smart phone to control lighting and other devices.
- It used complex and an old system for display consumption data on LCD screen, but in our project we used easier and modern system (LabVIEW2015). Also our project can control the consumption and protection of the fault.

Hardware they used : microcontroller PIC18F4550, and they used Voice recognition engine and speech synthesizer interface that component used to convert voice commands over the microphone into an integer code.

Software they used : Visual C#, MPLAB, C18, MS Windows 7 OS, MS SQL and Dia software.

Hardware we used: Bluetooth instead of wireless, and we used arduino instead of microcontroller to connect all devices such sensors (motion, and fingerprint), relay to get 220V from arduino voltage (5V) used to control lighting system, socket, and charger.

Software we used: Roboremo (instead of computer) application in smart to send commands to arduino and receive data from arduino, or control lighting intensity. We used arduino IDE program to write code that control everything from arduino, and we used LabVIEW to make the user is able to interface system, and for circuit simulation we used Proteus and Multism programs.

The second study is Green Seal's Report:-

One of the most overlooked energy-saving tools in the work place is the light switch. Lighting accounts for 30 to 50% of a building’s energy use. Simply turning off unneeded lights can reduce direct lighting energy consumption up to 45%. Reducing lighting electricity usage reduces your energy cost and lessens the environmental impacts associated with electricity generation, this all according to Green Seal's Report **[3].**

And so that the energy saving is very important to any project and we add it to our project.

1.7 Time Schedule

The time plane views the stages in studying, designing the system. This section includes two time schedules; the first one is done in the first semester while the second shows the task scheduling for the second semester

Fig1.1: shows the first semester tasks; all tasks are referred to the theoretical background and the whole system analysis.

Fig.1.2: shows the second semester tasks schedule; all tasks and referred to implementation and system testing.

Week Task	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Select the idea															
collecting information															
Determine equipment requirements															
Design and simulation															
Project analysis															
Report deadline for the electrical engineering department															

Figure 1.1: Time planning for the first semester.

Week Task	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Hardware															

design															
Software design															
Implementation and Testing															
Documentation															

Figure 1.2: Time planning for second semester.

1.8 Economical study

This section lists the overall cost of the project, these costs are summarize in Table1.1

Component	Price for one element	Number of element	Price for all element	Total Price
Fingerprint sensor	560	1	560	2026
Bluetooth Modem	220	1	220	
Caustic welding device	120	1	120	
Arduino	100	3	300	
Motion sensor	60	1	60	
Resisors,Capictors,and wires	-	-	40	
Welding board	20	2	40	
Triac	12	4	48	
Diac	5	1	5	
Current sensor	35	1	35	
Optocoupler	8	4	32	
Relay module	15	1	15	
Electronic door lock (سكرة الباب)	50	1	50	
Pins for board	1	70	70	
Clements	15	2	30	
Woodturning	-	-	350	
Transformer(9V)	18	2	36	
Additional component	-	-	20	

Table1.1: Overall cost of the project.

Chapter Two

Theoretical Background

2.1 Arduino

2.2 BlueSMiRF Silver - Bluetooth Modem

2.3 Motion sensor

2.4 RoboRemo User v1.9

2.5 Fingerprint sensor

2.6 Pulse width modulation (PWM)

2.7 Sensor detected human presence

2.8 LabVIEW

2.9 ACS712 Current Sensor

2.1 Arduino

Arduino is an open-source electronics prototyping platform it can sense environment by receiving input from a variety of sensor, it provides your robot the intelligence you want by using a variety of sensors ,Arduino can affect your robot's behavior by controlling motors, actuators, LCDs or any other robot component **[4]**.

Arduino can be stand-alone, or they can be communicate with software running in your computer ,it has digital and analog input/output pins ,serial communications pins, PWM digital pins, and arduino have many types (Shown in Figure2.1) **[4]**.

Arduino also simplifies the process of working microcontrollers, but it offers some advantage like the following:

- Inexpensive- the arduino module can be assembled by hand, and even the pre-assembled Arduino modules cost less than $50.
- Cross-platform-the arduino software runs on Windows, Macintosh OSX, and Linux operating systems, not like other microcontroller systems are limited to windows.
- Simple, clear programming environment- is easy-to-use for beginners, its conveniently based on the Processing programming environment, so students learning to program in that environment will be familiar with the look and feel of Arduino.
- Open source and extensible software-The arduino software and is published as open source tools, available for extension by experienced programmers.

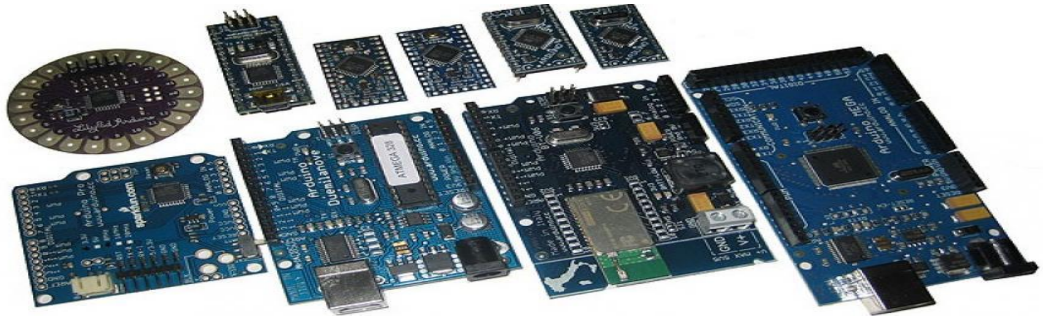


Figure2.1: Adriano type.

There are many type of arduino: (Shown in table 2.1).

Name	Describe	Digital input & output	Analog input & output
Arduino Uno	1.Operation volt 5v 2.port voltage 7- 12 v 3.Processor speed:16 MHz 4.Memory Size: 32 KB	14 (6 PWM)	6 input
Arduino Mega ADK	1.Operation volt 5v 2.port voltage 7- 12 v 3.Processor speed:16 MHz 4. Memory Size: 256 KB	54(15 PWM)	16 input
Arduino Due	1.Operation volt 3.3v 2.port voltage 7- 12 v 3.Processor speed:84 MHz 4. Memory Size: 512 KB	54(12 PWM)	12 input 2 output
Arduino Leonardo	1.Operation volt 5v 2.port voltage 7- 12 v 3.Processor speed:16 MHz 4. Memory Size: 32 KB	20 (7 PWM)	12 input
Arduino micro	1.Operation volt 5v 2.port voltage 7- 12 v 3.Processor speed:16 MHz 4. Memory Size: 32 KB	20 (7 PWM)	12 input

Table 2.1: Arduino type **[4]**.

In This project used Arduino UNO because it contains 14 digital input/output (6 PWM) pins and 6 analog input pins, the number of the digital and the analog pins is suitable for our project so we choose it.

2.2 Bluetooth Modem

Bluetooth this is communication technology using short-wave length(radio waves),design for transfer data to short destines from one mater to one hundred meter with law energy consumption, and this technology heavily used to transfer data between cellular devices **[5].**

Bluetooth is a standard that was developed by a group of electronics companies to allow any letter two devices - computers, cell phones, keyboards ... - to carry out the process of communication alone without wires or cables or any intervention by the user. Used BlueSMiRF Silver which is compatible with Arduino microcontroller **[5]**.

❖ BlueSMiRF Silver

BlueSMiRF consists from transmitter (Tx) and receiver (Rx), the transmitter sends serial data to the arduino and the receiver receives serial data from the arduino so it is very important to make connection between smart phone and the arduino.

The BlueSMiRF Bluetooth is serial link that works over a range of voltages from 3.3 to 6 V. It has a transmission distance of up to 18 meters. The board carries the RN-42 Class 2 bluetooth module from roving networks and you can use it to make connection between RoboRemo application and Arduino **[14].** (Shown in figure 2.2)

Figure2.2: BlueSMiRF **[14]**.

Features[14]:-

- FCC approved Class 2 Bluetooth radio modem
- Operating voltage: 3.3 to 6 V

- Very robust link both in integrity and transmission distance (18 m)
- Frequency: 2.4~2.524 GHz
- Serial communications: 2400 to 115200 bps
- Operating temperature: -40~+70 °C
- **Pins for BlueSMiRF (Shown in table2.2)**

Pin Label	Pin Function	Input, Output, Power	Description
RTS-O	Request to send	Output	RTS is used for hardware flow control in some serial interfaces. This output is not critical for simple serial communication.
RX-I	Serial receive	Input	This pin receives serial data from another device. It should be connected to the TX of the other device.
TX-O	Serial transmit	Output	This pin sends serial data to another device. It should be connected to the RX of the other device.
VCC	Voltage supply	Power In	This voltage supply signal is routed through a 3.3V regulator, and then routed to the Bluetooth module. It should range from 3.3V to 6V.
CTS-I	Clear to send	Input	CTS is another serial flow control signal. Like RTS, it's not required for most, simple serial interfaces.
GND	Ground	Power In	The 0V reference voltage, common to any other device connected to the Bluetooth modem.

Table 2.2: Pin for BlueSMiRF **[14]**.

In project used BlueSMiRF (Bluetooth) in our project to make connection between smart phone and arduino to receive data from arduino and pass command from smart phone to Arduino**.**

2.3 Motion sensor

A motion detector is a device that detects moving objects, particularly people. A motion detector is often integrated as a component of a system that automatically performs a task or alerts a user of motion in an area. Motion detectors form a vital component of security, automated lighting control, home control, energy efficiency, and other useful systems **[6]**.

- **Motion sensor (PIR)**

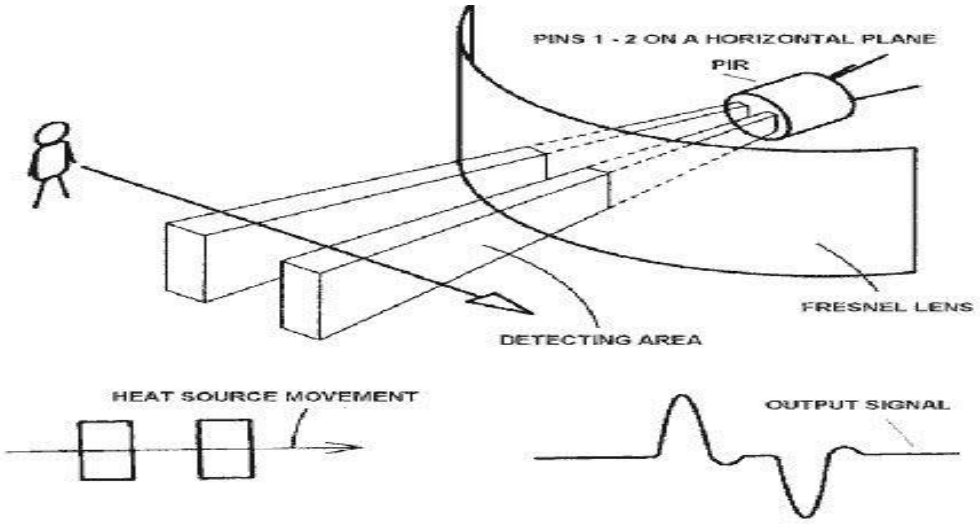


Figure 2.3: Shown how sensor work **[6]**.

PIR sensors allow you to sense motion, almost always used to detect whether a human has moved in or out of the sensors range. They are small, inexpensive, low-power, easy to use and don't wear out. For that reason they are commonly found in appliances and gadgets used in homes or businesses. They are often referred to as PIR, "Passive Infrared", "Pyroelectric", or "IR motion" sensors. PIRs are basically made of a pyroelectric sensor (which you can see above as the round metal can with a rectangular crystal in the center), which can detect levels of infrared radiation. Everything emits some low level radiation, and the hotter something is, the more radiation is emitted. The sensor in a motion detector is actually split in two halves. The reason for that is that we are looking to detect motion (change) not average IR levels. The two halves are wired up so that they cancel each other out. If one half sees more or less IR radiation than the other, the output will swing high or low **[6]**.

Features:

i. From about 6 meter with angle 110° x 70° detection range.
ii. This one has an adjustable delay before firing (approx. 2-4 seconds).

iii. Power supply 3V-9V input voltage, but 5V is ideal.

iv. Output: Digital pulse high (3V) when triggered (motion detected) digital low when idle (no motion detected).

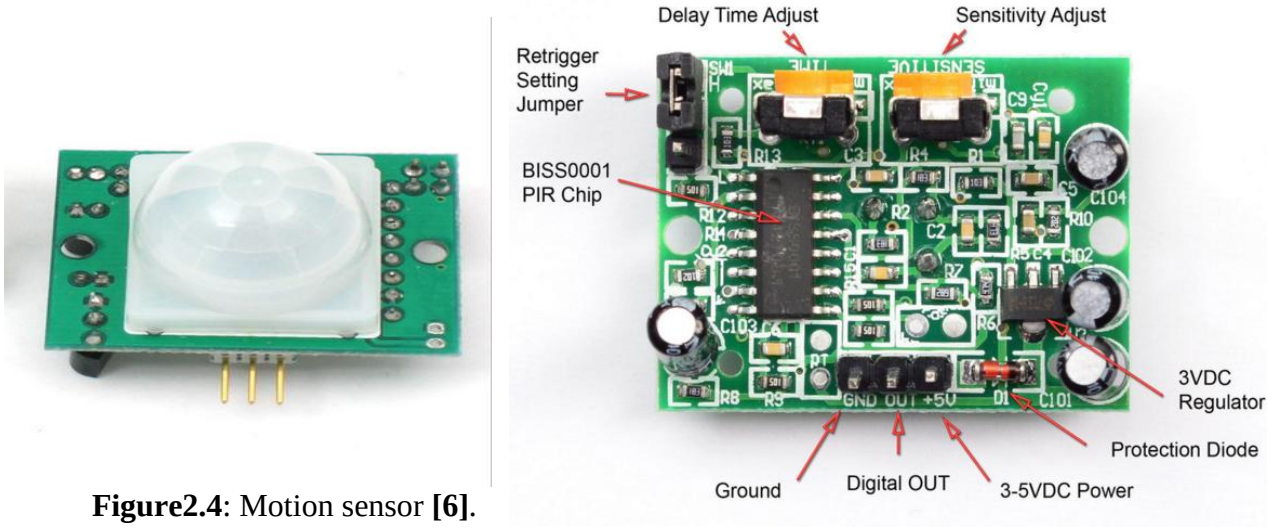


Figure2.4: Motion sensor **[6]**.

