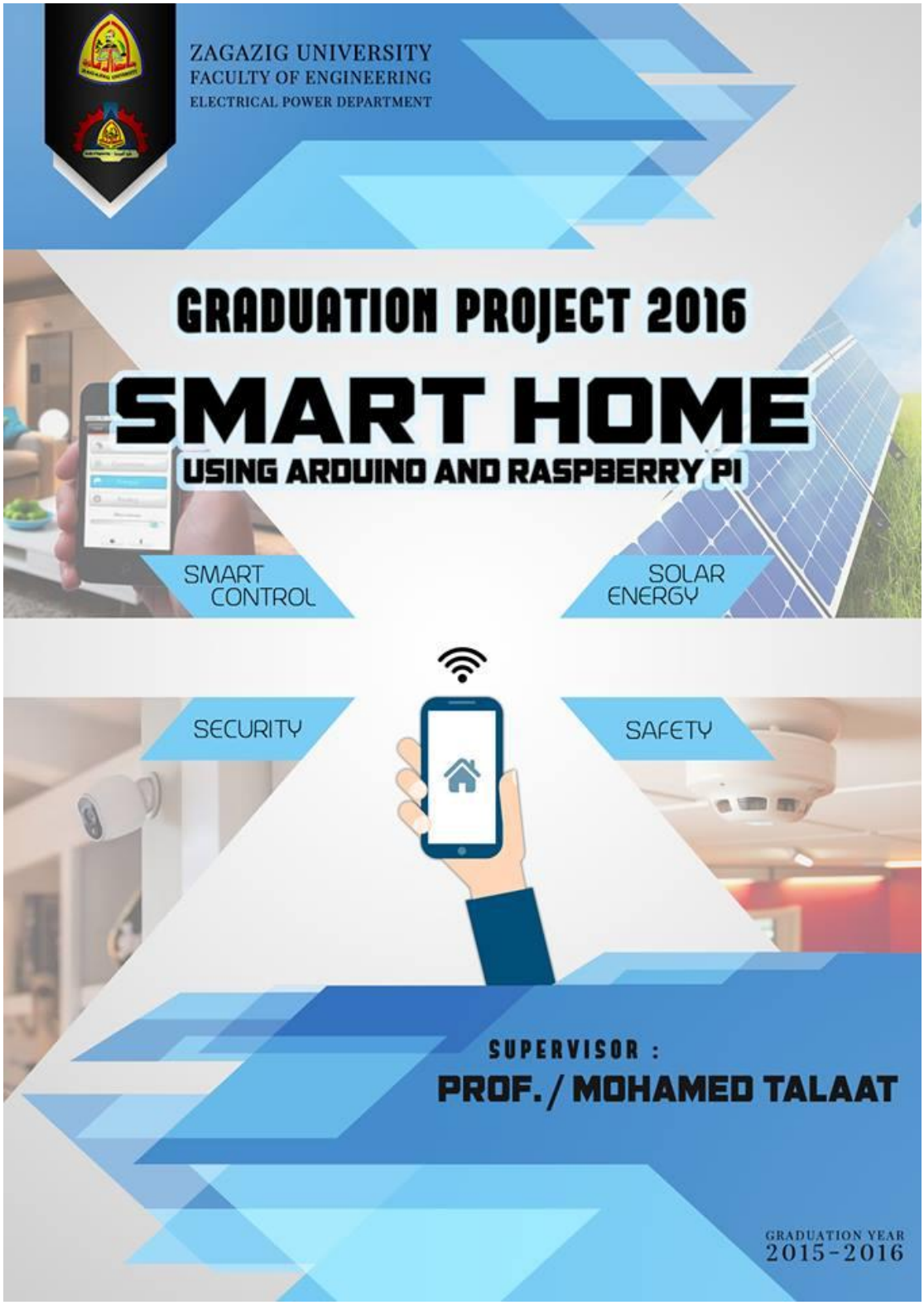
ZAGAZIG UNIVERSITY
FACULTY OF ENGINEERING
ELECTRICAL POWER DEPARTMENT
GRADUATION PROJECT 2016
SMART HOME
USING ARDUINO AND RASPBERRY PI
SMART CONTROL
SOLAR ENERGY
SECURITY
SAFETY
SUPERVISOR :
PROF. / MOHAMED TALAAT
GRADUATION YEAR
2015-2016


ZAGAZIG UNIVERSITY
FACULTY OF ENGINEERING
ELECTRICAL POWER DEPARTMENT
SMART HOME
USING ARDUINO AND RASPBERRY PI
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In the name of **Allah**, the Most Gracious and the Most Merciful.

Alhamdulillah, all praises to **Allah** for the strengths and His blessing in completing our graduation project.

Special appreciation goes to our supervisor **, Prof. Mohamed Talaat,** for his supervision, patience, motivation, enthusiasm, and immense knowledge. His invaluable help of constructive comments and suggestions throughout the experimental and project works have contributed to the success of our graduation project

TABLE OF CONTENTS

ABSTRACT

Imagine how helpful it will be to able to switch on your air conditioning system ten minutes before you get home on a hot afternoon ,how about having security system that will detect smoke ,excessive electrical power usage, burglar attempts and abnormal movements in your house and alert you ?

This is what home automation is about and there is no end to its applications.

Automation is use of control system and information technology to control equipment, reducing the need for human intervention.

Smart Home is collaboration of technology and services through a network for better quality living. A smart home allows the entire home to be automated and therefore provide ease and convenience to everyday activities in the home. This technology is used to make all electronic devices to act ‘smart’. Many people think this technology as pure networking. Others think this technology will reduce their work load, but smart home technology is combination of both and much more. Smart home technology is currently being implemented for entire house in particularly kitchen and living room. Basically, smart home facilitates users with security, comfortable living and energy management features as well as added benefits for disabled individuals.

Chapter (1) Introduction

1.1 Home automation

A technique to use computer, smartphone and information technology in controlling home appliances is called home automation.

Home automation has made it possible to have what is often referred to as a" smart home " ,A home that can detect and identify you automatically ,adjust the lighting ,open doors automatically, switch on the security lights at night and switch them off at the morning.

Home automation is the residential extension of building automation and involves the control and automation of lighting, heating, ventilation, air conditioning (HVAC), appliances, and security

1.2 smart home

it is one of applications of smart technologies within our home , it has some features such as home security system, controlled exterior & interior lighting , automatic window and curtain, automatic garage door and home energy management system.

To know what meant by smart home let’s take a look at an average day in the life of Mr. and Mrs. Mohamed Smart home, their kids, and their totally tricked out, automated home.

During the Day:

Once everyone is out the door and on their way to work or school, the security alarm is set and the Smart Home turns off all the lights the kids forgot about.

There are a number of sensors keeping the house safe and Secure, they are motion sensors, door and window sensors, and fire detectors and all making sure everything is safe.

During the day, Mohamed checks his house periodically via his web browser. His Smart Home controls are linked via web software, so he can check the status of various items in his home, even while he's at the office. Noticing that it's overcast out, Mohamed turns on a light in the kitchen, so Fido doesn't feel shut in.

Welcome Home:

When Mr. or Mrs. Mohamed or their kids entered the home the light will be auto- auto.

Going to Bed:

Time for bed, once everyone is tucked in, the security system is again set and vigilant for any signs of trouble. Mohamed isn't quite ready to go to sleep yet, so he sits up in bed and reads. He turns on the bedroom light immediately over his side of the bed, just a little bit so he can read, but not enough to keep his wife awake. Meanwhile, music plays softly in the background. It doesn't take long for Joe to be lulled asleep, in spite of his best efforts to get through his book. The Smart Home, however,

has been programmed to be aware of Mohamed's nocturnal reading habits and—at a certain time—turns off the stereo and lights, completely.

So, smart home is simplifying home duty with high level security such as:

- Gas alarm
- Fire alarm
- For lighting there is six modes:
    a. Full smart
    b. Auto intensity - Always on
    c. Full Intensity - Auto On/Off
    d. Full Intensity - Always On
    e. Manual Intensity – Auto On/Off
    f. Manual Intensity – Always On
    g. OFF

Security in smart home:

What would a Smart Home be without a security system? Though most security systems are designed as stand-alone units—whether they are monitored or not—many can be controlled as part of a Smart Home set up, like Home Automation.

For example, if you're at work,you can use your web browser to check on your home security system. If one of the sensors is tripped, not only can you set your security system to contact the monitoring station, but it can also turn on your TV, stereo, the exterior lighting, and anything else

you want to do to scare off would-be intruders (or at least aggravate your neighbors).

There are also measures you can take to make your home look lived in, even if you're out of town or working late. Setting up some lights on a preset schedule is a preventive measure you can take for the cost of just a few dollars.

Security and the Smart Home is a big topic (after all, once you install all that Smart Home gear, you don't want some thug breaking in and making off with it)

Remote protection:

The home would be controlled when no one at home

In case of abnormal action such as (fire, gas, robbery, etc.) the security system will be active and the consumer will receive message from GSM.

Garage:

A garage is in the same quasi–Smart Home category as the home's exterior. While not conventionally thought of as part of the house, a garage can still be made into a smart place.

Have you ever gotten up in the morning and stepped out into the garage only to find that the door has been open all night? Maybe you were lucky and no hooligans made off with your golf clubs and reciprocating saw, but a Smart Home can help ameliorate that mistake and make sure you

1.3 solar energy

Using solar energy in smart home:-

The world is heading for using solar energy because it`s clean and renewable. Solar energy in one form or another is the source of nearly all energy on the earth.

Solar energy is used for making interface between grid and batteries that charged by energy produced from solar cells.

The Interface Module

Aim of circuit:

Selection between grid and batteries

As in our smart and green house we want to use solar cells and use grid. When batteries are charged full we start our selection and batteries start to supply home.

When batteries reach to final voltage we return back to Grid.

The circuit of interface module consists of

1- connect and disconnect between batteries and grid circuit
2- Voltage drop circuit (voltage sensor).
3- Arduino.
4- Voltage drop circuit.

Chapter (2): control using Arduino

2.1 Introduction of control:

The control is the heart of the smart home that monitors and takes actions in order to make life much easier for consumers. It also is a must for the security and safety as it collects readings from sensors and security cameras all over the apartment, analyses them, compares them with pre written values in the program, and then takes actions such as (turn on buzzers, open fire fighting valves, shut off gas valves, turn off electricity and enabling emergency lighting, send alarm messages to consumer`s phone…….. etc.).

In our project the control is satisfied using Arduino . We will know in this chapter how to use arduino in control of anything at home such as light , curtains ,doors, locks ,windows, air condition , Garage,…….. etc.).

2.2 The concept of the Arduino

Arduino is an open-source prototyping platform based on easy-to-use hardware and software. Arduino boards are able to read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. All this is defined by a set of instructions programmed through the Arduino Software (IDE).

Over the years Arduino has been the brain of thousands of projects, from everyday objects to complex scientific instruments. A worldwide community of makers - students, hobbyists, artists, programmers, and professionals - has gathered around this open-source platform, their contributions have added up to an incredible amount of accessible knowledge that can be of great help to novices and experts alike.

Arduino is an easy tool for fast prototyping, aimed at students without a background in electronics and programming. As soon as it reached a wider community, the Arduino board started changing to adapt to new needs and challenges, differentiating its offer from simple 8-bit boards to products for IOT applications, wearable, 3D printing, and embedded environments. All Arduino boards are completely open-source, empowering users to build them independently and eventually adapt them to their particular needs. The software, too, is open-source, and it is growing through the contributions of users worldwide.

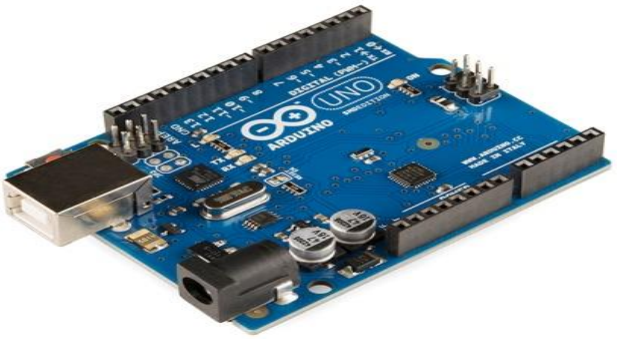
2.3 Using the Arduino

Thanks to its simple and accessible user experience, Arduino has been used in thousands of different projects and applications. The Arduino software is easy-to-use for beginners, yet flexible enough for advanced users. It runs on Mac, Windows, and Linux. Teachers and students use it to build low cost scientific instruments, to prove chemistry and physics principles, or to get started with

programming and robotics. Designers and architects build interactive prototypes, musicians and artists use it for installations and to experiment with new musical instruments. Makers, of course, use it to build many of the projects exhibited at the Maker Faire, for example. Arduino is a key tool to learn new things. Anyone - children, hobbyists, artists, programmers - can start tinkering just following the step by step instructions of a kit, or sharing ideas online with other members of the Arduino community.

2.4 Components used in this portion

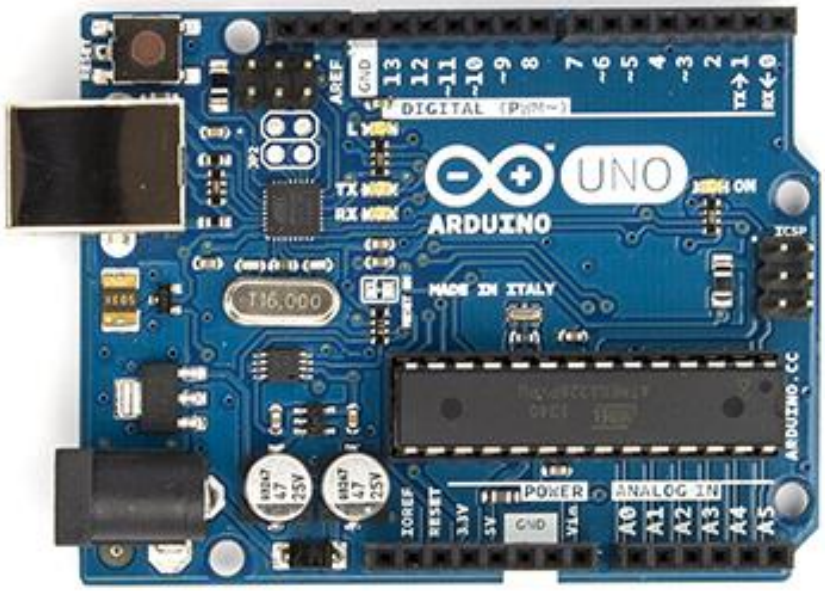
Arduino board

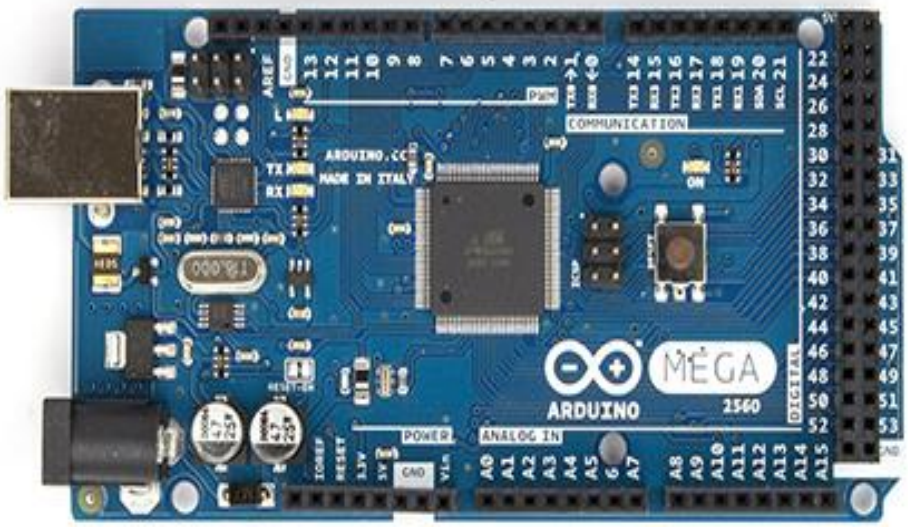


- It`s considered the computer or the brain of control system in this project.
- Arduino is a microprocessor based board that's manufactured for mini projects and prototyping , it has its own programming Interface that makes control much easier.

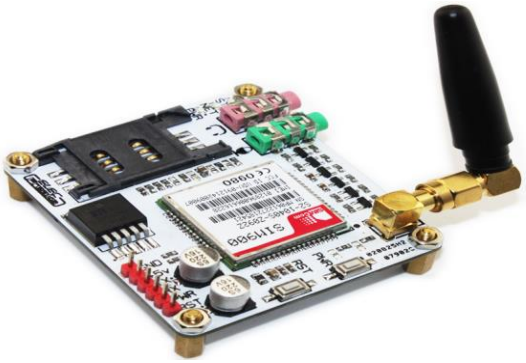
In this project one or multiple boards are programmed to take sensors readings,analyze them and give orders to actuators distributed all over the apartment.

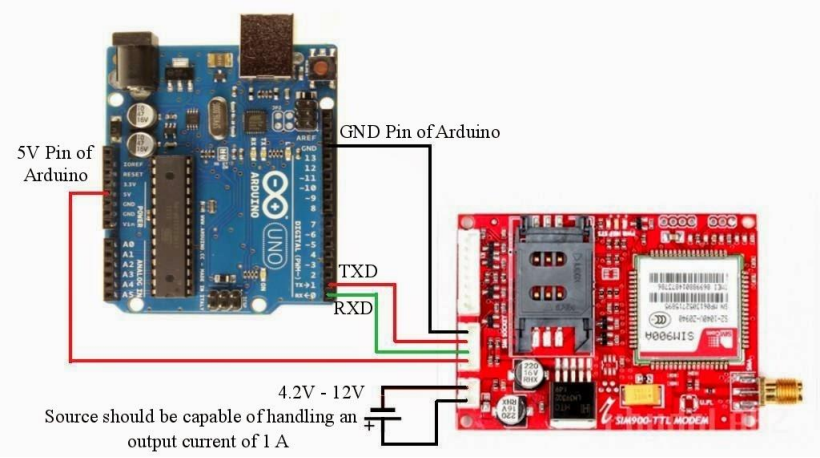
We use two types of Arduino in this project , Arduino UNO and Arduino MEGA





GSM Module





It`s a board used to send and receive SMSs to and from a specific pre saved numbers, and it is made to work with Arduino and programmed by its interface .

In this project it`s used to send information or alarm SMSs to consumer to inform him with important data or alert him from intrusion , fire or gas leakage in home while he`s apart from his house .

We connect GSM to Arduino through serial:

- transmitter (TX)
- receiving (RX)

We connectArduino(RX & TX) with GSM (RX&TX) ,so that if any ubnormal action occurs as(fire, Intrusion , abnormal motion , …..etc.),GSM sends SMSs to the consumer .

Sensors

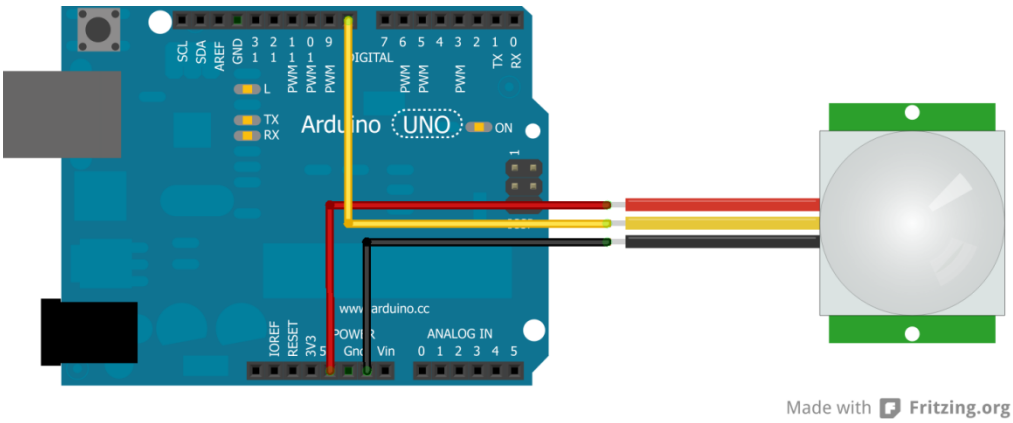
In order to make anything - not just home – smart or automated we must use a set of sensors to make the system automatically interact with the surrounding to achieve what we exactly desire from the system .

Sensors in this project are used to give readings to the control system in order to make specific functions such as (making lights turn on and off when someone enters or leaves the room , change the light intensity depending on the surrounding lux , open firefighting valves and start alarms …… etc.)

Sensors used are :

- Motion Sensor
- Photo interrupter
- Gas sensor
- Smoke sensor
- Light sensor
- Temperature sensor

Motion sensor

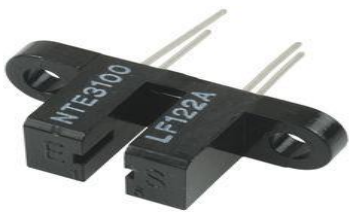


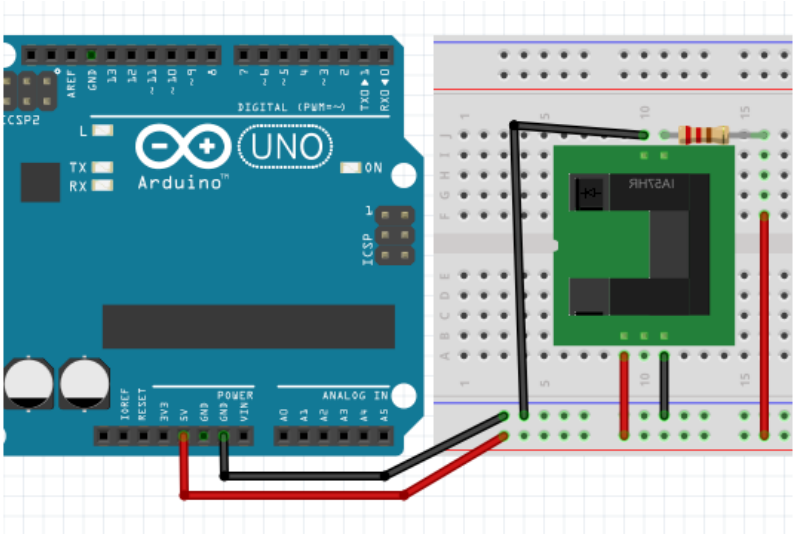
We used PIR (Passive Infrared) motion sensor module and used it for multiple usages in our project:-

- Turning Light on in a room when it`s occupied by any person and turning it off when it`s empty
- detecting intruders when security system is enabled and activate alarm

  In general Motion sensors work best when they can cover the widest possible area (reception , Directly Across a Window ,…..etc.)

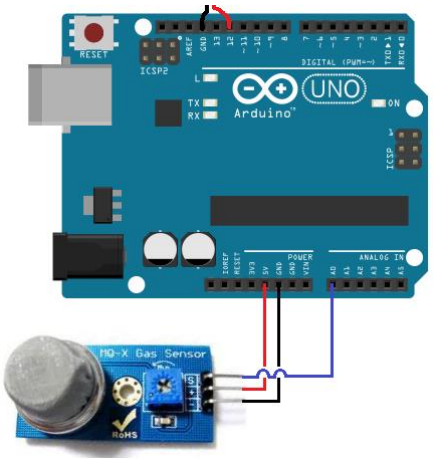
Photo interrupter





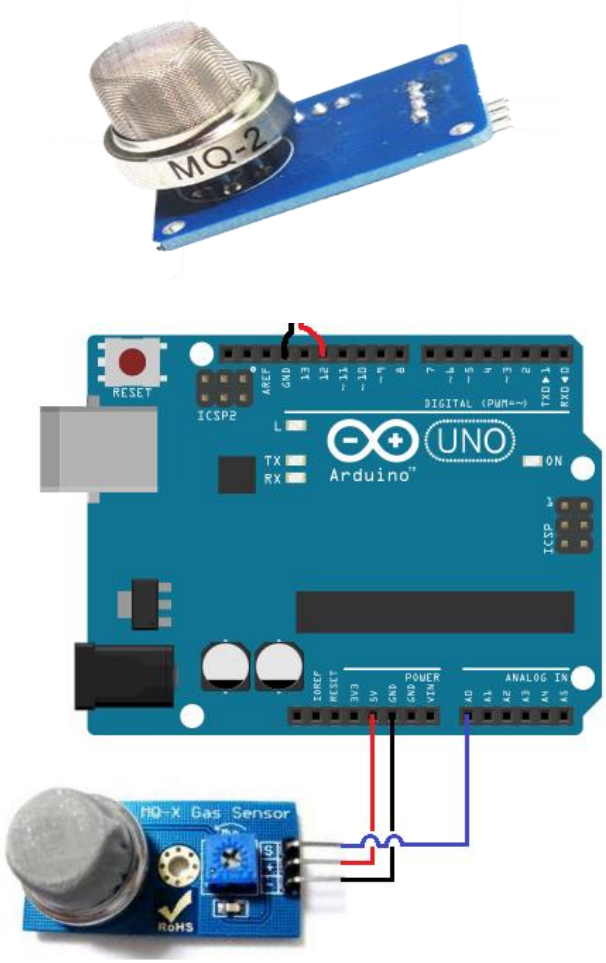
We used it in security system as it`s put at the end of doors and windows, when security is enabled and any door or window is opened it sends signal to the controller to activate alarm and notify the owner of the intrusion .

Gas sensor



We used MQ5 module as Gas detector , it will be installed near any source of gas like kitchen to detect any leakage and then send signal to controller to shut the main gas valve off , cut electricity in the area of leakage and open window if exist.