In project used PIR (motion sensor) that if anybody interrupts the IR irradiation of the sensor it will give alarm through Buzzer, and it dependent security system.

2.4 RoboRemo User v1.9

RoboRemo is an application allows us to use the smart phone as a remote control for microcontroller so we can use this application to send command and receive data from the microcontroller. (Roboremo shown in figure 2.5)

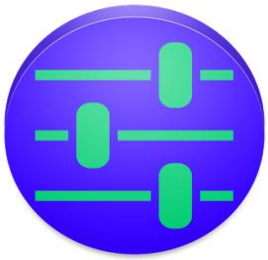


Figure2.5: Roboremo application.

This application support multi-protocol such as internet, USB, Wi-Fi and Bluetooth. RoboRemo is completely comfortable with Arduino, PIC, etc.

We can add many controls and indicators in the main screen such as button, led, slider and more items. To edit the interface, click menu → edit ui. Now in edit mode, click on blank space to add an item, then choose the item type. (Shown in figure 2.6)

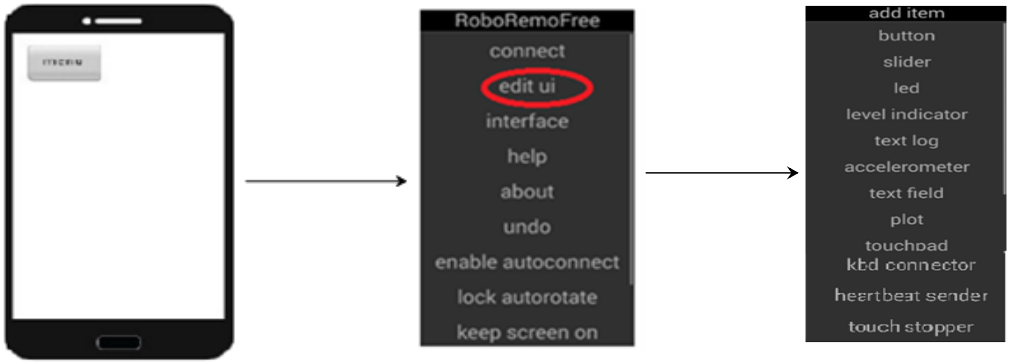


Figure2.6:Steps to add item.

❖ **Options:**

1-Menu options

***Connect / disconnect:** Connects to a remote device / disconnects from a remote device. To connect to a Bluetooth remote device, it has to be paired. To pair with a Bluetooth device, open Android settings → Bluetooth → search for devices. Pin code for Bluetooth to serial adapter is usually "1234" or "0000" **[13].**

Select port 1 (if port selection is set to manual from RFCOMM settings). To connect over internet or Wi-Fi, data connection or Wi-Fi has to be activated from Android settings. Then in RoboRemo app choose menu → connect → internet and select the ip and port. You can also use the domain name instead of ip **[13]**.

***Edit ui / don't edit ui:** Enters / exits the interface edit mode **[13].**

***Interface:** Opens interface menu **[13].**

2–Button edit options [13]

***set text**: - Sets the text that appears on button.

***set press action:** For remote action type (default): Sets the string to send to the remote device when you press the button. (RoboRemo will append the command ending to mark the end for each command).

***set release action:** For remote action type (default): Sets the string to send to the remote device when you release the button. (RoboRemo will append the command ending to mark the end for each command).

3–Slider edit options [13]

***set id**: Sets the slider id string.

For example if id is “s1” and you move the slider to the value 100 and command ending is “\n”, it will send “s1 100\n” (id followed by space followed by value followed by command ending).

***set label:** Sets the text string to appear under the slider. You can use the slider value inside the label.

Examples for slider with value 100: label “speed = #*0.1” will show “speed = 10.0” label “x = #*-5+10 cm” will show “x = -490 cm”

***set min:** Sets the minimum value, default is 0.

***set max:** Sets the maximum value, default is 255.

***send when moved / send when released:** Sets the slider send mode, default mode it to send when released.

4–Text field edit options[13]

***set id:** Sets the id for the text field. For example if id is “text1” and command ending is “\n”, you can change the text to “abc” by sending “text1 abc\n” from microcontroller.

***set text:** Sets the text to be displayed inside text field.

***set text size:** Sets the size of the displayed text

“To connect over Bluetooth, a remote device must contain a Bluetooth to Serial adapter like BlueSMiRF, BTM-222, HC-05, HC-06, etc. and a microcontroller programmed to interpret commands from RoboRemo. You can also find adapters for Wifi or Ethernet. All the commands from RoboRemo are text strings, ending with command ending which is LF character '\n' (hex code 0x0A) by default, but user can change it. For example if you configure a button to send “abc” when pressed, it will send “abc\n” if command ending is '\n' or it will send “abcqwerty123” if command ending is “qwerty123”. The command ending is used by the microcontroller program to know where each command ends.”(From application site) **[13]**.

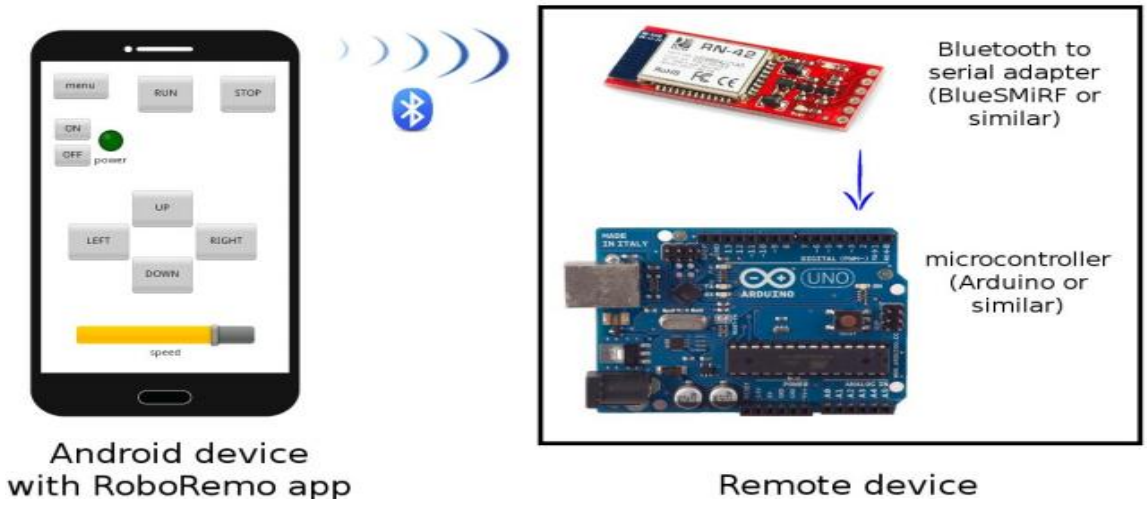


Figure2.7: connection over Bluetooth **[13]**.

Used this application in project to send commands and receive data from arduino so we can consider it as final controller to project device.

2.5 Fingerprint sensor

Fingerprint: Fingerprints are the tiny ridges, whorls and valley patterns on the tip of each finger. They form from pressure on a baby's tiny, developing fingers in the womb. No two people have been found to have the same fingerprints they are totally unique. There's a one in 64 billion chance that your fingerprint will match up exactly with someone else's. Fingerprints are even more unique than DNA, the genetic material in each of our cells. Although identical twins can share the same DNA or at least most of it, they can't have the same fingerprints. Fingerprinting is one form of biometrics, a science that uses people's physical characteristics to identify them. Fingerprints are ideal for this purpose because they're inexpensive to collect and analyze, and they never change, even as people age. Although hands and feet have many ridged areas that could be used for identification, fingerprints became a popular form of biometrics because they are easy to classify and sort. They're also accessible **[9]**.

Used fingerprint sensor ZFM-20 as part of door lock sensor to allow us to enter fingerprint to the arduino through code in arduino software, the door is open if we enter the correct fingerprint, so the door not open if we don't enter the correct fingerprint(Work as reader for fingerprint **[7]**.

❖ **Fingerprint sensor (ZFM-20):**

ZFM-20 series are separate fingerprint identification modules proposed by Hangzhou Zhian Technologies Co., Ltd., which takes Synochip DSP as the main processor and optical sensor with Zhians own intellectual property rights. The module performs series of functions like fingerprint enrollment, image processing, fingerprint matching, searching and template storage. (Shown in figure 2.8) **[7]**.

(ZFM-20 manual)

There is Technical details: (for more details you can reading ZFM-20 user manual in appendix)

- Supply voltage: 3.6~6.0 V.
- Operating current(Max) : 120 mA.
- Fingerprint imaging time: 1.0 S.
- Interface pins (shown in table 2.3)

Pin Number	Name	Type	Function Description
1	Vin	In	Positive Power Supply Input Terminal(Line color: Red)
2	TD	Out	Serial data output, TTL logic levels(Line color: Yellow)
3	RD	In	Serial data input, TTL logic levels(Line color: White)
4	GND	-	Signal ground(Line color: Black)

Table 2.3: Interface pins **[7]**

Figure2.8: Fingerprint sensor

2.6 Pulse width modulation(PWM)

Pulse Width Modulation, or PWM, is a technique for getting analog results with digital means. Digital control is used to create a square wave, a signal switched between on and off. This on-off pattern can simulate voltages in between full on (5 Volts) and off (0 Volts) by changing the portion of the time the signal spends on versus the time that the signal spends off. The duration of "on time" is called the pulse width. To get varying analog values, you change, or modulate, that pulse width. If you repeat this on-off pattern fast enough with an LED for example, the result is as if the signal is a steady voltage between 0 and 5v controlling the brightness of the LED**.** (Shown in figure 2.9) **[8]**.

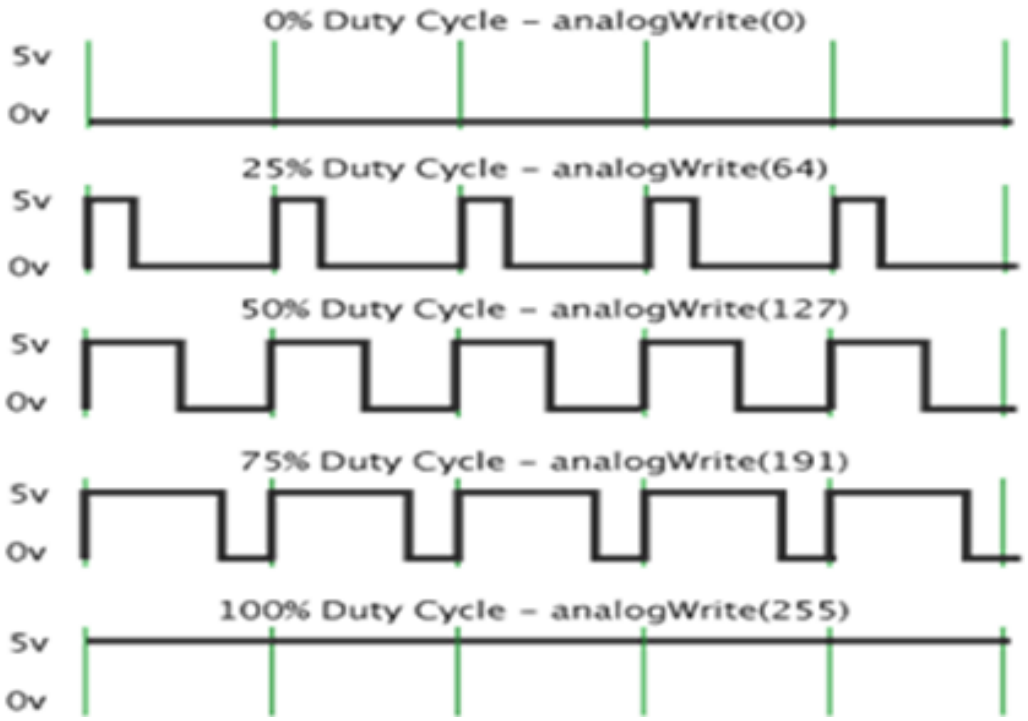


Figure2.9: PWM With different duty cycle**[8].**

In project used PWM digital pins because it allows us to control the lighting brightness, so it is technique for getting analog results with digital means.

2.7 Sensor detected human presence

Human sensing (also called human detection or human presence detection) encompasses a range of technologies for detecting the presence of a human body in an area of space,

typically without the intentional participation of the detected person. Common applications include search and rescue, surveillance, and customer analytics (for example, people counters) **[12]**.

Modern technologies proposed or deployed for human sensing include **[12]**:

- Acoustic sensors
- Image recognition of human shapes
- Infrared detectors
- Pressure-sensitive floor tiles
- Radar
- Chemical sensors
- Detection of the mobile phone, Bluetooth, or Wi-Fi signals of a device assumed to be in the possession of a person
- Thermal sensor for human

D6T-8L Thermal sensor:

The D6T series sensors are made up of a cap with silicon lens, thermopile sensor chips, and dedicated analog circuit and a logic circuit for converting to a digital temperature value on a single board through one connector **[10]** .

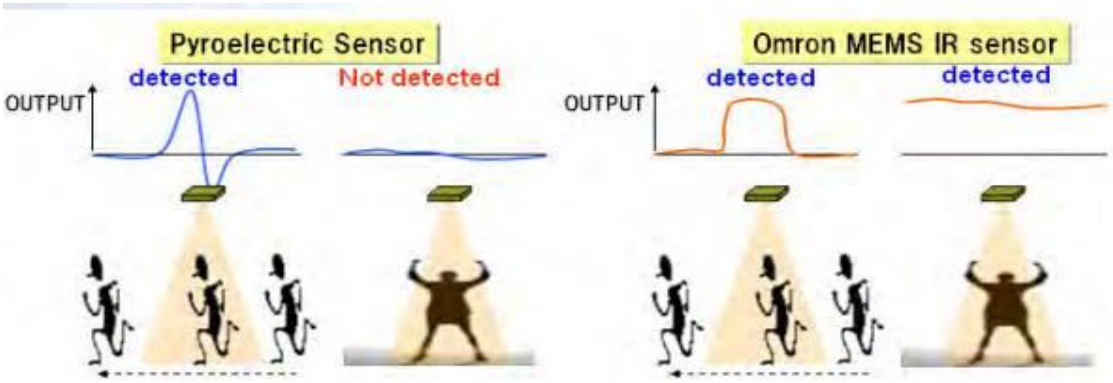
Operating principle

An outline of the basic measuring operation is as follows:

The silicon lens collects radiated heat (far-infrared ray) emitted from an object onto the thermopile sensor in the module. The radiated heat (far-infrared ray) produces an electromotive force on the thermopile sensor. The analog circuit calculates the temperature of an object by using the electromotive force value and a measured temperature value inside the module. The measured value is outputted through an I2C bus **[10]** .