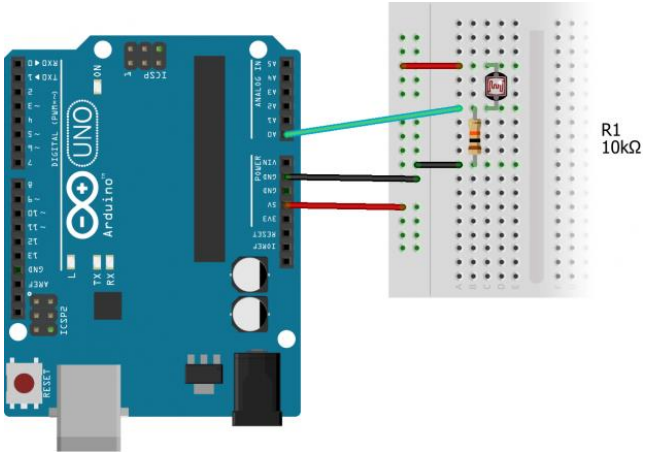
Smoke sensor



we used MQ2 module as smoke detector , one is installed in each area in the house , when it detects high amount of smoke it sends signal to controller to take some actions as (Open firefight valves , turn off main electricity and switch on emergency lights , open windows in the area of fire for ventilation)

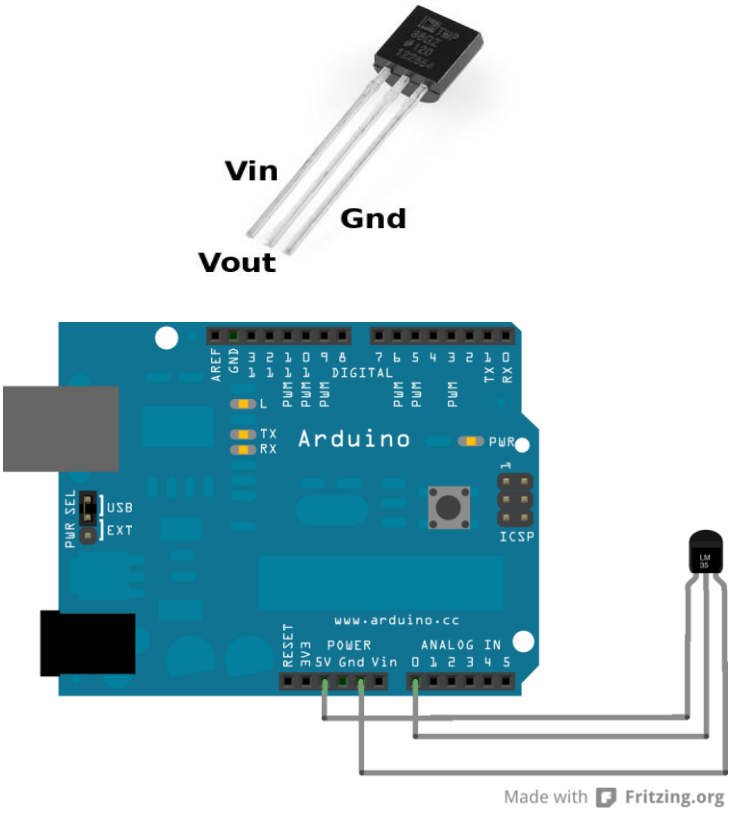
Light sensor

Light Dependent Resistor (LDR)



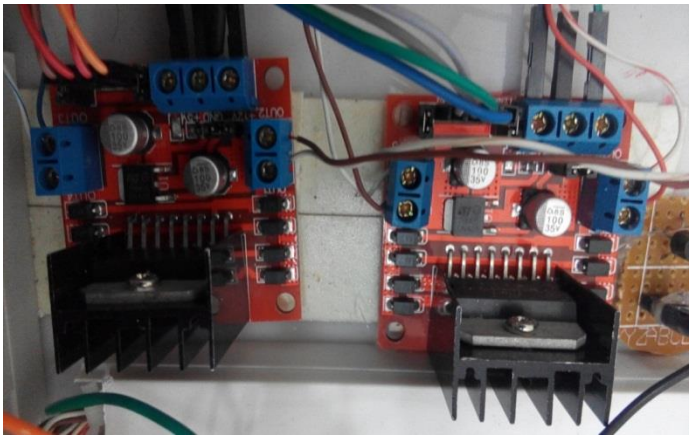
We used LDR (Light Dependent Resistor) as light sensor , we used it to make the lighting in the house interactive with the ambient lighting ; the intensity of lights in the house are made dependent on the ambient light in the area and lights are switched off if light in the room is enough , this option made the light system smarter and more economic .

Temperature sensor

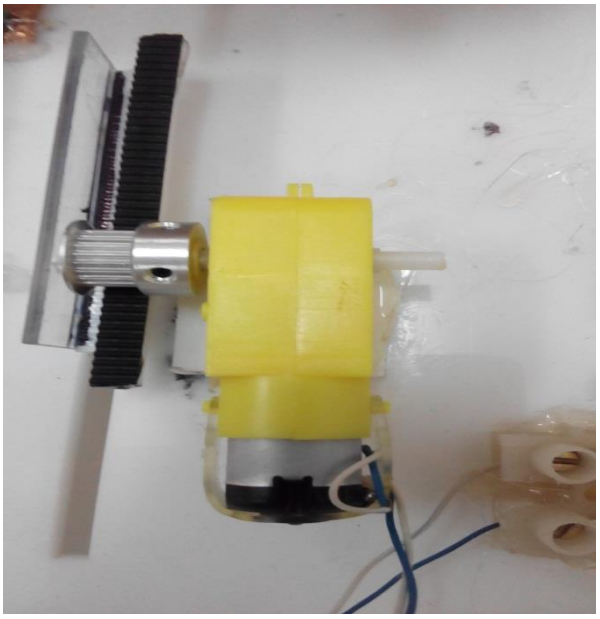


it`s used to control Ac And control , with light sensor they can control smart curtains and closes them automatically to protect area from direct sun in hot days to improve AC efficiency and save power.

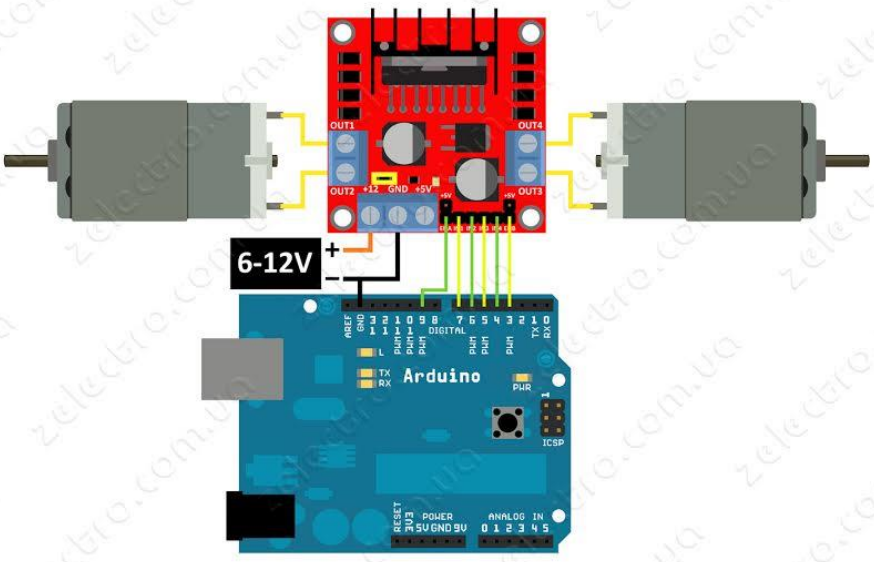
Dc Motor& Motor driver



Motor drive



Dc motor



DC Motor:

This DC or direct current motor works on the principal, when a current carrying conductor is placed in a magnetic field; it experiences a torque and has a tendency to move.

Control on DC motor:

We use motor driver and arduino to control on DC motor, where, the motor driver take signal from arduino to control on direction

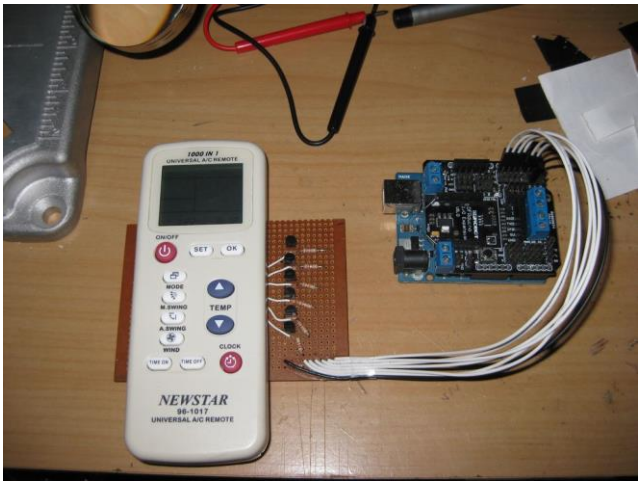
We use DC motor to control on open and closed door, open and closed window and open and closed Curtains So, there are two connection:

- DC motor with motor driver to control on the direction.
- Motor driver with arduino to sending signals.

There are two signal type to control on motor driver:

- Signal from arduino (HIGH , LOW) to rotating motor in clockwise direction
- Signal from arduino (LOW , HIGH) to rotating motor in Counterclockwise direction

Air condition Remote



In Our project we use A/c Remote to fully control the Air conditioner From Our integrated interface to control it using mobile without the need of holding the Remote itself.

We did some hacks on the remote using transistor based board enabling us from simulating the press on buttons using software signals from the arduino board.

Smart control

Smart control is applied to: In our project,

- Light
- Windows
- Door
- Curtains
- Air Conditioning

Smart control for Light

Smart lighting controls bring your home into the era of smart technology. Smart lighting adds elegance, ambiance, convenience and energy efficiency to your home.

The ability to control your home remotely through a mobile application helps you maintain an easier, carefree lifestyle. Controlling your lights through your phone is a small step toward a full smart home, and it is one you'll enjoy on a daily basis.

The code used to control the light

Light_Control | Arduino 1.6.7

File Edit Sketch Tools Help

Light_Control

```
int R1mlvalue ;
bool R1ML = 0 ; //En. Manual light
int PIR = 30 ; // Motion sensor pin
unsigned long previousMillisR1 = 0;
int R1LightPin = 6 ;  //light pin 6 for room 1
int R1LightMode = 0 ; //Light Mode room 1
int r1ldr ; //Light sensor Reading
int R1LDR = A3 ; //LDR pin
int R1intensity ; // intensity value by LDR


void setup() {
  pinMode(PIR , INPUT);
  pinMode(R1LightPin , OUTPUT);
  pinMode(R1EmergencyPin , OUTPUT);
  pinMode(R1LDR , INPUT);
}
```

```
    digitalWrite(R1LightPin, LOW);
  }

   //-------Manual Intensity control--------//
   if( R1ML == 1 ){
    for (int i=0 ; i<6 ; i++){
      ManualLight[i]= readString[i];
    }
    ManualLight[6]='\0';

    if(strcmp(ManualLight , "R01mlc")==0){
      for( int j=0 ; j<3 ; j++){
        MLval[j]= readString[j+6];
      }
      MLval[3]='\0' ;
      R1mlvalue= ((MLval[0]-48)*100) +((MLval[1]-48)*10) +(MLval
      Serial.println(R1mlvalue);
    }
```

```
void loop() {
//-------------- Serial Codes (from interface)-----------//

    if (readString == "R1LAA"){
      R1LightMode = 1 ;
      Serial.println("Room 1 Mode : Auto-Auto");
    }

    if (readString == "R1LAOn"){
      R1LightMode = 2 ;
      Serial.println("Room 1 Mode : Auto-On");
    }

    if (readString == "R1LFA"){
      R1LightMode = 3 ;
      Serial.println("Room 1 Mode : Full-Auto");
    }
```

```
      R1LightMode = 0 ;
      Serial.println("Room 1 Mode : Full-On");
      digitalWrite(R1LightPin , HIGH);
    }

    if (readString == "R1LMA") {
      R1LightMode = 4 ;
      Serial.println("Room 1 Mode : Manual-Auto");
    }

    if (readString == "R1LMOn") {
      R1LightMode = 5 ;
      Serial.println("Room 1 Mode : Manual-On");
    }

    if (readString == "R1LOff") {
      R1LightMode = 0 ;
      Serial.println("Room 1 Mode : Off");
```

```
//---------Code Proccessing For Light Modes -----//


        //Auto-Auto
        //---------
    if (R1LightMode == 1){
     r1ldr = constrain(analogRead(R1LDR) , 200 , 700);
     R1intensity = map( r1ldr , 200 , 700 , 0 , 255 );
     if (digitalRead(PIR) == 1){
        previousMillisR1 =  currentMillis ;
     }
     if (currentMillis - previousMillisR1 < intervalPIR){
        analogWrite(R1LightPin , R1intensity);
     }
     if (currentMillis - previousMillisR1 >= intervalPIR ){
         digitalWrite(R1LightPin , LOW);
     }
    }
```

```
     if (currentMillis - previousMillisR1 >= intervalPIR ){
        digitalWrite(R1LightPin , LOW);
      }
     }

          //Manual-Auto
          //-----------

     if (R1LightMode == 4){
       R1ML = 1 ;
       if(digitalRead(PIR) == 1){
         previousMillisR1 =  currentMillis ;
       }
       if (currentMillis - previousMillisR1 < intervalPIR ){
        analogWrite( R1LightPin , R1mlvalue );
       }
       if (currentMillis - previousMillisR1 >= intervalPIR ){
         digitalWrite(R1LightPin , LOW);
```

```
          //Manual-On
          //---------

     if (R1LightMode == 5){
       R1ML = 1 ;
       analogWrite(R1LightPin , R1mlvalue) ;
     }



}
```

Light moods

- Full smart (Auto – Auto)
- Auto intensity - Always on (Auto – On)
- Full Intensity - Auto On/Off (Full - Auto)
- Full Intensity - Always On (Full – On)
- Manual Intensity – Auto On/Off (Manual – Auto)
- Manual Intensity – Always On (Manual – On)
- OFF

Full smart

In this mode , LDR detect intensity and PIR detect the motion

If surrounding light is changed , LDR sense that lux in the area then send a signal to controller then the controller compare this LUX with a certain value then change the intensity to maintain the lux constant in the room