Features:-

The non-contact temperature sensor measures the surface temperature of an object. D6T-44L-06 and D6T-8L-06 have sensor chip arrays of 16 channels (4x4) and 8 channels



a) Pyroelectric sensor output b)Non-contact temperature output

Figure 2.10: Difference between pyroelectric and moron MEMS IE sensors **[10]**.

(1x8) respectively. By mounting the signal processing circuit closely to the sensor chip, a low noise temperature measurement is realized. The module can also be used for detecting the presence of human beings. Omron's non-contact temperature sensor can solve the shortcomings of a conventional pyroelectric sensor, which cannot catch the signal of a stationary person because the sensor detects the change of signal [in principle]. Moreover, Omron's non-contact temperature sensor keeps detecting the far-infrared ray of an object, while the pyroelectric models do not **[10]**.

2.8 LabVIEW :(Lab Virtual Instrument Engineering Workbench)

LabVIEW is a highly productive development environment for creating custom applications that interact with real-world data or signals in fields such as science and engineering**.** The net result of using a tool such as LabVIEW is that higher quality projects can be completed in less time with fewer people involved. So productivity is the key benefit, but that is a broad and general statement. To understand what this really means, consider the reasons that have attracted engineers and scientists to the product since 1986. At the end of the day, engineers and scientists have a job to do – they have to get something done, they have to show the results of what they did, and they need tools that help them do that. Across different industries, the tools and components they need to succeed vary widely, and it can be a daunting challenge to find and use all these disparate items together. LabVIEW is unique because it makes this wide variety of tools available

in a single environment, ensuring that compatibility is as simple as drawing wires between functions **[11]**.

❖ **G Programming Language**

- Intuitive, flowchart-like dataflow programming model
- Shorter learning curve than traditional text-based programming
- Naturally represents data-driven applications with timing and parallelism

The G programming language is central to LabVIEW; so much so that it is often called "LabVIEW programming." Using it, you can quickly tie together data acquisition, analysis, and logical operations and understand how data is being modified. From a technical standpoint, G is a graphical dataflow language in which nodes (operations or functions) operate on data as soon as it becomes available, rather than in the sequential line-by-line manner that most programming languages employ. You lay out the "flow" of data through the application graphically with wires connecting the output of one node to the input of another **[11].**

The practical benefit of the graphical approach is that it puts more focus on data and the operations being performed on that data, and abstracts much of the administrative complexity of computer programming such as memory allocation and language syntax. New programmers typically report shorter learning curves with G than with other programming languages because they can relate G code to flow charts and other familiar visual representations of processes. Seasoned programmers can also take advantage of the productivity gains by working at a higher level of abstraction while still employing advanced programming practices such as object-oriented design, encapsulation, and code profiling **[11]**.

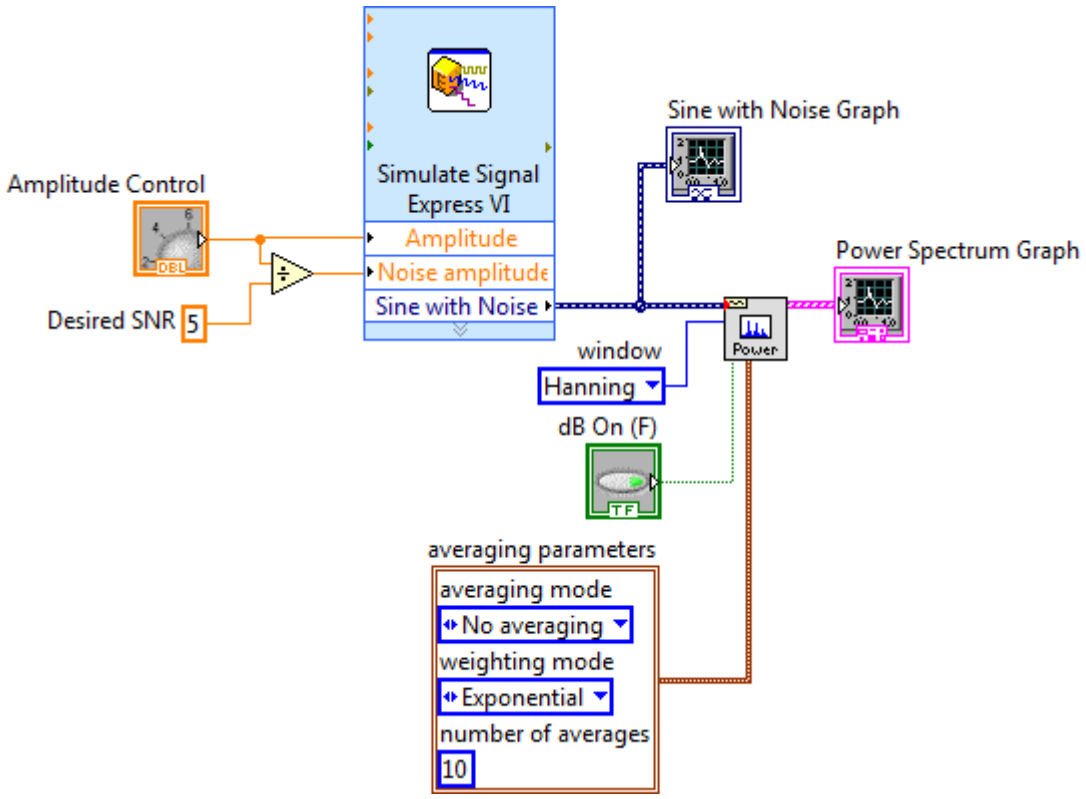


Figure 2.11: This block diagram shows self-documenting G code **[11]** .

LabVIEW contains a powerful optimizing compiler that examines your block diagram and directly generates efficient machine code, avoiding the performance penalty associated with interpreted or cross-compiled languages. The compiler can also identify segments of code with no data dependencies (that is, no wires connecting them) and automatically split your application into multiple threads that can run in parallel on multi core processors, yielding significantly faster analysis and more responsive control compared to a single-threaded, sequential application **[11]** .

With the debugging tools in LabVIEW, you can slow down execution and see the data flow through your diagram, or you can use common tools such as breakpoints and data probes to step through your program node-by-node. The combination of working with higher-level building blocks and improved visibility into your application's execution results in far less time spent tracking down bugs in your code **[11]** .

2.9 ACS71230A Range AC/DC Current Sensor Module

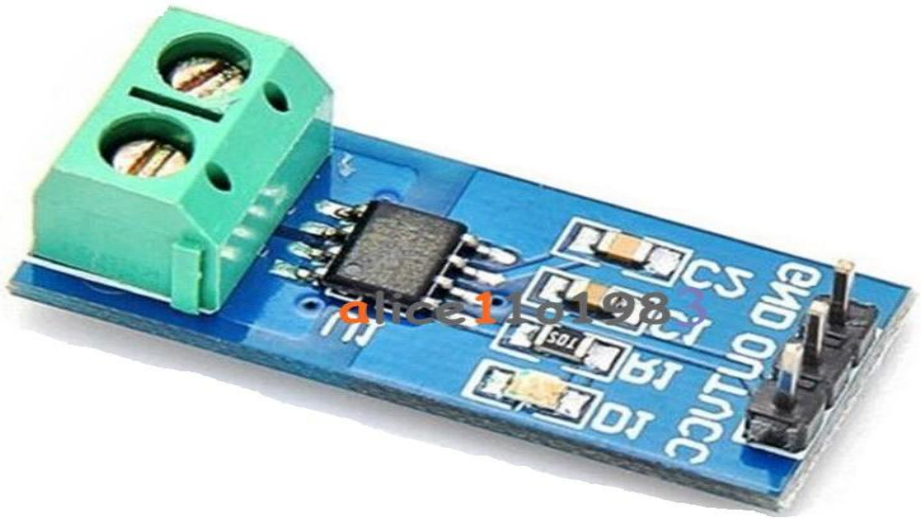


Figure 2.12: ACS712 current sensor.

ACS712sensor provides economical and precise solutions for AC or DC current sensing in industrial, commercial, and communications systems. The device package allows for easy implementation by the customer. Typical applications include motor control, load detection and management, switched-mode power supplies, and over current fault protection **[15]** .`

Features**:-**

1. Current_sensor chip: offered with full scale values of 5A, 20A and 30A.

2. 5V power supply

3. Can measure plus and minus 5A current, corresponding simulation output 66mV/A .

4. When testing no current though, the output voltage is VCC/2.

The ACS712 Current Sensors are designed to be easily used with micro controllers like the Arduino.

Sensor Component:-

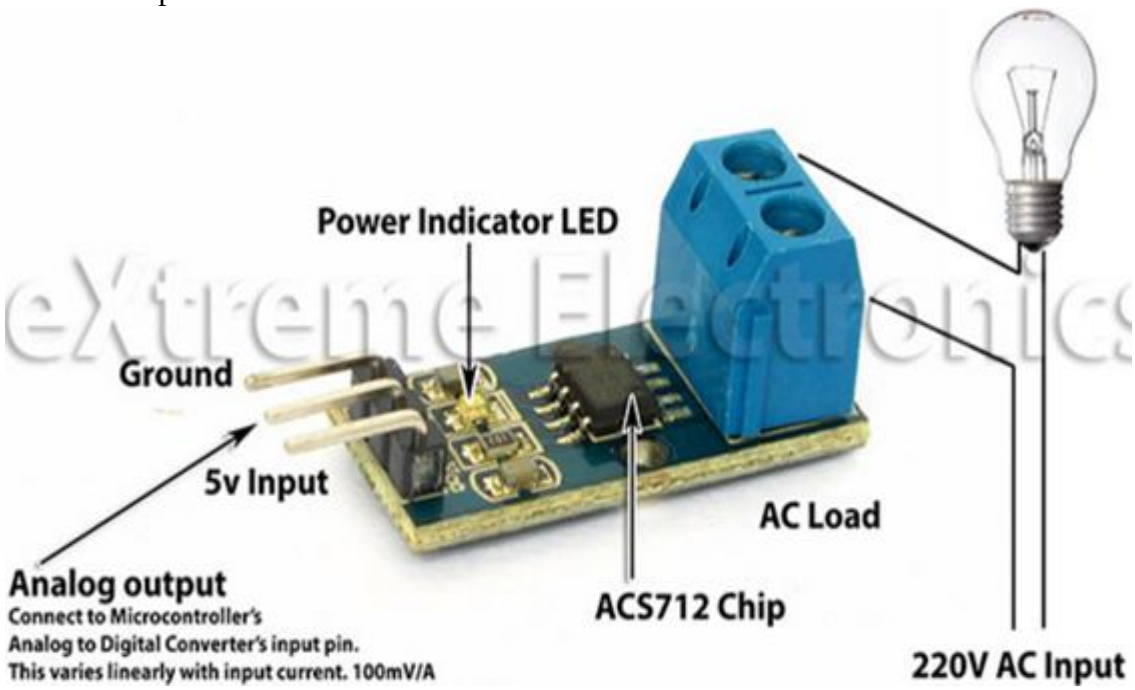


Figure 2.13: ACS712 current sensor components **[15]**.

2.10 Solid State Relay (SSR)

is an electronic switching device that switches on or off when a small external voltage is applied across its control terminals. SSRs consist of a sensor which responds to an appropriate input (control signal), a solid-state electronic switching device which switches power to the load circuitry, and a coupling mechanism to enable the control signal to activate this switch without mechanical parts. The relay may be designed to switch either AC or DC to the load. It serves the same function as an electromechanical relay, but has no moving parts **[16]** .

Figure 2.14: Solid state relay.

Advantages over mechanical relays**[16]:**

- Slimmer profile, allowing tighter packing.
- Totally silent operation
- SSRs switch faster than electromechanical relays; the switching time of a typical optically coupled SSR is dependent on the time needed to power the LED on and off - of the order of microseconds to milliseconds
- Increased lifetime, even if it is activated many times, as there are no moving parts to wear and no contacts to pit or build up carbon
- Output resistance remains constant regardless of amount of use
- No sparking, allows it to be used in explosive environments, where it is critical that no spark is generated during switching
- Inherently smaller than a mechanical relay of similar specification (if desired may have the same "casing" form factor for interchangeability).
- Much less sensitive to storage and operating environment factors such as mechanical shock, vibration, humidity, and external magnetic fields.

2.11 Electronic door lock

Is a locking device which operates by means of electric current. Electric locks are sometimes stand-alone with an electronic control assembly mounted directly to the lock. Electric locks may be connected to an access control system, the advantages of which include: key control, where keys can be added and removed without re-keying the lock cylinder; fine access control, where time and place are factors; and transaction logging, where activity is recorded. Electronic locks can also be remotely monitored and controlled, both to lock and unlock **[17].**

Figure 2.15: Electronic door lock.

Operation:-

Electric locks use magnets, solenoids, or motors to actuate the lock by either supplying or removing power. Operating the lock can be as simple as using a switch, for example an apartment intercom door release, or as complex as a biometric based access control system **[17]**.

Chapter Three

System Design

3.1 Control lighting and devices using Smartphone

3.1.1 Lighting control ON/OFF and Brightness design

3.1.2 Socket and charger design

3.2 Door lock system design

3.3 Energy saving system design

3.4 Display the system consumption and protection on LabVIEW

3.1 Control lighting and devices using Smartphone

3.1.1 Lighting system design

The circuit contains 3 units of lighting and it can control it using two different ways, the first way is from Smartphone by using Roboremo application and the second way by using potentiometer, the way of lighting can be selected by using selector switch

❖ **Block diagram operation**

It's done by receiving commands from smart phone to the Arduino that sends a PWM signal, according to duty cycle of the signal the voltage values given are from 0V to 5V as average value, at 5V the brightness has a maximum value, and at 0V the brightness is Zero. And when sending any values between zero and five volts, the lamp brightness depends on the voltage values and decreases when the voltage decreases.

The PWM signal is transferred to resistance by using LDR optocoupler in order to navigate with dimmer circuit, and by using selector switch that selects the control signal whether from potentiometer or the optocoupler as shown in Fig. 3.1.

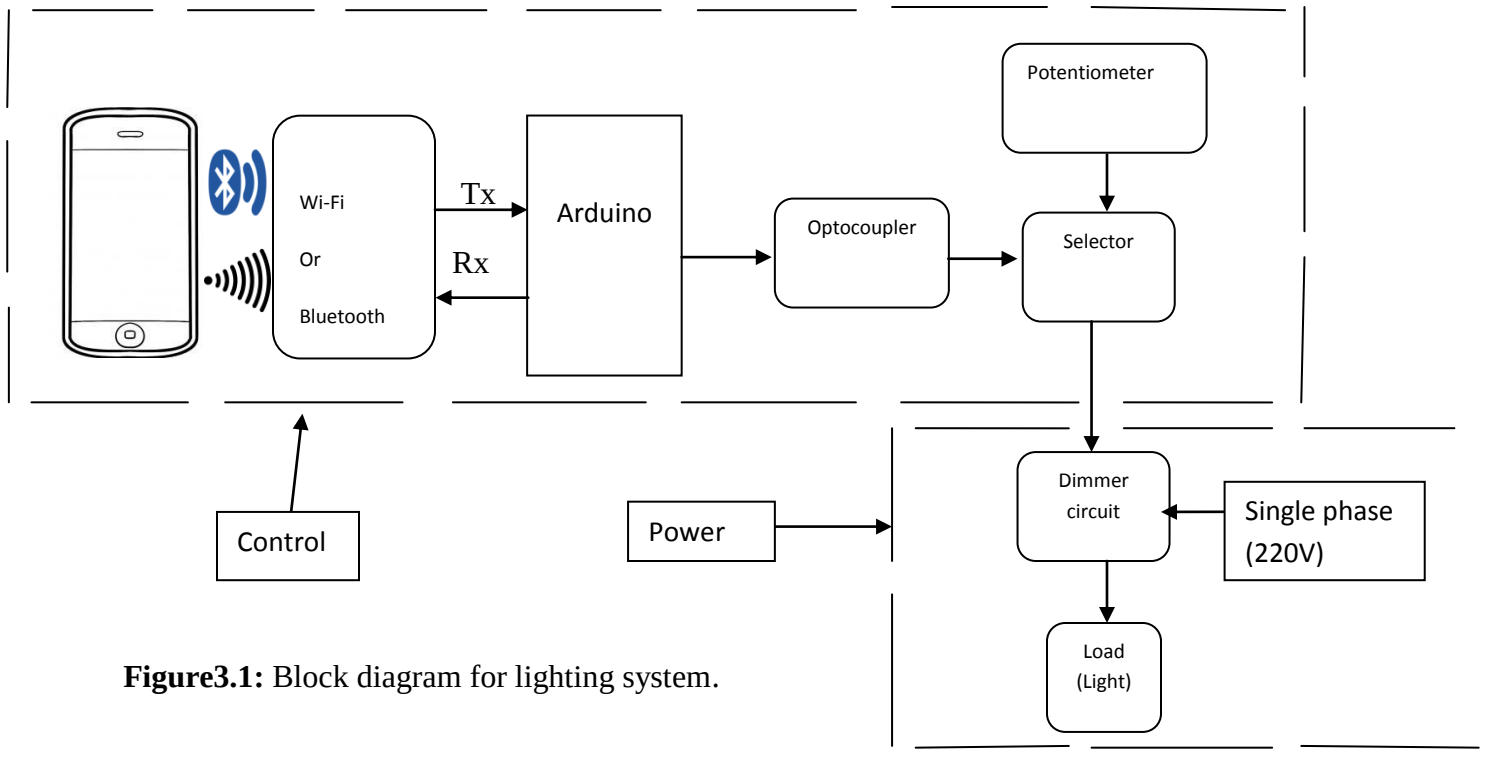


Figure3.1: Block diagram for lighting system.

❖ **Roboremo application for lighting system**

For every lighting unit we need three item, two button and one slider, the first button in text write" light 1 on" ,in set press action write "on 1",the second button in text write" light 1 off" ,in set press action write "off 1", and in slider set id write"L1",in set label write "brightness", inset max put"255",in set min put"0".(Shown in Figure 3.2)

*Note: This setting is for the first lighting unit , for the second and third unit we do the same but just change the light number, for example, light 1 on became light 2 on, etc..

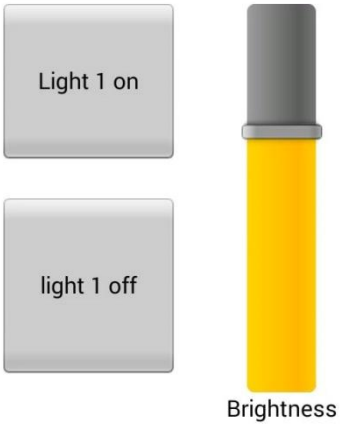


Figure3.2: Control light from Roboremo application.

❖ **Arduino code for lighting system**

Code for analysis on/off command:-

charcmd[100]; // cmd a string that store in it the command that received from application

.

.

.

If (cmd= ="on1") // check if the command is on1

digitalWrite(Light1, HIGH); //if the condition is true turn the light 1on

If (cmd= ="off1") // check if the command is off1

digitalWrite(Light1, LOW); //if the condition is true turn the light 1off

❖ **Circuit design for lighting**

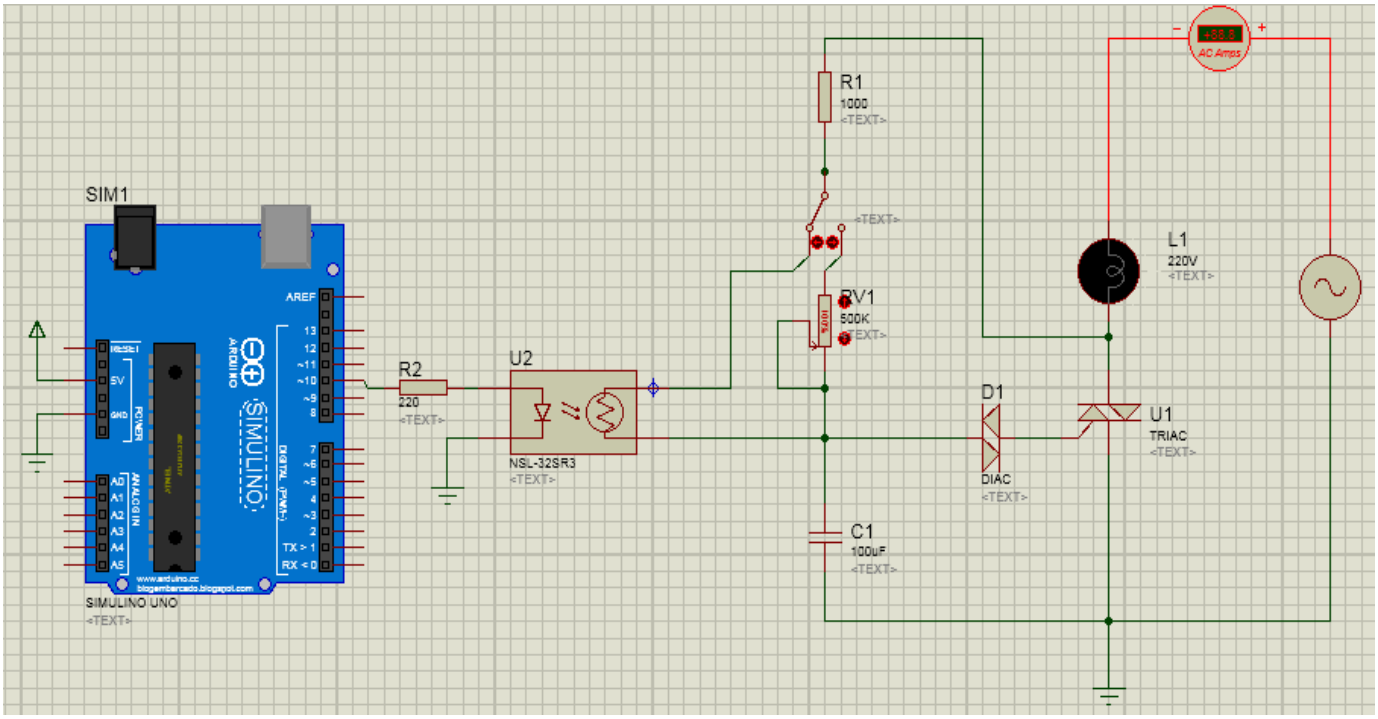


Figure3.3: Lighting circuit design.

We build a dimmer circuit to control the brightness by two ways, first using variable resistance of 500KΩ, and second using a signal from Arduino. But need to modify that 500k resistance somehow by Arduino signal. And also you need to assure electrical insulation between the Arduino and the rest of the circuit. The easiest way is to use a Light Dependent Resistor (LDR).

The LDR07 works up to 300V DC. Maybe it works with AC too, but to be safe, used 4 diodes (rectifier), so that the LDR07 will work with DC. Then put it together with a yellow LED and 1k resistor inside a shrink tube.

In addition added selector switch to select control from two ways using potentiometer or arduino signal.

3.1.2 Socket and charger design

Control the state of the socket and the charger by smart phone, that by smart phone can active and inactive it through Roboremo application ,like the charger that connect to phone via USB can active it when we need it by send command from the smart phone .

❖ **Block diagram operation**

Send command from smart phone to microcontroller where the microcontroller send digital signal to relay, it connect series with socket, and we used it to connect and disconnect the socket , the relay work at arduino voltage (5V) and give 220 V to run the device.

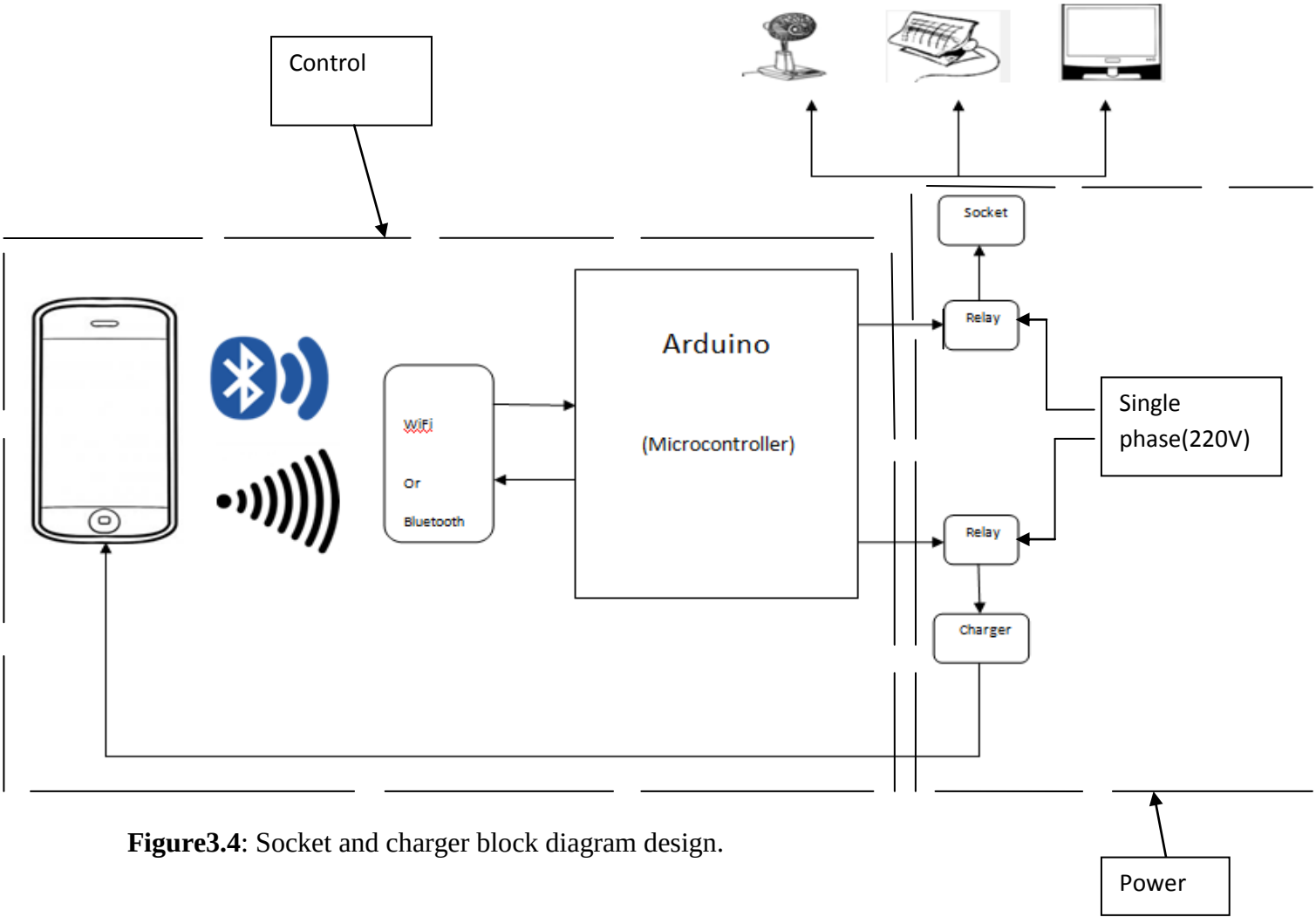


Figure3.4: Socket and charger block diagram design.

❖ **Roboremo application for socket and charger :**

For this part need four button to enable and disable the charger and the socket, set the text for the buttons as shown in the figure3.6.For the socket the button for enable write in set press action "enable socket", the button for disable write in set press action "disable socket" , and for the charger the button for enable write in set press action "enable charger" , and the button for disable write in set press action "disable charger".