PIR detect motion in the room then send signal to controller to turn on the light, if there isn't any motion inside the room for limited time as 15 min, the light is off automatically

Auto intensity_ always on

In this mood, LDR detect intensity and PIR not active

If surrounding light is changed, LDR sense that lux in the area then send a signal to controller then the controller compares this LUX with a certain value then change the intensity to maintain the lux constant in the room

The light will be continuous all the time if PIR detect motion or not

Full Intensity - Auto On/Off

In this mode LDR is disabled and PIR detect motion

The light intensity will be full neglecting the signal from LDR

PIR detect motion in the room then send signal to controller to turn on the light, if there isn't any motion inside the room for limited time as 15 min, the light is off automatically

Full Intensity - Always On

In this mode LDR and PIR are disabled

The light intensity will be full not considering the signal from LDR

The light will be continuous all the time if PIR detect motion or not

Manual Intensity – Auto On/Off

In this mode , we control in light intensity manual . the consumer increase and decrease the light as he like

PIR detect motion in the room then send signal to controller to turn on the light, if there isn't any motion inside the room for limited time as 15 min, the light is off automatically

Manual Intensity – Always On (Manual – On)

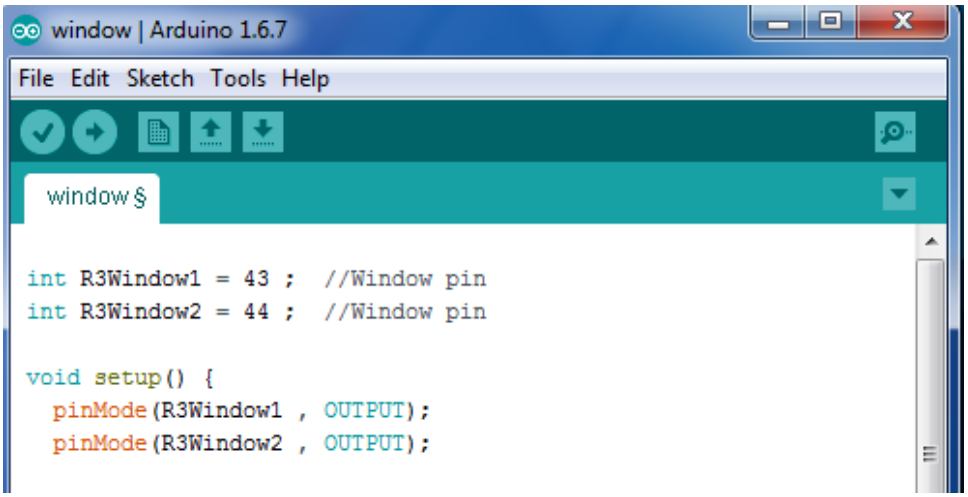
In this mood, we control in light intensity manual. The consumer increase and decrease the light as he like

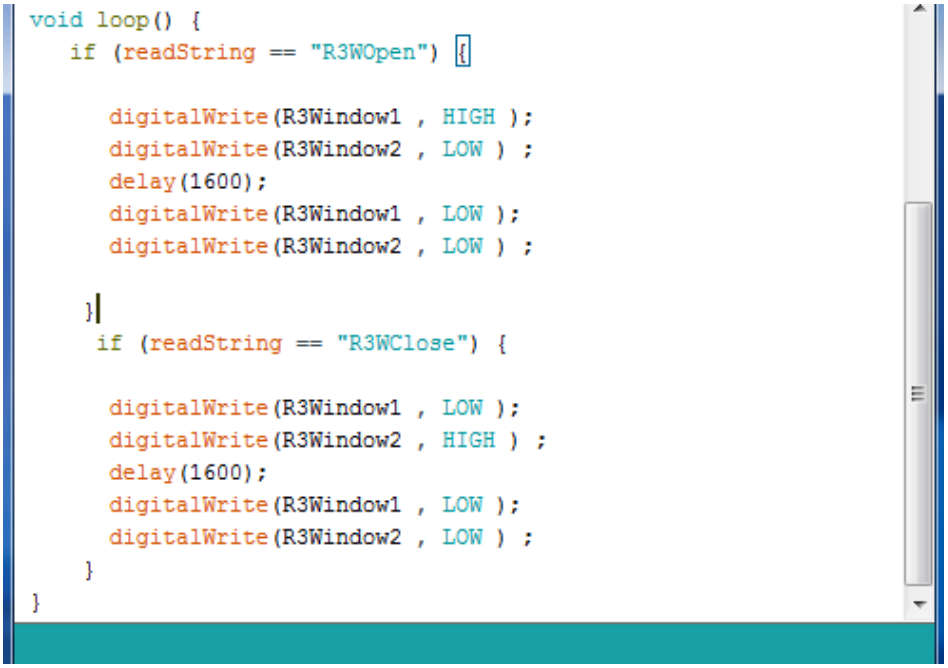
The light will be continuous all the time if PIR detect motion or not

Smart control for windows

In this project, we can control the open and close windows using mobile application. This is more easy and comfortable for the consumer

The code used to control the window



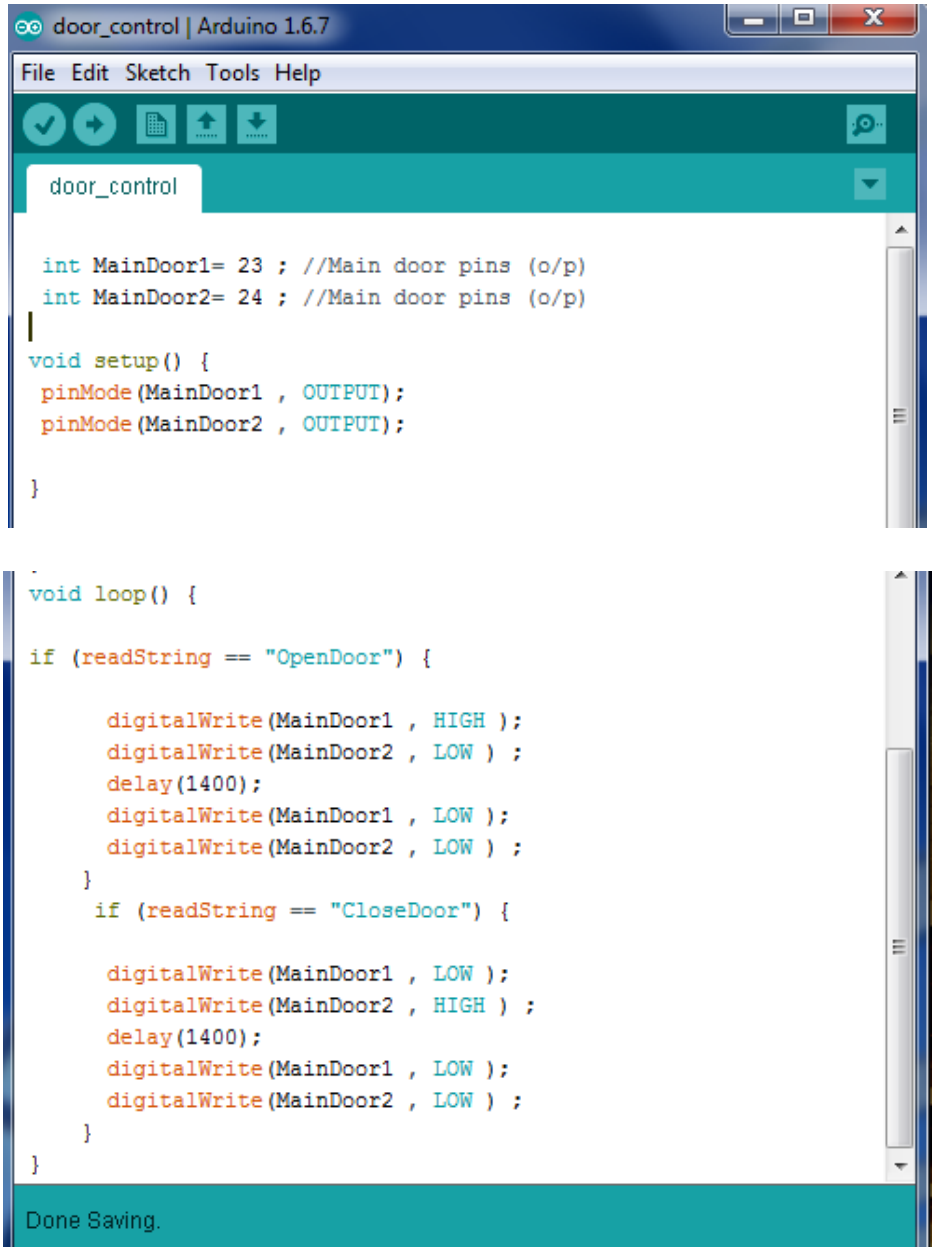


\

Smart control for Doors

In this project, we can control the open and close the main door using mobile application.

The code used to control the main door

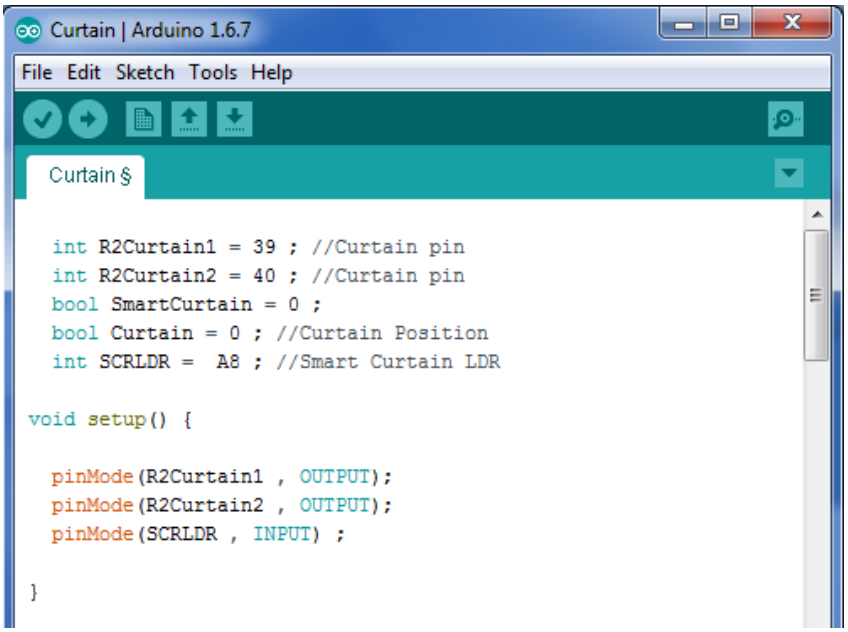


Smart control for curtains

In this project, we can control the open and close the curtain using mobile application.

The curtain will close automatically when sun light is direct on the window entire the room and open when sunlight decreases to reach the normal temperature.

The code used to control the curtain



```
 if (readString == "R2CRCL") {

  SmartCurtain = 0 ;
  digitalWrite(R2Curtain1 , LOW );
  digitalWrite(R2Curtain2 , HIGH ) ;
  delay(5000);
  digitalWrite(R2Curtain1 , LOW );
  digitalWrite(R2Curtain2 , LOW ) ;
  Curtain = 0 ;
}

  if( SmartCurtain == 1 ){

  if( (analogRead ( SCRLDR ) >= 900) && (Curtain == 1) ){

    digitalWrite(R2Curtain1 , LOW );
    digitalWrite(R2Curtain2 , HIGH ) ;
    delay(5000);
    digitalWrite(R2Curtain1 , LOW );
```

```
    digitalWrite(R2Curtain2 , LOW ) ;
    Curtain = 0 ;
  }

     if((analogRead ( SCRLDR ) < 900) && (Curtain == 0)){

      digitalWrite(R2Curtain1 , HIGH );
      digitalWrite(R2Curtain2 , LOW ) ;
      delay(5000);
      digitalWrite(R2Curtain1 , LOW );
      digitalWrite(R2Curtain2 , LOW ) ;
      Curtain = 1 ;

     }

  }
```

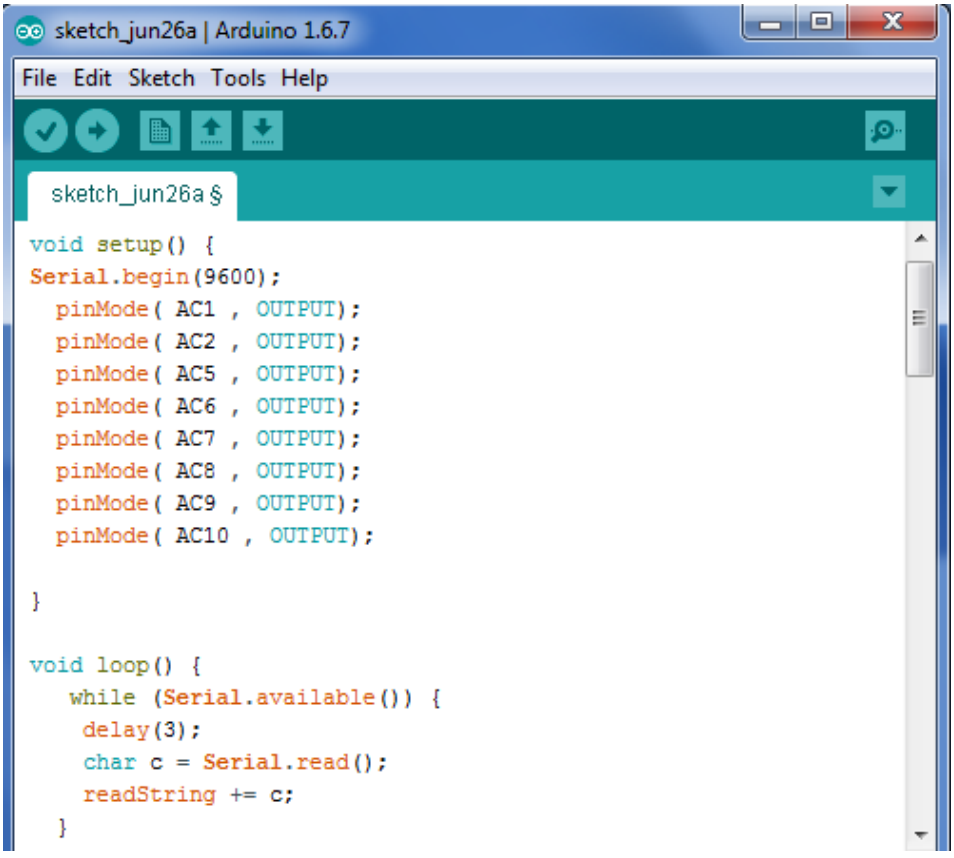
Smart control for Air conditioning

Consumer can have access on the A/C from the Application And Do all the functions exactly as he is using the remote Controller

User can do the following:

- Power the A/C on and off
- Increase or decrease Temperature
- Change the Modes of the A/C
- Change Fan Speeds
- Change swing Options

The code used to control the air condition



```
if (readString.length() >0) {

     if (  (readString == "ACPowerOn") && ( ACPower == 0) ) {
      digitalWrite(AC1 , HIGH);
      digitalWrite(AC5 , HIGH);
      delay(100);
      digitalWrite(AC1 , LOW);
      digitalWrite(AC5 , LOW);
      ACPower = 1 ;
      Serial.println("On");

       if (  (readString == "ACPowerOff") && ( ACPower == 1) ) {
      digitalWrite(AC1 , HIGH);
      digitalWrite(AC5 , HIGH);
      delay(100);
      digitalWrite(AC1 , LOW);
      digitalWrite(AC5 , LOW);
      ACPower = 0 ;
}
```

```
if (  readString == "ACTempUp" ) {
      digitalWrite(AC1 , HIGH);
      digitalWrite(AC8 , HIGH);
      delay(100);
      digitalWrite(AC1 , LOW);
      digitalWrite(AC8 , LOW);
     }

     if (  readString == "ACTempDown" ) {
      digitalWrite(AC1 , HIGH);
      digitalWrite(AC6 , HIGH);
      delay(100);
      digitalWrite(AC1 , LOW);
      digitalWrite(AC6 , LOW);
     }

     if (  readString == "ACMode" ) {
      digitalWrite(AC2 , HIGH);
      digitalWrite(AC5 , HIGH);
```

```
 delay(100);
 digitalWrite(AC5 , LOW);
 digitalWrite(AC2 , LOW);
}

if (  readString == "ACFan" ) {
 digitalWrite(AC1 , HIGH);
 digitalWrite(AC7 , HIGH);
 delay(100);
 digitalWrite(AC1 , LOW);
 digitalWrite(AC7 , LOW);
}

if (  readString == "ACSwing" ) {
 digitalWrite(AC2 , HIGH);
 digitalWrite(AC7 , HIGH);
 delay(100);
 digitalWrite(AC2 , LOW);
 digitalWrite(AC7 , LOW);
```

```
if (  readString == "ACReset" ) {
 digitalWrite(AC9 , HIGH);
 digitalWrite(AC10 , HIGH);
 delay(100);
 digitalWrite(AC9 , LOW);
 digitalWrite(AC10 , LOW);
}

}
readString="";
```

Chapter (3): smart home security and safety system

Security system

A security alarm is a system designed to detect intrusion into a building or area.

Home security systems work on the same basic principle of securing entry points, like doors and windows. Regardless of the size of your home, or the number of doors and windows or interior rooms a homeowner decides to protect, the only real difference is in the number of security components used throughout the home and monitored by the control panel.

In our project, home security system includes:

- A control panel which is the primary controller of a home's security system.
- Motion sensor (Door and window sensors)
- Photo interrupter
- Camera

A home security includes two levels:

Level one: security system will be activated to protect the home from outside when the owner is inside the home and also protect the garage from intrusion.

For example, if any person tries to enter the home by wrongful way as (person enters the home from window), photo interrupter sends the signal to the controller which takes some actions:

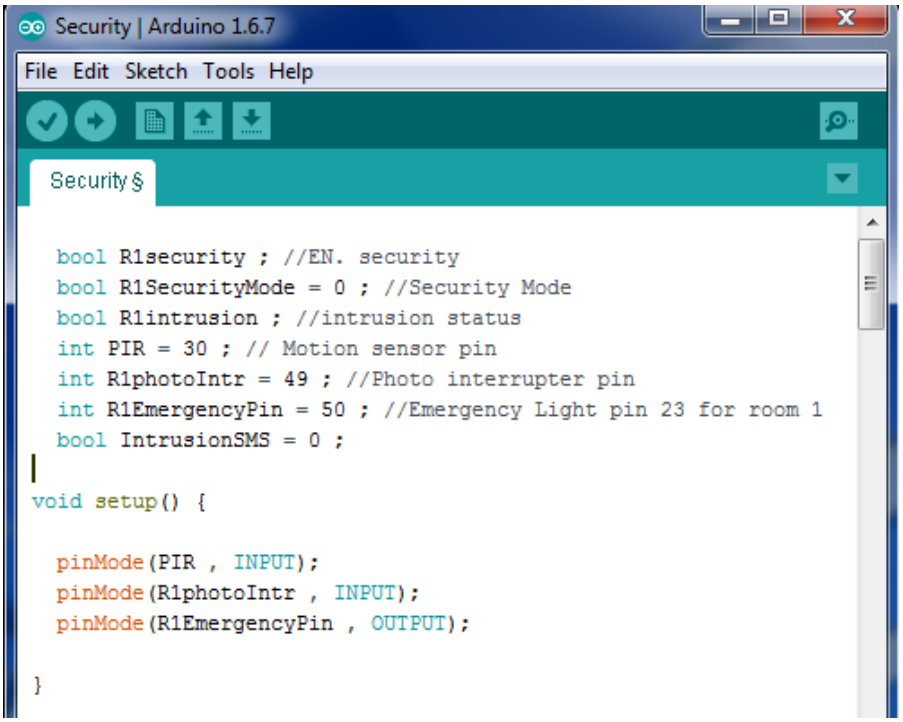
- Activate alarm
- Activate emergency light
- Activate camera which take a photo for abnormal action
- Sends SMS to the owner notifying him with this abnormal activity so he can call police

Level two: security system will be active to protect the home when the owner is outside. Motion sensors detect any motion inside the home and used to protect garage and the park

For example, if any person tries to enter the home by wrongful way as (person enters the home from window), photo interrupter and motion sensor sends the signal to the controller which takes the same actions:

- Activate alarm
- Activate flashing red light
- Activate camera which take a photo for abnormal action
- Sends SMS to the owner notifying him with this abnormal activity so he can call police

The code used for security




```
bool R1security ; //EN. security
bool R1SecurityMode = 0 ; //Security Mode
bool R1intrusion ; //intrusion status
int PIR = 30 ; // Motion sensor pin
int R1photoIntr = 49 ; //Photo interrupter pin
int R1EmergencyPin = 50 ; //Emergency Light pin 23 for room 1
bool IntrusionSMS = 0 ;

void setup() {

  pinMode(PIR , INPUT);
  pinMode(R1photoIntr , INPUT);
  pinMode(R1EmergencyPin , OUTPUT);

}
```

```
void loop() {


    if (readString == "R1SOne"){
      R1SecurityMode = 0 ;
      R1security = true ;
    }

    if (readString == "R1STwo"){
      R1SecurityMode = 1 ;
      R1security = true ;
    }

    if (readString == "R1SOff") {
      R1security = false ;
      digitalWrite( Buzzer , LOW ) ;
    }
```

```
    if (readString == "R1ALOff") {
       Serial.println("Alarm off");
       R1intrusion = false ;
    }

     if ( R1security == true && R1intrusion == false ){
      digitalWrite(Buzzer , LOW);
      digitalWrite(R1EmergencyPin ,LOW);


      if ( R1SecurityMode = 1 ){
        if (digitalRead(PIR)== 1 || digitalRead(R1photoIntr) == 1)

          IntrusionSMS = 1 ;

          Serial.println("Intrusion Alarm");
          digitalWrite( Buzzer , HIGH);
          digitalWrite(R1EmergencyPin , HIGH);
```

```
          R1intrusion = true ;
        }
      }

      if ( R1SecurityMode = 0 ){
        if ( digitalRead(R1photoIntr) == 1){

          IntrusionSMS = 1 ;


          Serial.println("Intrusion Alarm");
          digitalWrite( Buzzer , HIGH);
          digitalWrite(R1EmergencyPin , HIGH);

          R1intrusion = true ;
        }
      }
      }
```

```
      if ( IntrusionSMS == 1 ){

         IntrusionSMS = 0 ;
         SIM900.print("AT+CMGF=1\r");
        delay(100);
        SIM900.println("AT + CMGS = \"+201067555999\"");
        delay(100);
        SIM900.println("Intrusion At Room 1 ");
        delay(100);
        SIM900.println((char)26);
        delay(100);
        SIM900.println();


       }

}
```

Safety (Fire and Gas Leakage Protection)

One important feature of smart home is safety and how the house will be protected against fire or any gas leakage the can occur in it.

Because it`s a smart home the safety system also must be smart and intelligent in protecting the house, sequence and procedures of firefighting and gas leakage protection are fully automated to avoid any human mistakes that could threaten the lives of the people living in the house .

Tools used in this Part :

- Arduino board.
- DC motor.
- Motor Driver.
- MQ2 (Smoke Sensor).
- MQ5 (Gas Sensor).
- SIM900 (GSM Module)
- Electromagnetic valves (Not in the model but must be used in real application).

In our project safety system is split into two part

- Firefighting.
- Gas leakage protection

Fire-Fighting system:

Smoke sensor is installed in the room to be protected and is connected to the Arduino board (master controller) and the sensitivity is set to detect only heavy smoke. When the sensor detects heave smoke

it sends a signal to the controller which begins the firefighting sequence:

1- Open Fire-Fight Valves.
2- Open Window of the room for ventilation and smoke dissipation.
3- Shut the main power off and open emergency lights only.
4- Sends SMS to the owner to notify him to take action or call the emergency.

Gas leakage protection:

Gas sensor is installed in the kitchen and near to any gas operated equipment that uses gas, and the sensor is connected to main controller, When the gas sensor detects any leakage it sends a signal to control system which takes some actions:

1- Shuts the main gas valve off
2- Sends SMS to the owner to notify him with this leakage

The code used for safety

Fire___Gas | Arduino 1.6.7

File Edit Sketch Tools Help

Fire___Gas

```
//gas leakage

 bool GasLeakage ; //Gas Leakage Detection
 int GasSnsPin = 27 ; //Gas sensor Pin
 int GasValvePin = 48 ; //Gas Valve Pin
 bool GasSMS = 0 ;

//Smoke & Fire

  bool fire ; //Fire status
  int Smoke = 26 ; // Smoke sensor pin
  int FireValve = 47 ; //Fire Fight Valve pin
  int EmergencyLight1 = 22 ; //Emergency pin (o/p)
  int EmergencyLight2 = 25 ;
  bool Emergency ; //Emergyency status
  bool FireSMS = 0 ;
```

```
void setup() {

  pinMode(GasSnsPin , INPUT );
  pinMode(GasValvePin , OUTPUT);
  pinMode(EmergencyLight1 , OUTPUT );
  pinMode(EmergencyLight2 , OUTPUT );
  pinMode(Smoke , INPUT);
  pinMode(FireValve , OUTPUT) ;

}

void loop() {

   if (readString == "GasSecure") {
          GasLeakage = false ;
           Serial.println("GAS-Secured");
        }
```

```
if (readString == "FireSecure") {
  fire = false ;
  Serial.println("Fire-Secured");
}

 if (readString == "EmergencyOff") {
  Emergency = false ;
  Serial.println("Emergency-OFF");
}

if (fire == false) digitalWrite(FireValve , LOW);

 if (Emergency == false){
  digitalWrite(EmergencyLight1 , LOW);
  digitalWrite(EmergencyLight2 , LOW);
 }
```