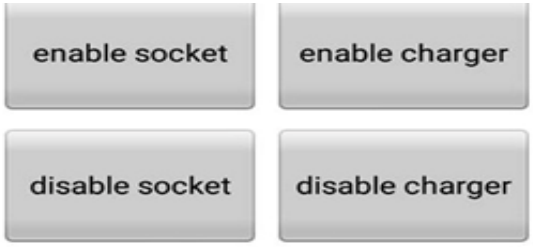


Figure3.5: Control socket through Roboremo application.

❖ **Circuit design for charger and socket:**

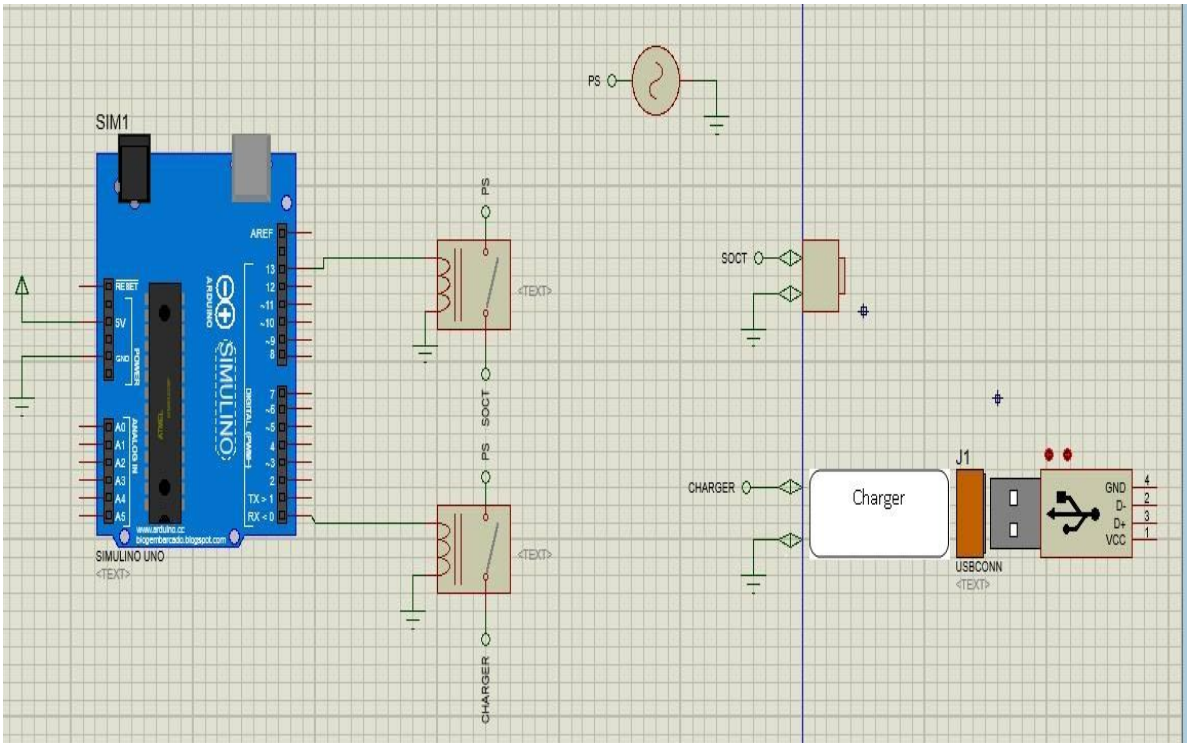


Figure3.6: Circuit design for charger and socket.

Connect relay series with socket and power supply, where an digital signal from arduino enable relay, and the same thing about charger

3.2 Door lock system design

Door lock using fingerprint sensor is effective and high security because we used fingerprints, in addition to key, and can add many fingerprints for many users, the door will open if enter the correct fingerprint or using key.

The key can open the door all the time but can't open the door using fingerprint if the door locked using key.

❖ **Block diagram operation**

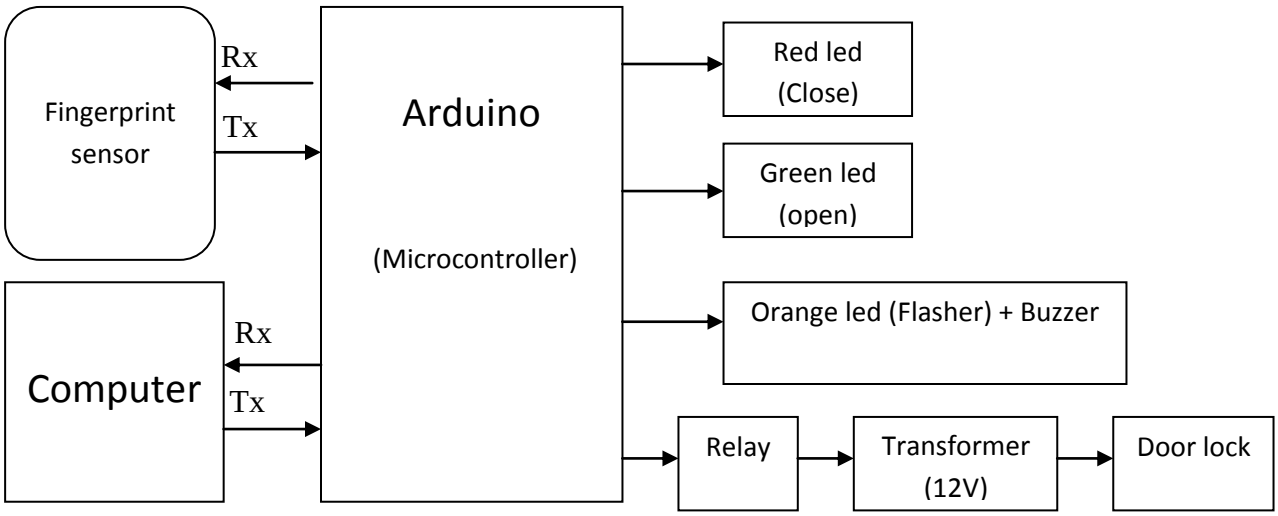


Figure3.7: Block diagram for door lock system.

At the beginning the red led be active to show the state of the door is close and when enter one of the correct fingerprints that defined previously the lock will be open, and the green led active to show the state of the door is open , the orange led work as flasher after we open the door to show that the door still open , also use buzzer to make sound to show that the door still open and after 10 second the door will be close again and the red led will active again

Use 12 v Transformer to drive the circuit to open the door after we enter the correct fingerprint.

Use the computer to add and delete fingerprints and to monitoring who enter or leave the home by knowing his fingerprint.

❖ Arduino codes for door lock system

There is specially code in appendix for adding a new fingerprint and code for compare between the input and storage fingerprint.

❖ Circuit design at Protous:-

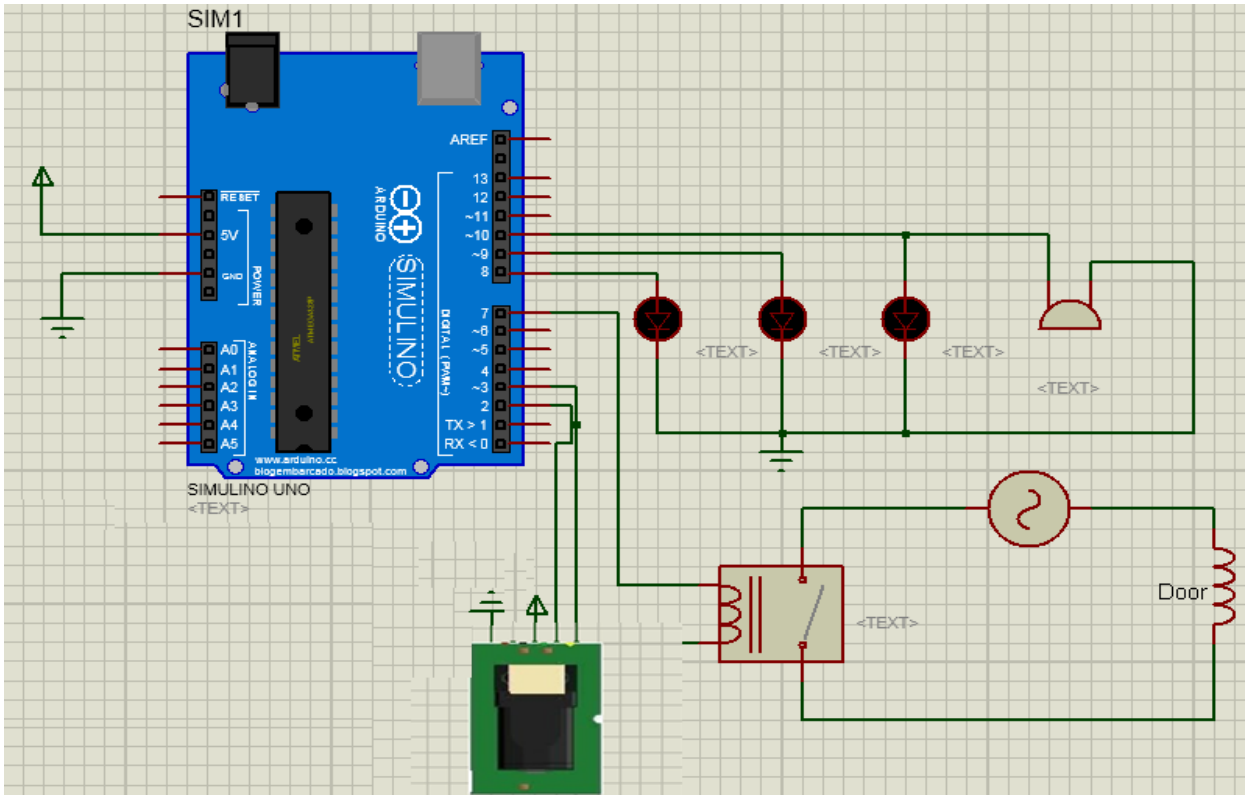


Figure3.8: Circuit design for door lock system.

3.3 Energy saving system design

Using the previous designs (lighting and socket system design) and with adding sensor that check human existence in the place ,the sensor depend for temperature and radiated heat ,that sensor contains many features but we don't used all.

The same relies that used to control lighting and socket will be also used to disconnect the electricity when human body detection sensor don't give signal that there is any body in the room.

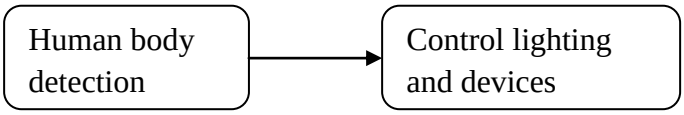


Figure3.9: Block diagram for energy saving system.

This sensor gives us an array to analog pin on arduino, the value of array giving different values depending on the distance between human and sensor ,but we convert this analog signal to digital signal (zero and one), zero when human absent, one when detect human, this conversion depend on the room temperature.

3.4 Display the system consumption and protection on LabVIEW:

This part allows the user to supervise the power and energy consumption into effective interface and it also display the voltage, the current and the frequency. This smart system Contain protection for over load and alarm, it also disconnect the power from the home when a fault occur, also it display the state of the Lighting system (work or close) if the lighting is work the picture at **figure 3.10a** will be display, but if it is close the picture at **figure 3.10b** will be display at LabVIEW program screen .

Figure3.10a: The lighting is work

Figure3.10b: The lighting is close

It is also display the state of the door (open or close) if the door is close the picture at figure **3.11a** will be display at LabVIEW, but if it is open the picture at figure **3.11b** will be display at LabVIEW program screen.

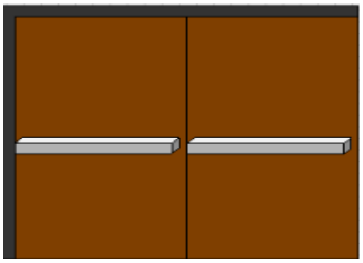


Figure3.11a: The door is close

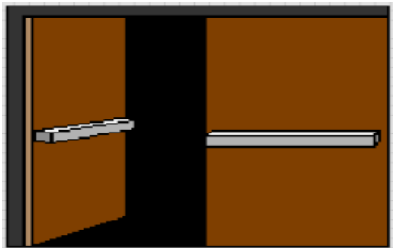


Figure3.11b: The door is open

It is also display the state of the socket (active or inactive) if socket is active the picture at figure **3.12a** will be display at LabVIEW, but if it is inactive the picture at figure **3.11b** will be display at LabVIEW program screen.

Figure3.12a: The socket is active

Figure3.12b: The socket is inactive

It is also display the state of the charger(active or inactive) if the charger is active the picture at figure **3.13a** will be display at LabVIEW, but if it is inactive the picture at figure **3.13b** will be display at LabVIEW program screen.

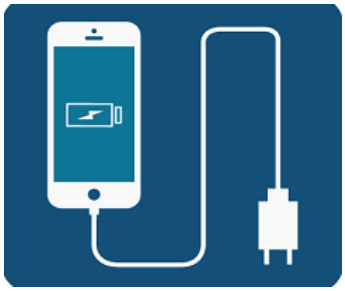


Figure3.13a: The charger is active

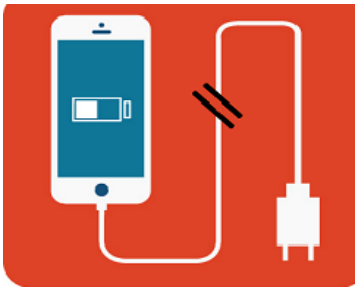


Figure3.13b: The charger is inactive

It is also display the state of the human(existing or absent) if the human is existing the picture at figure **3.13a** will be display at LabVIEW, but if they absent the picture at figure **3.13b** will be display at LabVIEW program screen.

Figure3.14a: The human **is** existing

Figure3.14b: The human **is** absent

❖ **Block diagram operation:**

The block diagram show all parts that we talked about it previously.