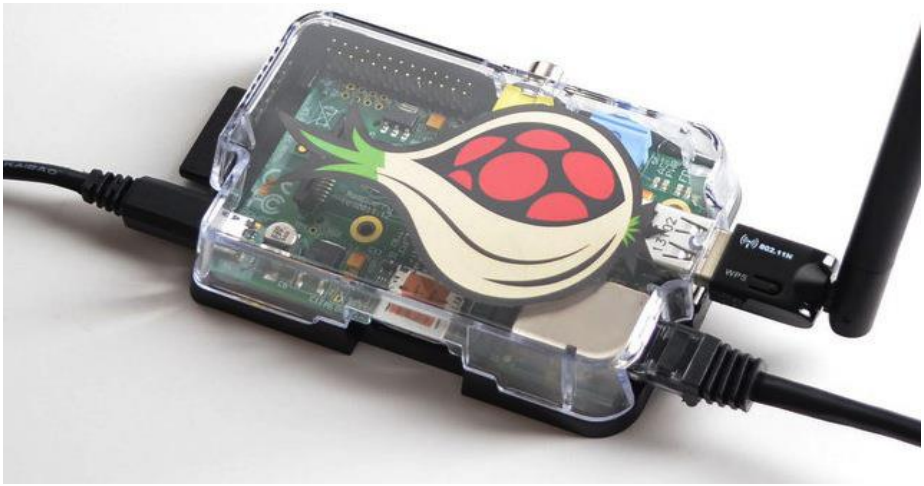
```
 if ( fire == false && Emergency == false ){
    digitalWrite(FireValve , LOW);
    digitalWrite(EmergencyLight2 , LOW);
    digitalWrite(EmergencyLight1 , LOW);

      if ( digitalRead(Smoke) == 0){

        FireSMS=1 ;


        digitalWrite(FireValve , HIGH);
        digitalWrite(EmergencyLight2 , HIGH);
        digitalWrite(EmergencyLight1 , HIGH);
```

```
              //open window
        digitalWrite(R3Window1 , HIGH );
        digitalWrite(R3Window2 , LOW ) ;
        delay(1600);
        digitalWrite(R3Window1 , LOW );
        digitalWrite(R3Window2 , LOW ) ;

        fire = true ;
        Emergency = true ;
        Serial.println("Fire Alarm");
      }
 }

 if(FireSMS == 1 ){

         FireSMS = 0 ;
         SIM900.print("AT+CMGF=1\r");
         delay(100);
```

```
        digitalWrite(GasValvePin , HIGH);
        GasLeakage = true ;
        Serial.println("GAS Leakage");
       }


    }

  if(GasSMS == 1 ){

          GasSMS = 0 ;
          SIM900.print("AT+CMGF=1\r");
          delay(100);
          SIM900.println("AT + CMGS = \"+201067555999\"");
           delay(100);
           SIM900.println("Gas Leakage At Kitchen ");        //
           delay(100);
```

```
          SIM900.println("AT + CMGS = \"+201067555999\"");
           delay(100);
           SIM900.println("Fire At Room 3 ");        // message
           delay(100);
           SIM900.println((char)26);                        // E
           delay(100);
           SIM900.println();

       }

        // GAS Leakage Alarm

   if (GasLeakage == false){
    digitalWrite(GasValvePin , LOW);
      if ( digitalRead(GasSnsPin) == 0 ){

        GasSMS = true ;
```

Chapter (4): programming and Raspberry pi



RPi Hardware Basic Setup

Typical Hardware You Will Need:-

While the RPi can be used without any additional hardware (except perhaps a power supply
of some kind), it won't be much use as a general computer. As with any normal PC, it is
likely you will need some additional hardware.

The following are more or less essential:-

- Raspberry Pi board
- Prepared Operating System SD Card
- USB keyboard

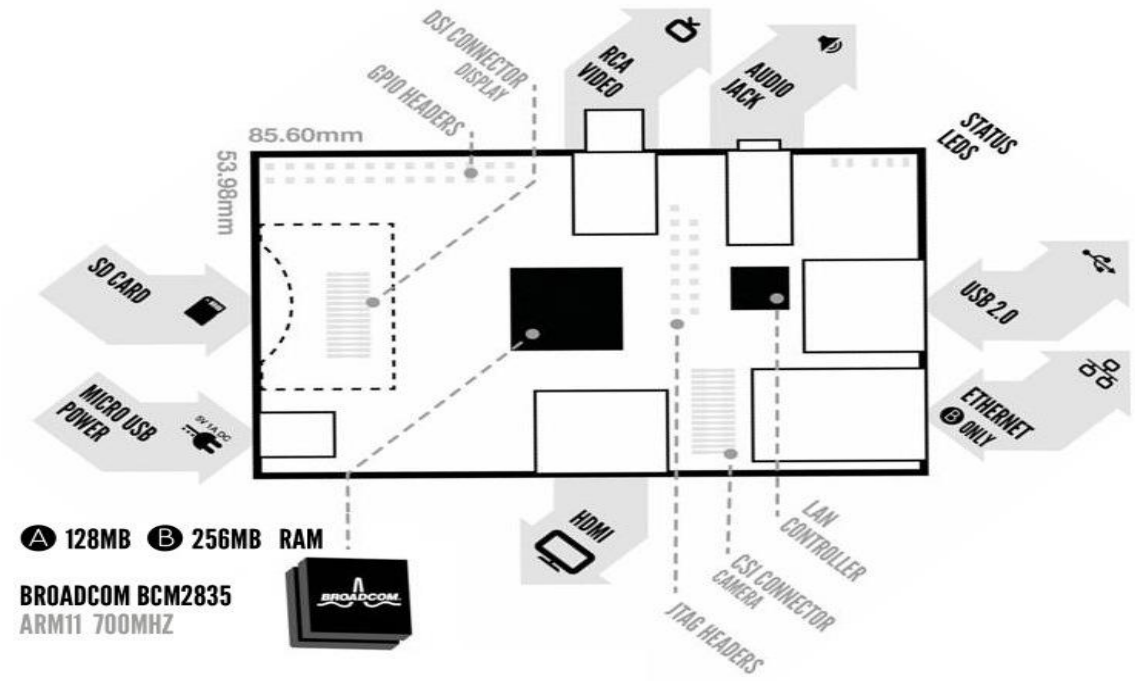
- Display (with HDMI, DVI, Composite or SCART input)
- Power Supply
- Cables

.

Highly suggested extras include:-

- USB mouse
- Internet connectivity - a USB WiFi adaptor (Model A/B) or a LAN cable (Model B)
- Powered USB Hub
- Case

Connecting Together……



You can use the diagram to connect everything together, or use the following instructions

- ❖ Plug the preloaded SD Card into the Pi.

- Plug the USB keyboard and mouse into the Pi, perhaps via a USB Hub. Connect the
- Hub to power, if necessary. 3. Plug the video cable into the screen (TV) and into the Pi.
- Plug your extras into the Pi (USB WiFi, Ethernet cable, hard drive etc.). This is where
- you may really need a USB Hub.
- Ensure that your USB Hub (if any) and screen are working.
- Plug the power source into the main socket.
- With your screen on, plug the other end of the power source into the Pi.
- The Pi should boot up and display messages on the screen.

It is always recommended to connect the Micro USB Power to the unit last (while most

Connections can be made live; it is best practice to connect items such as displays/h/w pin

Connections with the power turned off).

Initialization the component of the device

Prepared Operating System SD Card

As the RPi has no internal storage or built-in operating system it requires an SD-Card that is

set up to boot the RPi.

You can create your own preloaded card using any suitable SD card you have. Be sure

to backup any existing data on the card.

Preloaded SD cards will be available from the RPi Shop.

This guide will assume you have a preloaded SD card.

Keyboard & Mouse

Most standard USB keyboards and mice will work with the RPi. Wireless keyboard/mice

We should use a single USB port for an RF dongle. In order to use a bluetooth keyboard or mouse you would need to use a Bluetooth dongle, which again uses a single port.

Remember that the Model A has a single USB port and the Model B only has two (typically a Keyboard and mouse will use a USB port each).

Display:-

There are two main connection options for the RPi display, *HDMI* (high definition) and *Composite* (low definition).

HD TVs and most LCD Monitors can be connected using a full-size 'male' HDMI cable, and with an inexpensive adaptor if DVI is used. HDMI versions 1.3 and 1.4 are supported, and a version 1.4 cable is recommended. The RPi outputs audio and video via HMDI, but does not support HDMI input.

Older TVs can be connected using Composite (a yellow-to-yellow cable) or via SCART (using a Composite to SCART adaptor). PAL and NTSC TVs are supported.

When using composite video, audio is available from a 3.5mm (1/8 inch) socket, and can be sent to your TV, to headphones, or to an amplifier. To send audio your TV. you will need a cable which adapts from 3.5mm to double (red and white) RCA connectors.

Using an HDMI to DVI-D (digital) adaptor plus a DVI to VGA adaptor will not work. HDMI does not supply the DVI-A

(analogue) needed to convert to VGA - converting an HDMI or DVI-D source to VGA (or component) needs an active converter.

Power Supply:-

The unit uses a Micro USB connection to power itself (only the power pins are connected - so
it will not transfer data over this connection). A standard modern phone charger with a micro-
USB connector will do, but needs to produce at least 700mA at 5 volts. Check your power
supply's ratings carefully. Suitable mains adaptors will be available from the RPi Shop and
are recommended if you are unsure what to use.
You can use a range of other power sources (assuming they are able to provide enough
Current ~700mA)
Phone Backup Battery (will depend on power output) (in theory - needs
Confirmation)
To use the above, you'll need a USB A 'male' to USB micro 'male' cable - these are often
shipped as data cables with MP3 players.

Cables:-

You will probably need a number of cables in order to connect your RPi up.

1. Micro-B USB Power Cable
2. HDMI-A or Composite cable, plus DVI adaptor or SCART adaptor if required, to

connect your RPi to the Display/Monitor/TV of your choice.

3. Audio cable, this is not needed if you use a HDMI TV/monitor.
4. Ethernet/LAN Cable

Additional Peripherals

You may decide you want to use various other devices with your RPi, such as Flash Drives/Portable Hard Drives, Speakers etc.

Internet Connectivity:-

This may be an Ethernet/LAN cable (standard RJ45 connector) or a USB WiFi adaptor. The

RPiethernet port is auto-sensing which means that it may be connected to a router or directly to another computer (without the need for a crossover cable).

USB-Hub:-

In order to connect additional devices to the RPi, you may want to obtain a USB Hub, which

will allow multiple devices to be used.

It is recommended that a **powered** hub is used - this will provide any additional power to the

devices without affecting the RPi itself.

USB version 2.0 is recommended. USB version 1.1 is fine for keyboards and mice, but may

not be fast enough for other accessories.

Case

Since the RPi is supplied without a case, it will be important to ensure that you do not use it
in places where it will come into contact with conductive metal or liquids, unless suitably
protected.

Expansion & Low Level Peripherals

If you plan on making use of the low level interfaces available on the RPi, then ensure you have suitable header pins for the GPIO (and if required JTAG) suitable for your needs.

Also if you have a particular low-level project in mind, then ensure you design in suitable
protection circuits to keep your RPi safe.

RPi Advanced Setup

Finding hardware and setting up

You'll need a preloaded SD card, USB keyboard, TV/Monitor (with HDMI/ DVI/ Composite/SCART input), and power supply (USB charger or a USB port from a powered USB Hub or another computer).

You'll likely also want a USB mouse, a case, and a USB Hub (a necessity for Model A).

A Powered USB Hub will reduce the demand on the RPi. To connect to the Internet, you'll need either an Ethernet/LAN cable (Model B) or a USB WiFi adaptor (either model).

When setting up, it is advisable to connect the power after everything else is ready.

- **Serial connection**:-

The Serial Port is a simple and uncomplicated method to connect to the Raspberry Pi. The
communication depends on byte wise data transmission, is easy to setup and is generally
available even before boot time.

- **First interaction with the board**

Connect the serial cable to the COM port in the Raspberry Pi, and connect the other end to
the COM port or USB Serial Adapter in the computer.

Serial Parameters

The following parameters are needed to connect to the Raspberry. All parameters
except**Port_Name**and **Speed** are default values and may not need to be set.

_ **Port Name**: Linux automatically assigns different names for different types of
serial connectors. Choose your option:

_ Standard Serial Port: ttyS0 ... ttySn

_ USB Serial Port Adapter: ttyUSB0 ... ttyUSBn

_ **Speed**: 115200

_ Bits: 8

_ Parity: None

_ Stop Bits: 1

_ Flow Control: None

The Serial Port is generally usable by the users in the group **dialout**.

SD card setup

Now we want to use an SD card to install some GNU/Linux distort in it and get more space for our stuff. You can use either an SD or SDHC card. In the latter case of course take care that your PC card reader also supports SDHC. Be aware that you are not dealing with an x86 processor, but instead a completely different architecture called ARM, so don't forget to install the ARM port for the distro you are planning to use.

Formatting the SD card via the mkcard.txt script

1. Download **mkcard.txt.**
2. $ chmod +x mkcard.txt
3. $ ./mkcard.txt /dev/sd*x*, where *x* is the letter of the card. You can find this by inserting your card and then running dmesg | tail. You should see the messages about the device being mounted in the log. Mine mounts as **sdc**.

Once run, your card should be formatted.

Setting up the boot partition

The boot partition must contain:

- boot code .bin : 2nd stage boot loader, starts with SDRAM disabled
- start.elf: The GPU binary firmware image, provided by the foundation.
- Kernel. Mg: The OS kernel to load on the ARM processor. Normally this is Linux - see instructions for compiling a kernel.
- cmdline.txt: Parameters passed to the kernel on boot.

Additional files supplied by the foundation

These files are also present on the SD cards supplied by the foundation.

Additional kernels. Rename over kernel.img to use them (ensure you have a backup of the Original kernel.img first!):

Kernel _emergency.img : kernel with busyboxrootfs. You can use this to repair the main Linux partition using e2fsck if the linux partition gets corrupted.

Additional GPU firmware images, rename over start.elf to use them:

arm128_start.elf : 128M ARM, 128M GPU split (use this for heavy 3D work,

possibly also required for some video decoding)

arm192_start.elf : 192M ARM, 64M GPU split (this is the default)

arm224_start.elf : 224M ARM, 32M GPU split (use this for Linux only with no 3D or

video processing. It's enough for the 1080p frame buffer, but not much else)

Writing the image into the SDcard and finally booting GNU/Linux

The easiest way to do this is to use PiCard. It even saves you from some hassles explained

Above. You will need your SD card + reader and a Linux pc to use PiCard. After that, just plug the card into your Rpi. Setting up the boot args

Installing xrdp

After wiring the raspberry pi and start it up we'll need to install xrdp on it to be able to remotely access the Rpi using remote desktop top on any operating system (Windows , Android ,IOS or Windows phone) without the need of a mouse , keyboard or monitor only the power supply and the internet connection will be required. To do this open a terminal and write this

Sudo apt-get update

Apt-get install xrdp

Reboot

The last line reboot to restart the Rpi . after doing this now we can remotely access our Rpi using any remote desktop application

Programming using python

In our project we made graphical user interface using python in addition to QT designer to generate .ui file responsible for designing the layout.

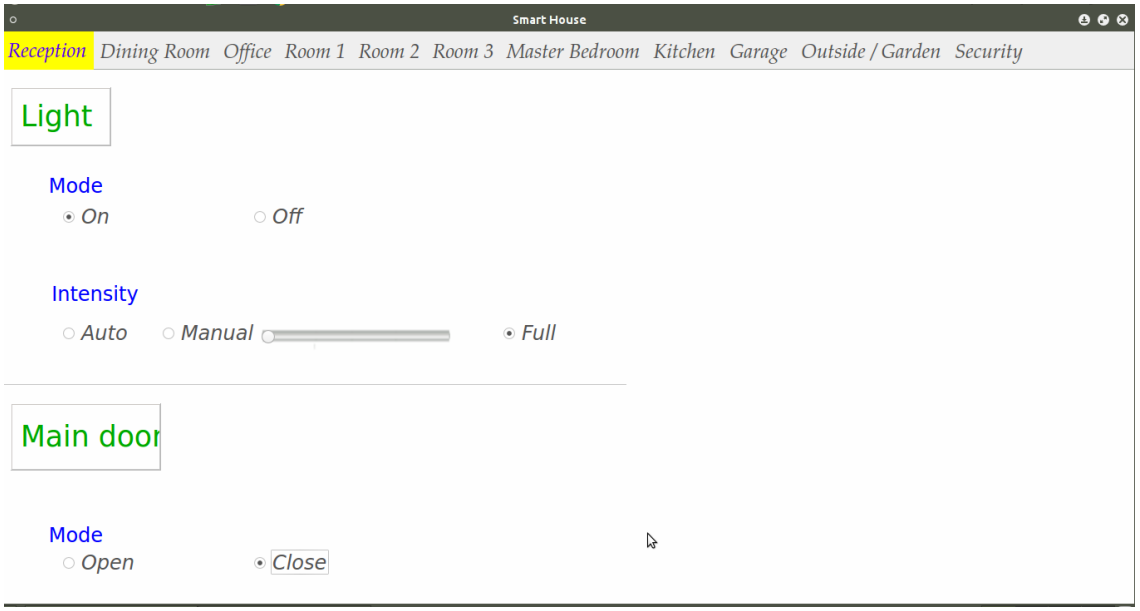
Then using the pyqt4 module to program this layout to work properly this will generate program which will be user-friendly as there's no need to have experience in Arduino and it's programming.

This is the result program which contains 11 tabs. Every tab contains the lights, windows, door and Alarm if possible.

Reception tab contains Light and the main door

In the reception we control light (mode and intensity) using application on pc.

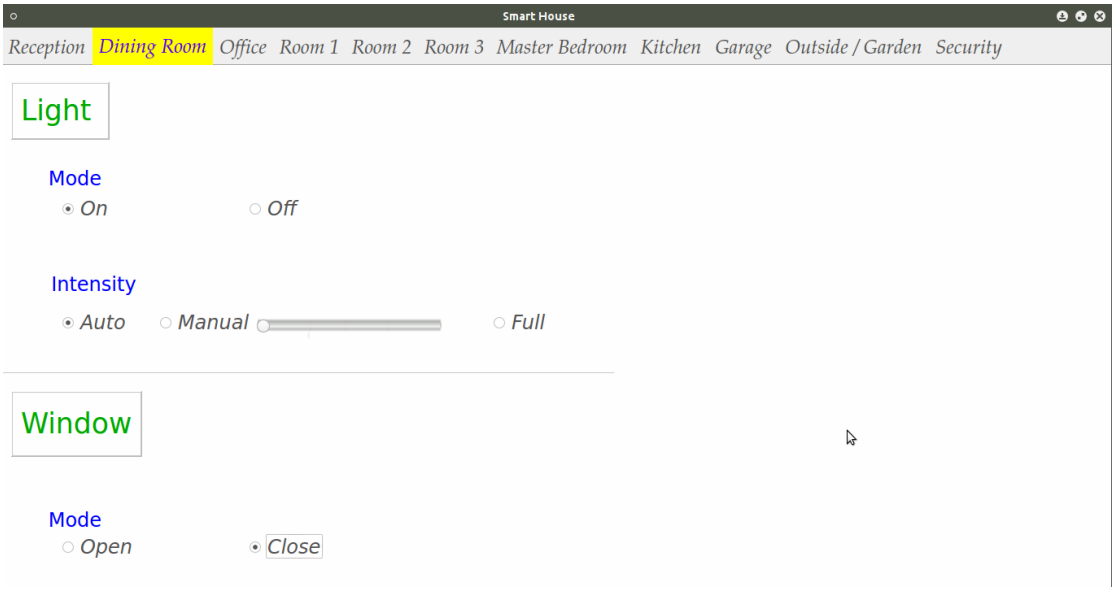
We also control the main door to open or close using application on pc .



Dining Room

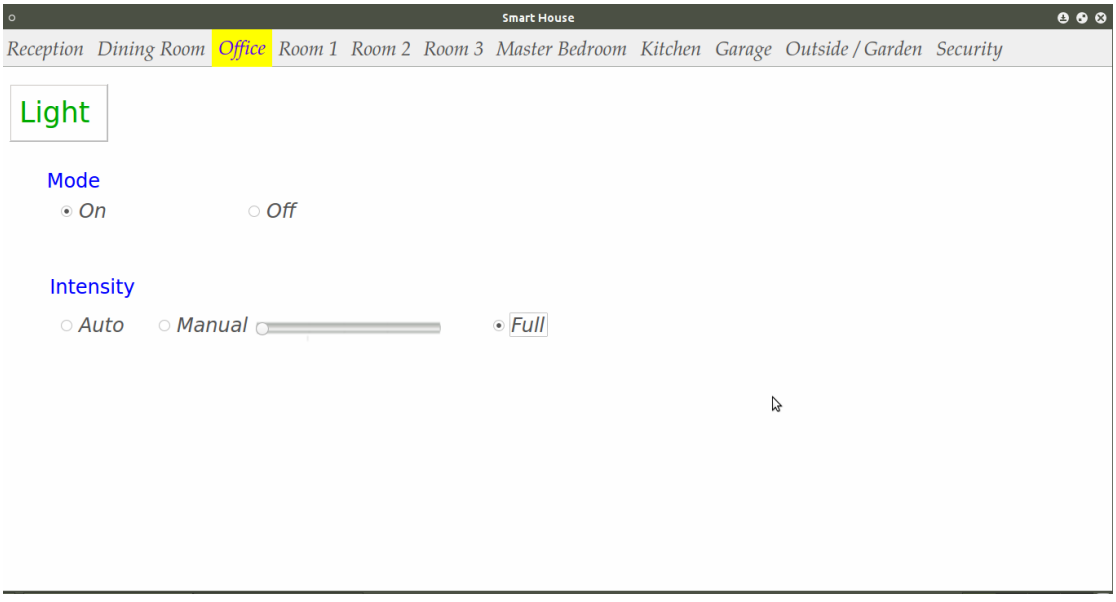
In dining room we control light (mode and intensity) using application on pc. We can change the intensity of the light (auto – manual – full)

We also control opening and clothing the window using app on pc



Office

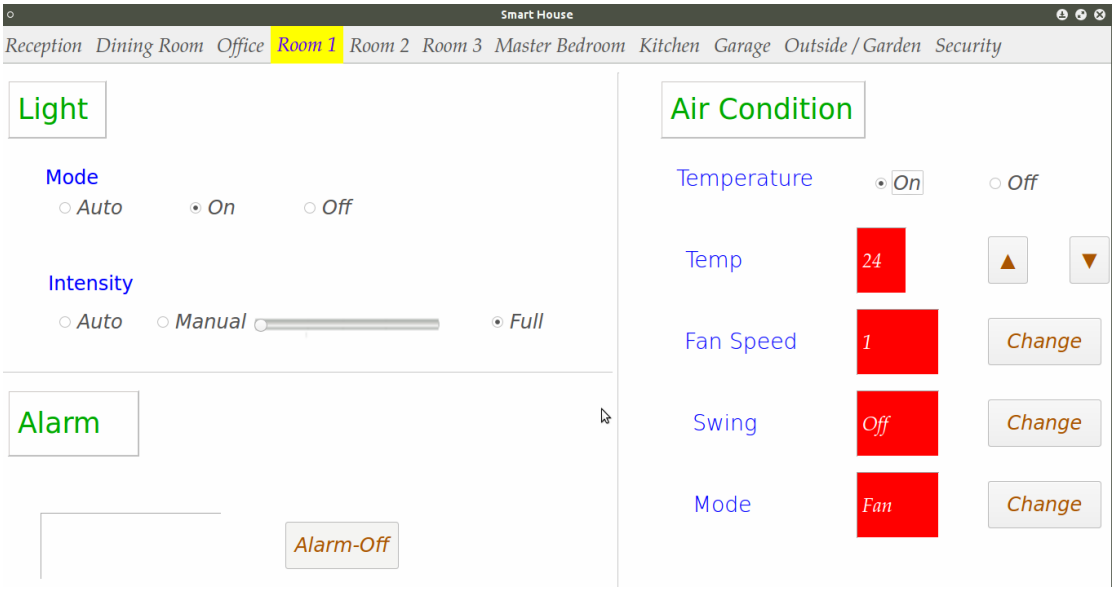
In the office we control the light modes (on and off) and the light intensity (auto – manual – full)



Room 1

In room 1, we control the light (mode and intensity) and air condition. we can control temperature of Ac by press on Temperature on so the arrows are enabled also the 3 button named "change" the temp is 24 {default} and we can change them between 16 and 30, the fan speed can be changed between 1 {default}, 2, 3 and auto. The swing can also be changed between off {default} and on. The mode can be changed between Fan {default}, cool, heat and dry. When clicking the off radio button the arrows and the buttons are disabled

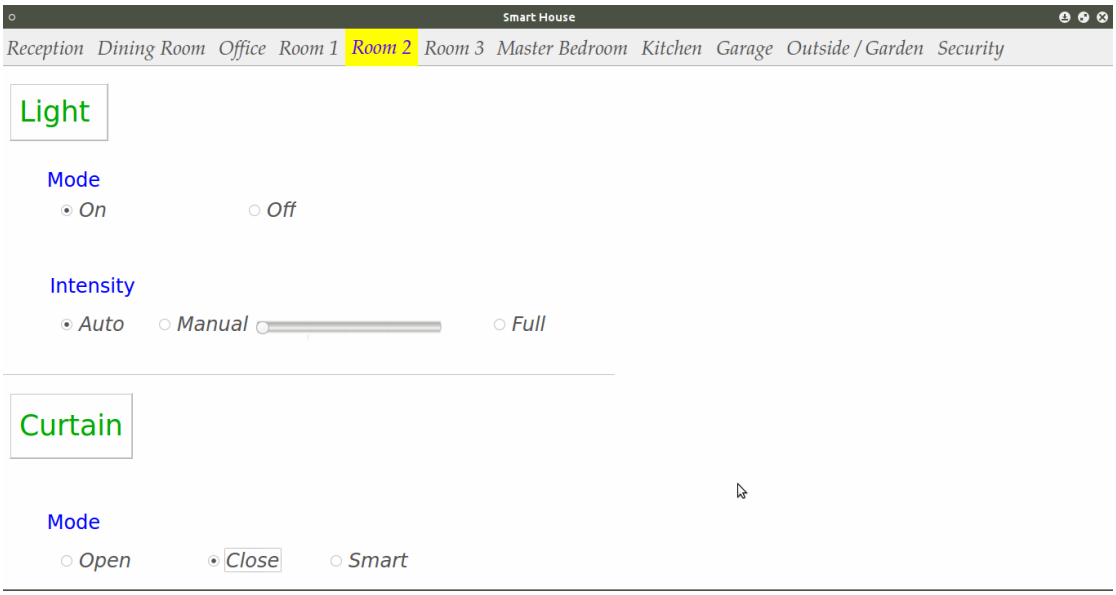
For security alarm, the default for the alarm is off and the button "Alarm-Off" is disabled. If there's an alarm the label text will change to be "Security Alarm" and the button will be enabled. Now the button is enabled so we can secure the alarm by clicking on the button and the label text will return to its default "empty".



Room 2

In room 1, we control the light (mode and intensity) and the curtain (open – close – smart).