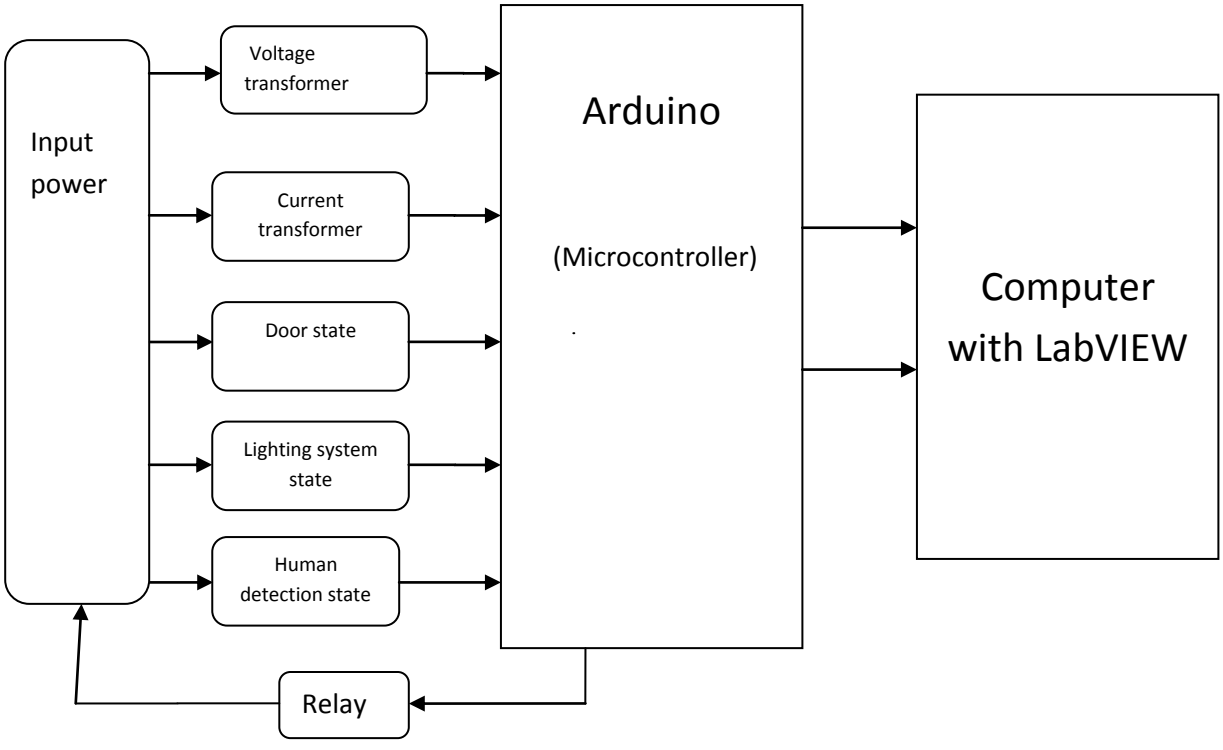


Figure3.15: Block diagram for Lab VIEW

Using circuit for convert the line voltage from alternative between +312v and -312v to voltage between 0v and 5v,this circuit for sense the voltage into the grid because the arduino can't read above 5v and negative voltage, the circuit build and simulate using Multism (shown in figure3.) arduino input (shown in figure3.15)

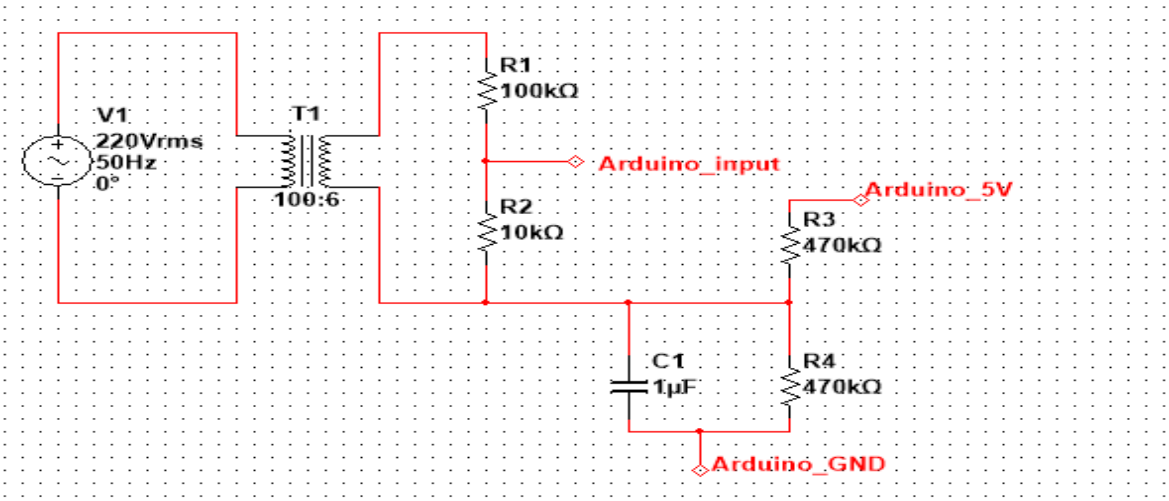


Figure3.16: Circuit for convert alternative line voltage (-312-+312) to arduino alternative voltage (0-5)

Also to sense the current there is current transformer which transfers each five ampere to one volte. This data transfer from arduino to computer through USB cable. The computer contains program (LabVIEW) which take the data and analyze it and display the result on computer screen and send a command to arduino.

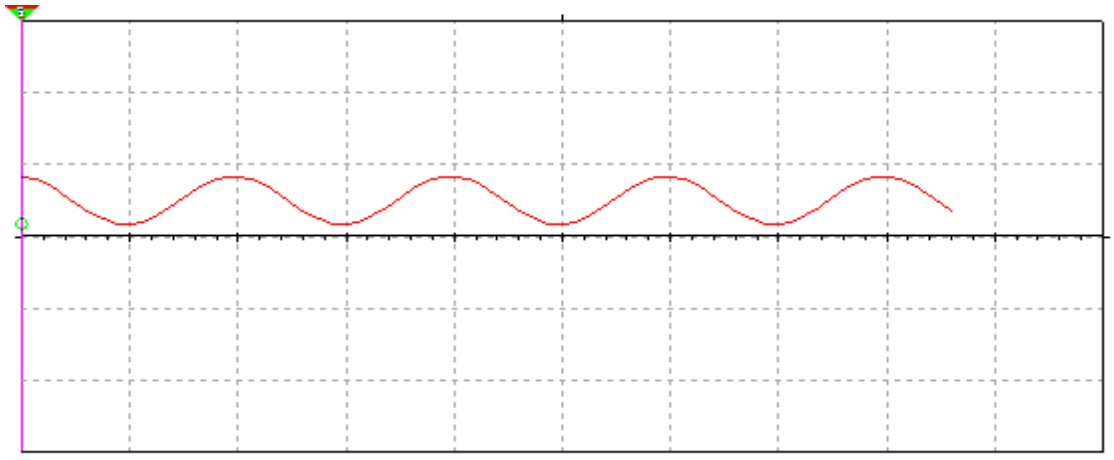


Figure3.17: Waveform graph for convert alternative line voltage to alternative arduino voltage

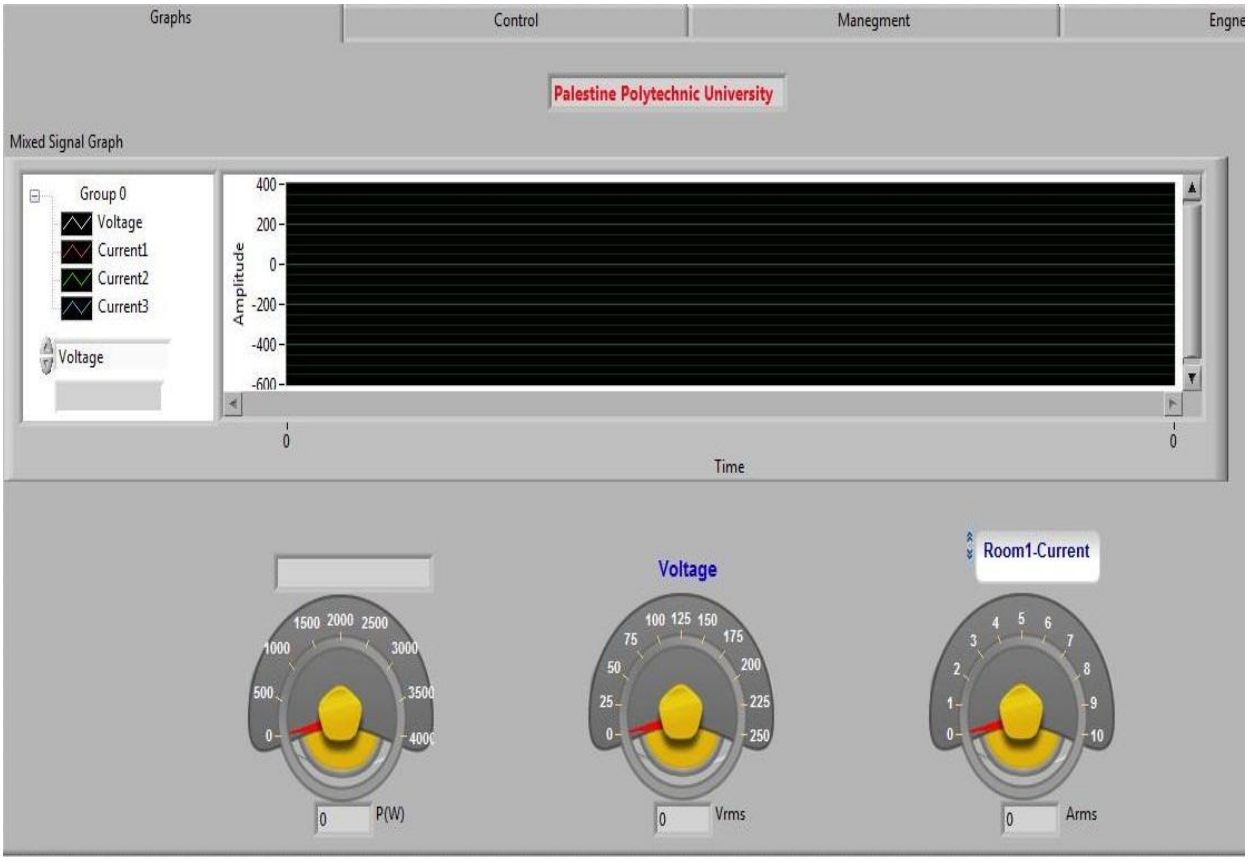


Figure3.18: Graph tap

The graph tap is user interface that display voltage and current curve, and also calculate voltage, current RMS value then calculate apparent power from it. There is emergency stop button, when fault or wrong occur the user must press it to disconnect the electricity and stop everything (Shown in graph3.15)

Figure3.19: Control tap

The control tap contains programmable Circuit Breaker that can control its rated current programmatic with any value. Basically its relay and current transformer connected with the arduino, LabVIEW analyzed the value of the current and compare it with rated value if its greater or equal it will give command to the relay for disconnect the electricity. There are three programmable CBs to three rooms.(Shown in graph 3.16)

Using LabVIEW features can calculate the phase shift between two signals so also can calculate the power factor and from it calculate the active and reactive power.

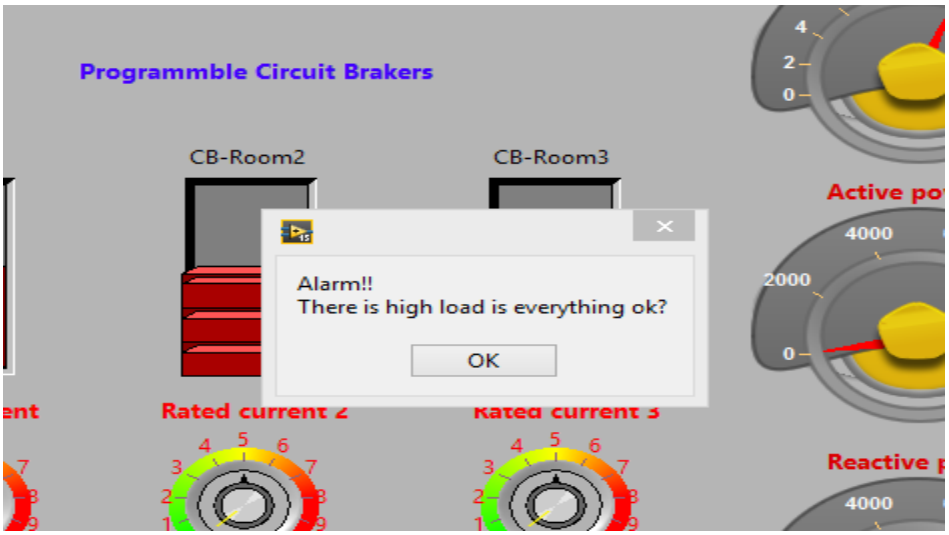


Figure3.20: Message appear when the current reach to specific value.

When the current reach to specific value the program will give message to the user to attention him , so the user must check the electrical devices and sure there is no problem, then press OK.

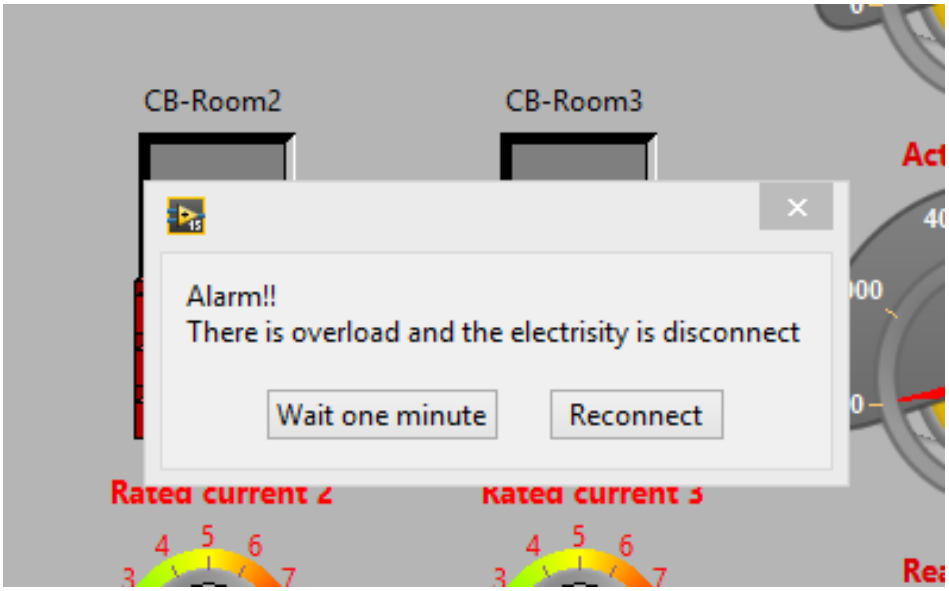


Figure3.21: Message appear as warming for the user if the current reach the maximum value

When the current reach to specific value(Maximum) the program will disconnect the electricity immediately and give message to the user to warning him , so the user must check the electrical devices and solve the problem then press reconnect.

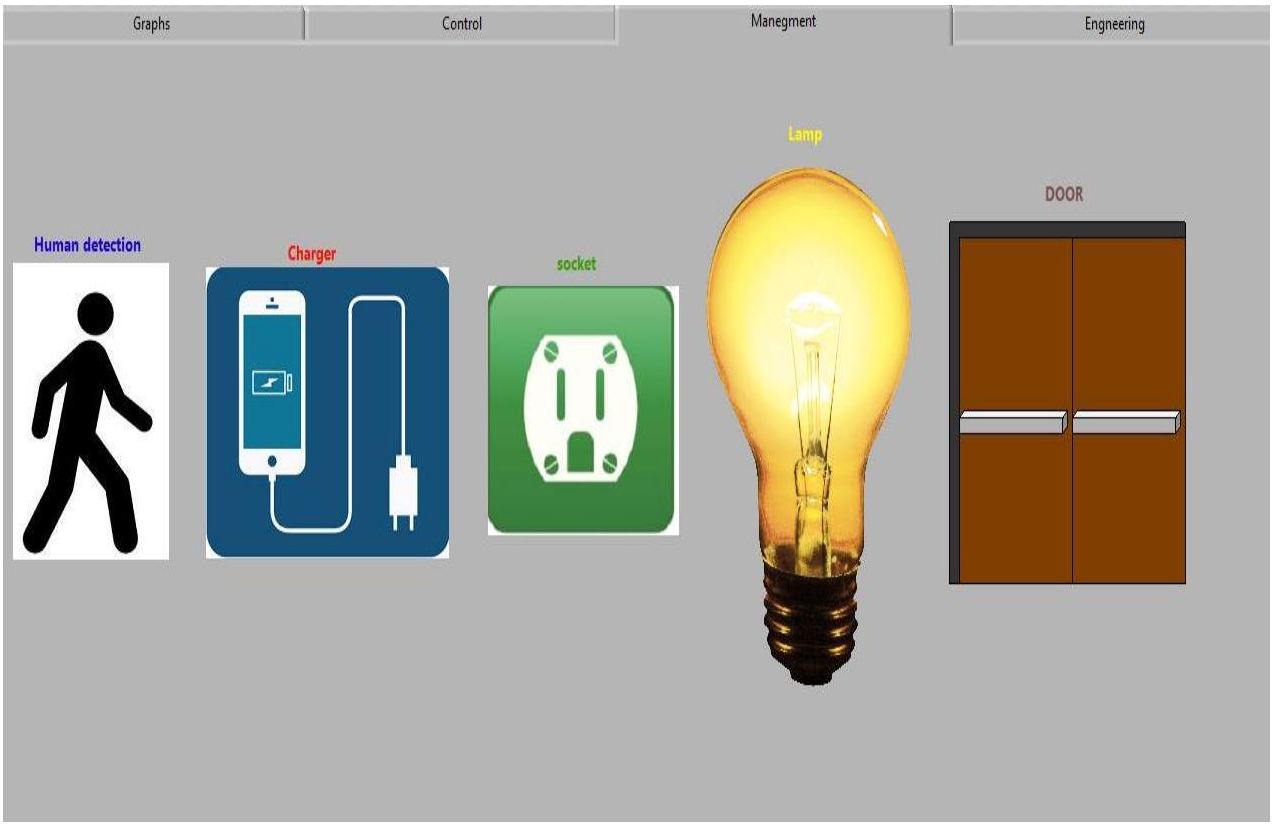


Figure3.22: Management tap

The management tap display the state of the all project systems , like the state of the door (open or close), the state of the lighting(work or close), the state of the charger and the socket (active or inactive), human state(existent or absent).

Chapter Four

Project component and codes

We designed the project on module board such as laboratories design to display and run the project to benefit university students in control and microcontroller course

4.1 Voltage sensor circuit

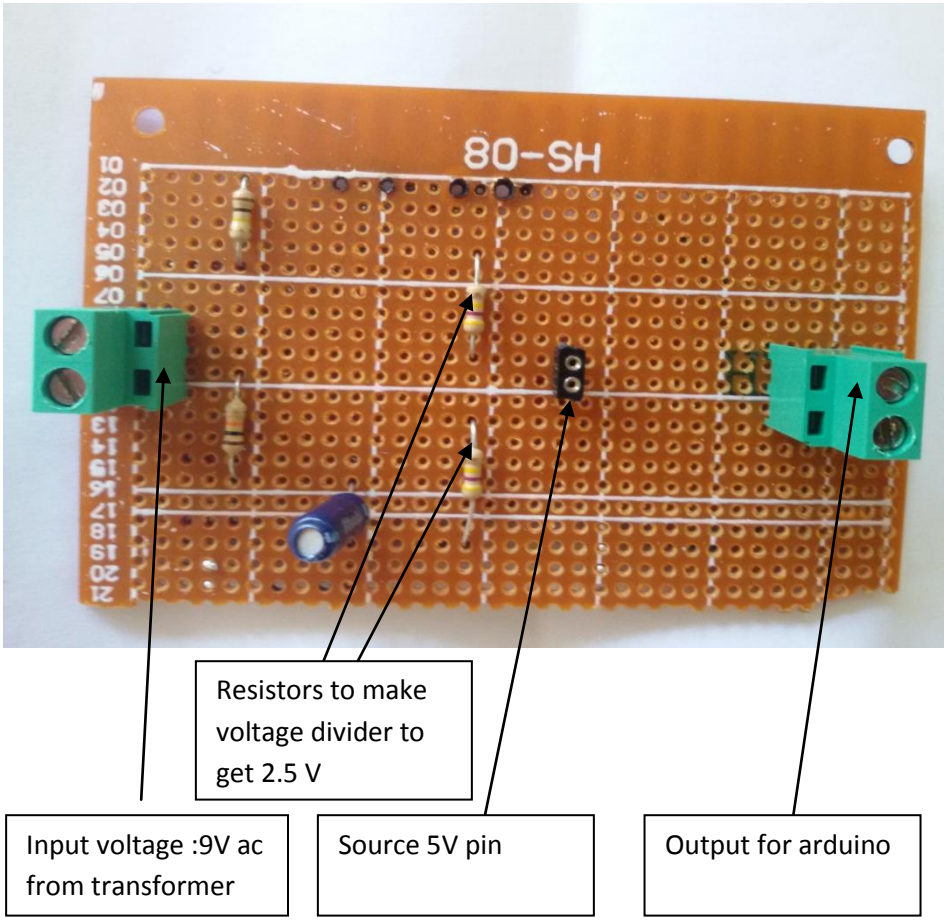


Figure4.1: Voltage sensor circuit

4.2 Lighting circuit

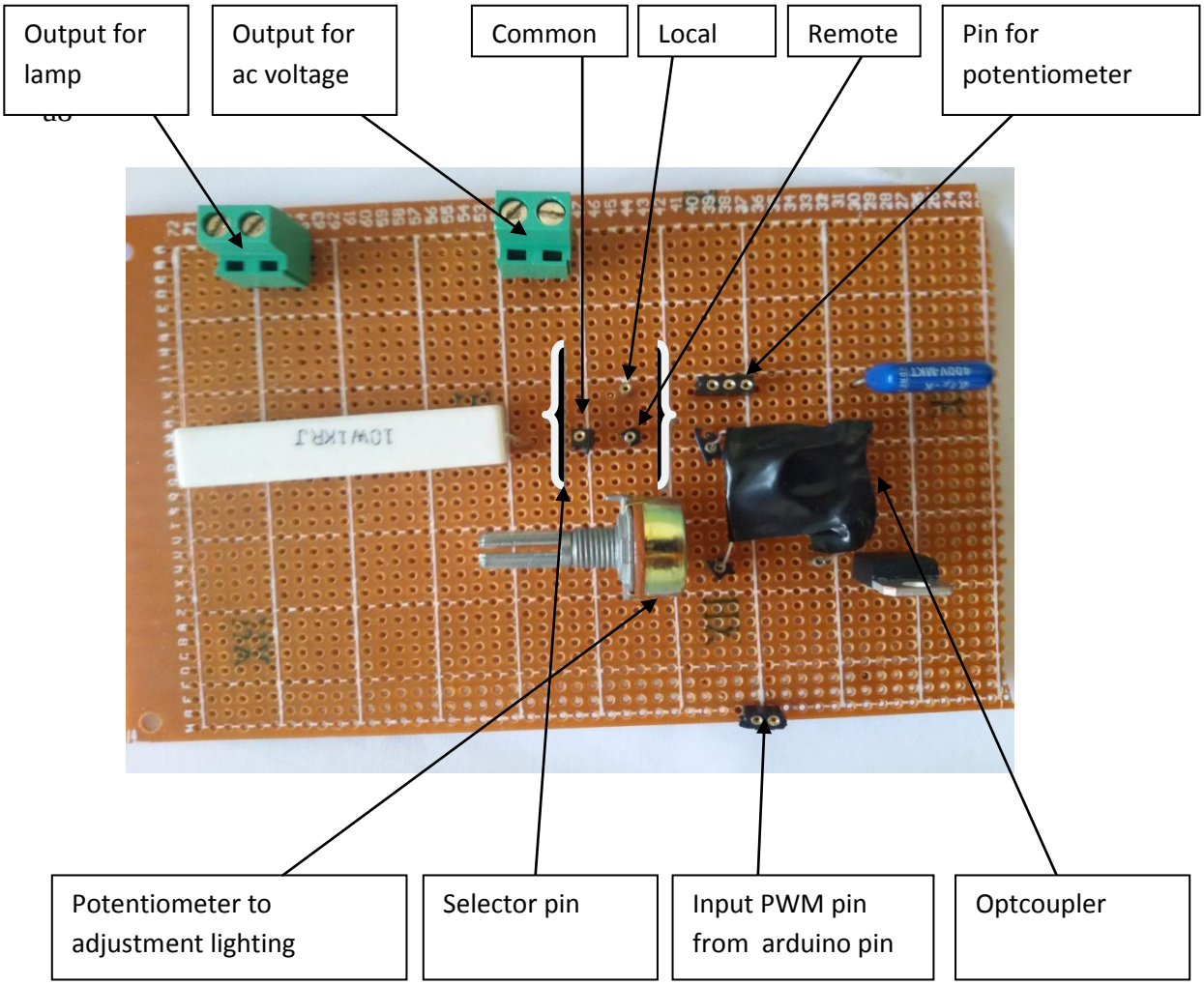


Figure4.2:Lighting circuit

4.3 Solid state relay(SSR) circuit

We have three solid state relay circuit that can used it instead of normal relay because it is expensive and the solid state relay is cheap .

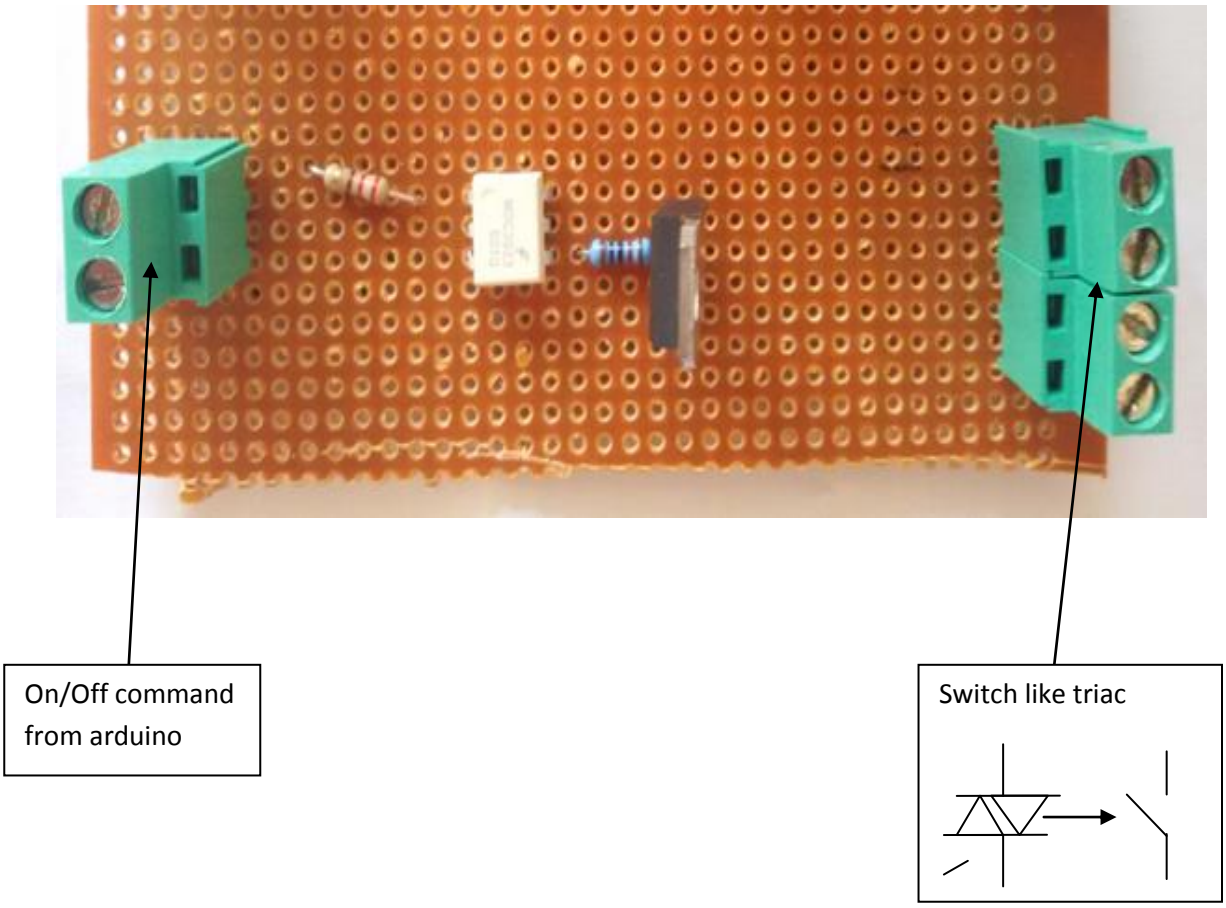


Figure4.3: Solid state relay(SSR)

4.4 Door lock circuit

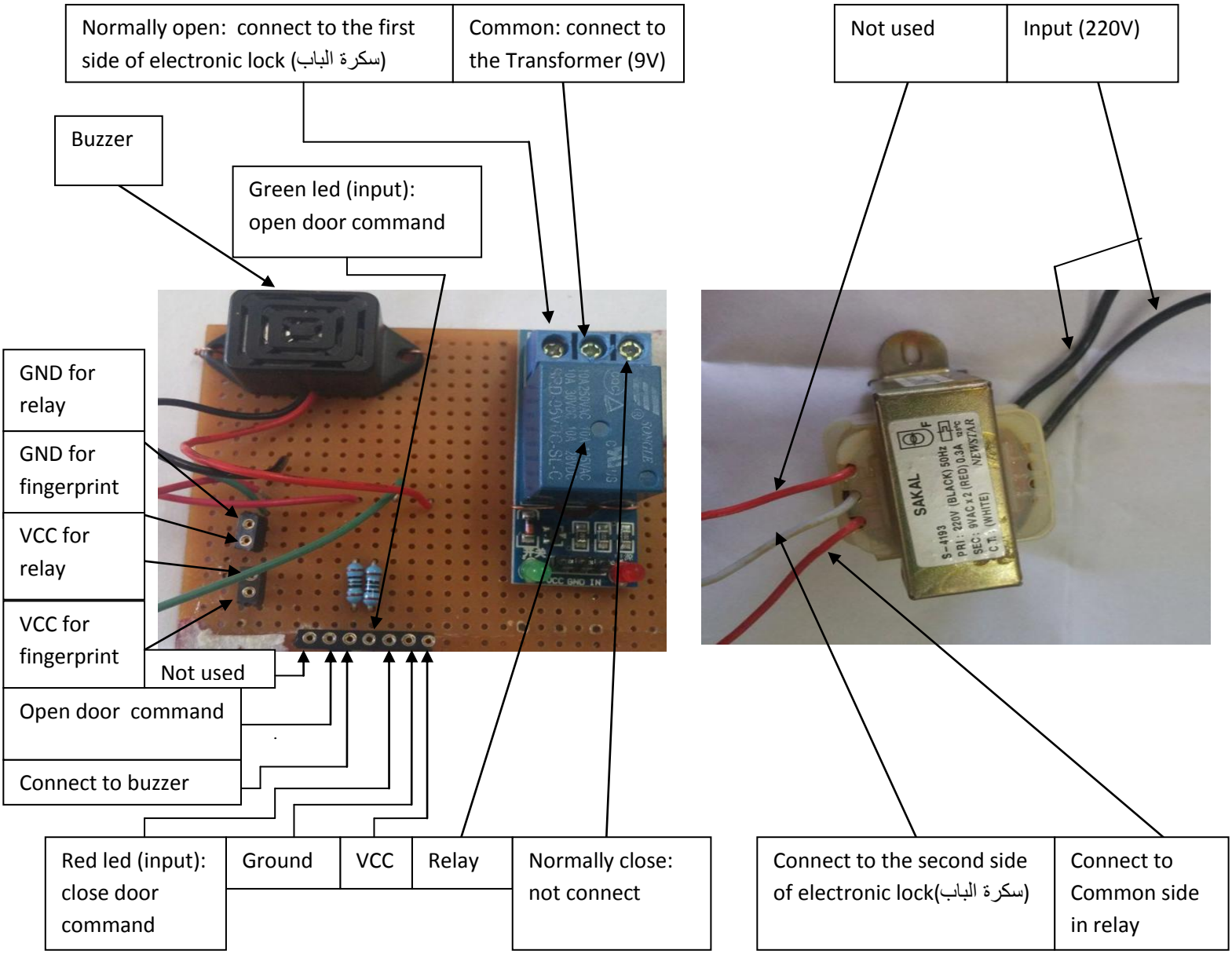


Figure4.4: Door lock circuit

4.5 Arduino codes

4.5.1 Controller by bluetooth code

```
// Control socket, charger and Lamp on/off and brightness(PWM)
// over Bluetooth using RoboRemo app
// www.roboremo.com
// Hardware setup:
// BT module   Arduino
// GND ------- GND
// VCC ------- 5V
// TX-O ------ pin0
// RX-I ------ pin1
#define bluetooth Serial
// In this project we use Hardware Serial.
// But Arduino UNO also uses Hardware Serial
// for programming, so when you program the Arduino,
// you need to disconnect the Bluetooth module,
// and to run the circuit, you need to disconnect
// the USB cable and connect the Arduino DC power supply.

int Lamp = 10,stat=13,soc=12,CHG=11,Human=9,motion=8,alarm=7,enable;
char cmd[100];
int cmdIndex;
boolean cmdStartsWith(char *st) {
```

```
  for(int i=0; ; i++) {
    if(st[i]==0) return true;
    if(cmd[i]==0) return false;
    if(cmd[i]!=st[i]) return false;;
  }
  return false;
}
int brightness = 0;
int socket = 0,charger=0;
void exeCmd() {
  if( cmdStartsWith("br ") ) // example: if cmd is "br 100"
  {
    brightness = atoi(cmd+3);  // brightness will be 100
  }
  if( cmdStartsWith("socket") ) { // toggle on/off
    if(socket) {
      socket = 0;
    } else {
      socket = 1;
    }
  }
   if( cmdStartsWith("charger") )// toggle on/off
   {
       if(charger) {
```

```
    digitalWrite(CHG, 0);
    charger = 0;
   }
   else
   {
    digitalWrite(CHG,1);
    charger = 1;
   }}
   if( cmdStartsWith("Enb") )// toggle on/off
  {
     if(enable) {
    enable= 0;
   }
   else
   {
    enable= 1;
   }}}
void setup() {
  delay(500); // wait for bluetooth module to start
  bluetooth.begin(115200); // Bluetooth default baud is CHG5200
  pinMode(Lamp, OUTPUT);
  pinMode(soc, OUTPUT);
  pinMode(stat, OUTPUT);
  pinMode(CHG, OUTPUT);
```

```
  pinMode(alarm, OUTPUT);
  pinMode(Human, INPUT);
  pinMode(motion, INPUT);
  digitalWrite(stat,0);
  digitalWrite(soc,0);
  digitalWrite(CHG,0);
  analogWrite(Lamp, 0);  // off
 socket = 0;
 charger=0;
  cmdIndex = 0;
}
void loop() {
  if(bluetooth.available()) {
        char c = (char)bluetooth.read();
    if(c=='\n') {
      cmd[cmdIndex] = 0;
      exeCmd();  // execute the command
      cmdIndex = 0; // reset the cmdIndex
    } else {
      cmd[cmdIndex] = c;
      if(cmdIndex<99) cmdIndex++;
    }}
    if(digitalRead(Human))
    {
```

```
  analogWrite(Lamp, brightness);
  digitalWrite(soc,socket);
   if(brightness>4) digitalWrite(stat,1);
   else digitalWrite(stat,0);
   }
  else
  {
  analogWrite(Lamp, 0);
  digitalWrite(soc,0);
  digitalWrite(stat,0);
  }
  if (digitalRead(motion))
 digitalWrite(alarm,enable);
 else digitalWrite(alarm,0);
  }
```

4.5.2 Fingerprint code

```
#include <Adafruit_Fingerprint.h>
#include <SoftwareSerial.h>
int getFingerprintIDez();
// pin #2 is IN from sensor (GREEN wire)
// pin #3 is OUT from arduino  (WHITE wire)
SoftwareSerial mySerial(2, 3);
Adafruit_Fingerprint finger = Adafruit_Fingerprint(&mySerial);
```

```
// On Leonardo/Micro or others with hardware serial, use those! #0 is green wire, #1 is white

//Adafruit_Fingerprint finger = Adafruit_Fingerprint(&Serial1);

void setup()

{

 pinMode(13,OUTPUT);

  pinMode(12,OUTPUT);

  pinMode(11,OUTPUT);

  pinMode(10,OUTPUT);

  digitalWrite(11,1);

  digitalWrite(10,1);

 while (!Serial);  // For Yun/Leo/Micro/Zero/...

 Serial.begin(9600);

   Serial.println("Welcome TO Home Automation Project");

 Serial.println("Adafruit finger detect test");

 // set the data rate for the sensor serial port

 finger.begin(57600);

 if (finger.verifyPassword()) {

   Serial.println("Found fingerprint sensor!");

 } else {

   Serial.println("Did not find fingerprint sensor :(");

   while (1);

 }

 Serial.println("Waiting for valid finger...");
```

```
}
void loop()                     // run over and over again
{
  getFingerprintIDez();
  delay(50);            //don't ned to run this at full speed.
}
uint8_t getFingerprintID() {
  uint8_t p = finger.getImage();
  switch (p) {
    case FINGERPRINT_OK:
      Serial.println("Image taken");
      break;
    case FINGERPRINT_NOFINGER:
      Serial.println("No finger detected");
      return p;
    case FINGERPRINT_PACKETRECIEVEERR:
      Serial.println("Communication error");
      return p;
    case FINGERPRINT_IMAGEFAIL:
      Serial.println("Imaging error");
      return p;
    default:
      Serial.println("Unknown error");
      return p;
```

```
}
// OK success!
p = finger.image2Tz();
switch (p) {
  case FINGERPRINT_OK:
    Serial.println("Image converted");
    break;
  case FINGERPRINT_IMAGEMESS:
    Serial.println("Image too messy");
    return p;
  case FINGERPRINT_PACKETRECIEVEERR:
    Serial.println("Communication error");
    return p;
  case FINGERPRINT_FEATUREFAIL:
    Serial.println("Could not find fingerprint features");
    return p;
  case FINGERPRINT_INVALIDIMAGE:
    Serial.println("Could not find fingerprint features");
    return p;
  default:
    Serial.println("Unknown error");
    return p;
}
  // OK converted!
```

```
  p = finger.fingerFastSearch();
  if (p == FINGERPRINT_OK) {
    Serial.println("Found a print match!");
  } else if (p == FINGERPRINT_PACKETRECIEVEERR) {
    Serial.println("Communication error");
    return p;
  } else if (p == FINGERPRINT_NOTFOUND) {
    Serial.println("Did not find a match");
    return p;
  } else {
    Serial.println("Unknown error");
    return p;
  }
    // found a match!
  Serial.print("Found ID #"); Serial.print(finger.fingerID);
  Serial.print(" with confidence of "); Serial.println(finger.confidence);
}
// returns -1 if failed, otherwise returns ID #
int getFingerprintIDez() {
  uint8_t p = finger.getImage();
  if (p != FINGERPRINT_OK)  return -1;
  p = finger.image2Tz();
  if (p != FINGERPRINT_OK)  return -1;
  p = finger.fingerFastSearch();
```

```
 if (p != FINGERPRINT_OK)  return -1;
 // found a match!
 if (finger.fingerID==3){
 Serial.print(finger.fingerID); Serial.println("  Welcome Mohammed Jundi"); }
 if (finger.fingerID==1){
 Serial.print(finger.fingerID); Serial.println("  Welcome Ibrahim"); }
 digitalWrite(10,0);
 digitalWrite(12,1);
 digitalWrite(11,0);
for(int i=0;i<10;i++){
 digitalWrite(13,1);
 delay(300);
 digitalWrite(13,0);
  delay(300);
 }
digitalWrite(10,1);
 digitalWrite(12,0);
 digitalWrite(11,1);
 return finger.fingerID;
}
```

4.6 LabVIEW code

Chapter Five

Conclusion and recommendation

Conclusion:

This project runs in approximately 95 % as we planned , but it's done by facing many problems such as : spending many time in order to get the components of the project from Israel , some of the components like Human detection sensor is not allowed to enter the west bank because of security conditions , this sensor replaced by motion sensor, but its performance not good as needed i.e. (when the human presence at home without any movement the sensor does not respond) , so we changed the sensor settings as follows :

1- Increase time delay.
2- Increase sensitivity.
3- Put jumper set to repeat triggering.

After that, the sensor became more "acceptable".

The other problems that faced us, LabVIEW program cannot read wave at 50 Hz, and also display wrong waveform, after that we tried to solve the problem by finding library for the LabVIEW program to control the number of the sample rate and reading speed to be able to read the wave with kilo Hertz.

We faced problem with the code of the finger print sensor where the sensor does not respond with this code, so we made some modifications to the code until the sensor responded. This project is economical because it has a low cost with excellent performance, at the same time saving energy. The project cost did not exceed 2100 NIS despite of it contains:

Components	Real price(NIS)	Project price(NIS)
SSR	150	20
Dimmer	170	45
Oscilloscope and multimeter	4000	600
Management system	1200	
Control system at least for 3 devices	1800	
Door lock system	800	680

Table5.1: Differences between our project price and real price

Door lock system costs 680 NIS because the finger print sensor export from Israel so the price became double.

Recommendation

This project designed on module board to control the home partially as lighting, socket, charger, door lock system, and energy consumption. This project can be developed to become more inclusive by adding many sensors to the same system without significant changes , i.e. : can add sensors for humidity , temperature , and CO2 and the reading result of these sensors can be display by LabVIEW program , depending on these sensors reading it can be used to control the air conditioning device , in addition , can save energy , we can add another sensors to display water and gas consumption . To consider this project completely smart, it's better to add Scheduler system to control home, or organization by this Scheduler according to time, and date, for example: can activate the lighting at working hours, but after working hours the lighting will be deactivated automatically, the same thing applies on the air conditioning and other devices, the scheduler system consider as saving energy system.

This project depends on Bluetooth to transfer commands from smart phone to the microcontroller but this control method consider local method , and by using wifi and internet we can develop it , and then we can control the project from any place in the world . The LabVIEW program contains remote access for monitoring the home and it’s devices from any place in the world.

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