The curtain will close automatically when sun light is direct on the window entire the room and open when sunlight decreases to reach the normal temperature, this is smart mode of curtain

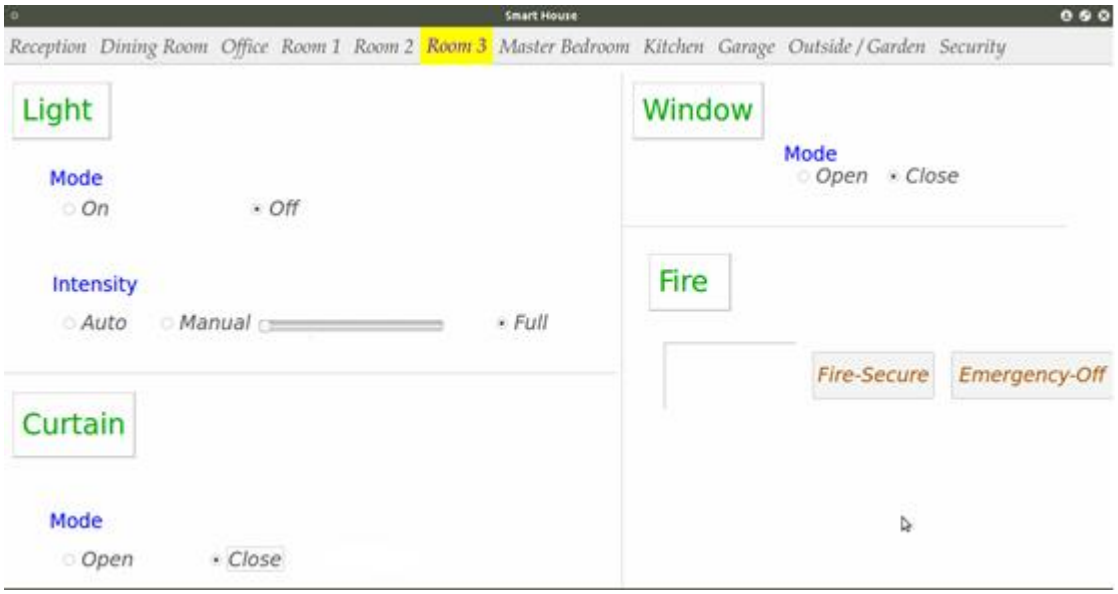


Room 3

In room 1, we control:

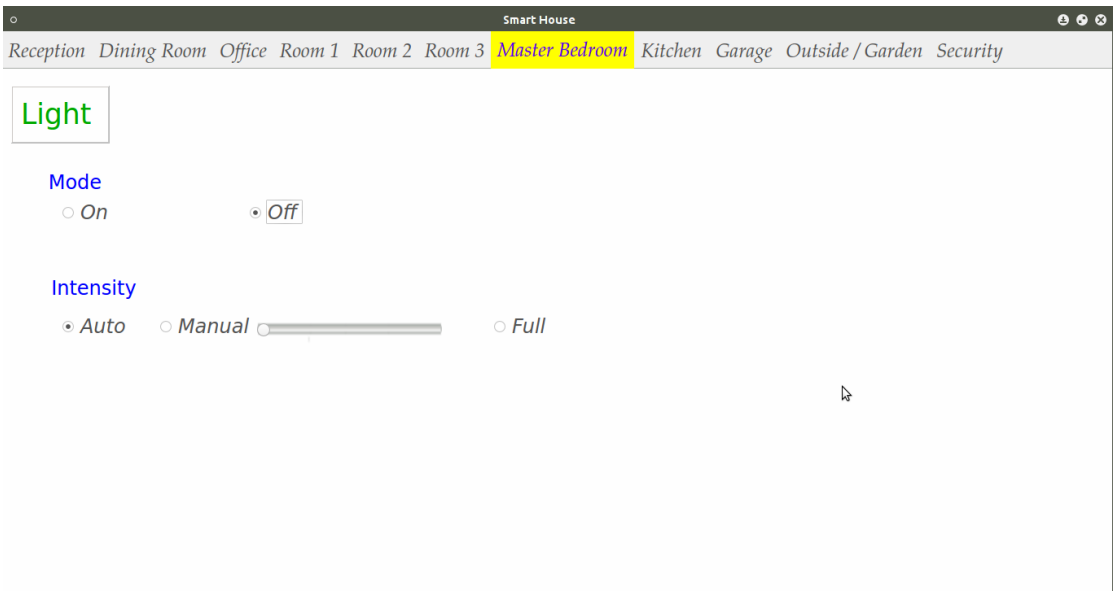
- The light (mode and intensity)
- The window (open – close)
- The curtain (open – close – smart)
- The fire: the default for the fire alarm is off so the label text is empty and the button "fire secure" is disabled. If there's an alarm the label text will change to be "fire Alarm", Fire-Secure button will be enabled. Now the

button is enabled so we can secure the alarm by clicking on the button and the label text will return to it's default "empty" then the emergency-off button will be enabled and we can turn off the emergency.



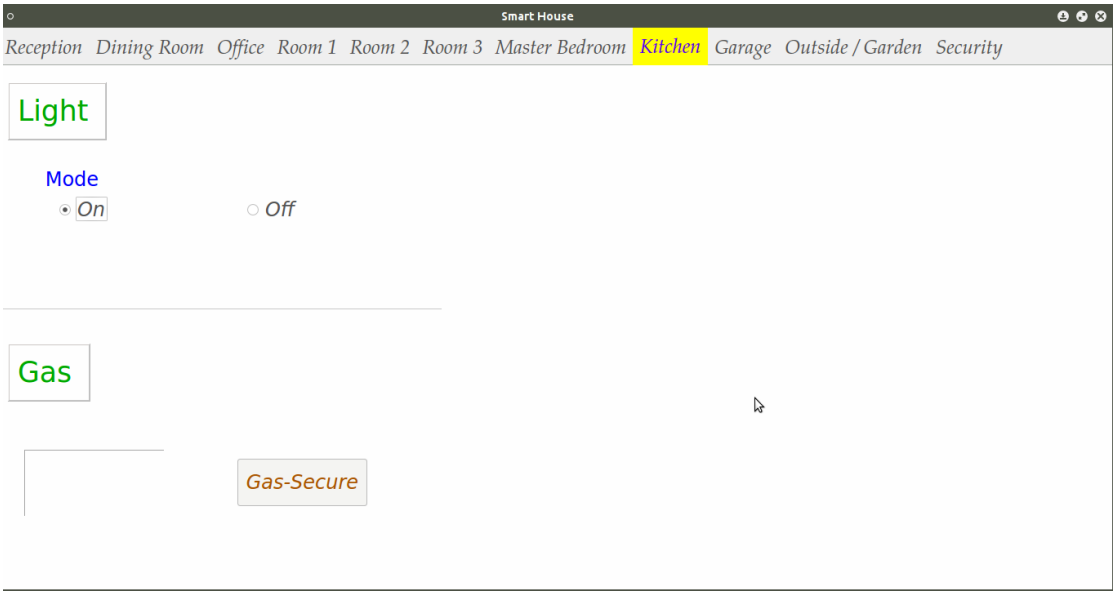
Master Bedroom

in master Bedroom , we control light mode (on – off) and intensity (auto – manual – full).



Kitchen

- In the kitchen, we control the light (on - off). The gas: the default for the gas alarm is off so the label text is empty and the button "Gas secure" is disabled. If there's an alarm the label text will change to be "Gas Alarm", Gas-Secure button will be enabled. Now the button is enabled so we can secure the alarm by clicking on the button and the label text will return to it's default "empty".



Garage

We control the garage door by three radio button open , close and stop.

Outside/Garden

we control the outside light by two radio buttons on and off. Also control the Garden light by two buttons on and off

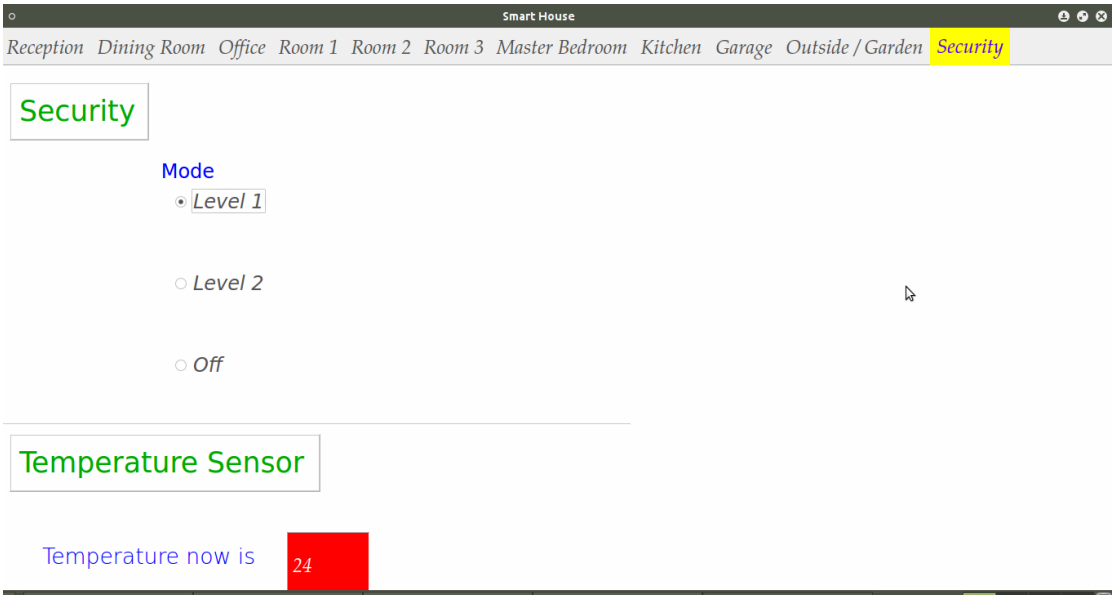
Security

in the security there's three modes:

Level 1: security system will be activated to protect the home from outside when the owner is inside the home and also protect the garage from intrusion

Level 2: security system will be active to protect the home when the owner is outside. Motion sensors detect any motion inside the home and used to protect garage and the park

Off: the security will be disabled. Also the temperature sensor which changes the label text to the current temperature is disabled.



Chapter (5) Solar Energy and Distribution System

Introduction for Solar Energy

the sun's energy arrives on earth in the primary form of heat and light. Other aspects of solar radiation are less easily perceived and their detection often requires sophisticated equipment. All solar radiation travels through space in waves, and it is the length of these waves (the shortest is less than a millionth of an inch, the longest more than a thousand yards) by which all solar radiation is classified. The aggregate of all radiation aspects of the sun is called the solar spectrum.

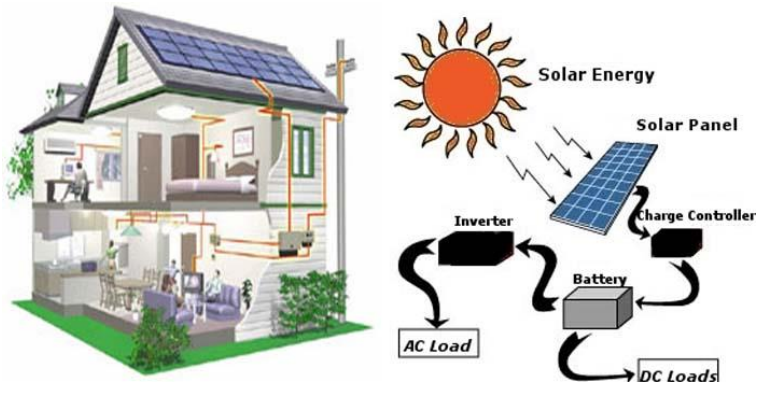
There are two important facets about the solar spectrum:

- While the sun emits radiation in all wavelengths, it is the short wavelength radiation that accounts for the majority of energy in the solar spectrum. For example, the portion of the spectrum perceived as the visible light is a relatively small segment compared to the variety of spectrum wavelengths, yet accounts for 46 percent of the energy radiating from the sun. Another 49 percent, that which is perceived as heat, is derived from the infrared band of the spectrum. 1
- The proportion of different wavelengths in the solar spectrum does not change and therefore the

energy output of the sun remains constant. A measurement of these phenomena is known as the Solar Constant, defined as the amount of heat energy delivered by solar radiation to a square foot of material set perpendicular to the sun's rays for one hour at the outer edge of the earth's atmosphere.

As a practical matter, global averages are of little interest. The essential point is that the atmosphere impacts on the amount of solar energy that actually reaches the earth's surface - the more atmospheres solar radiation has to move through, the more is lost on the way. In this regard, two celestial events – the daily rotation of the earth and its seasonal tilt of the earth's axis – are important in determining the length of atmosphere through which the sun's rays must pass before striking any particular location on the globe. These events set the upper limit amount of solar energy that can reach the surface of the earth at any location on any day of the year.

Solar Energy System Block Diagram



In this part we will take exhaustively about the components of solar energy system that consists of:

- Solar Panels
- Charge Controller
- Battery
- Inverter
- Loads

1. Solar Panels...

The Science behind Solar Panels

The sun beams more than enough energy onto the earth to meet the needs of global energy demand for a whole year. Solar panels produce energy less than a tenth of one percent of the entire global energy demand. The panels are called photovoltaic cells which are found on things like spacecraft, rooftops, and calculators. The cells are made of semiconductor materials like those found in computer chips. When sunlight hits the cells, it knocks the electrons loose from their atoms. The electrons generate electricity as they flow through the cell.

A solar panel can generate power with a four-piece battery system that can be filled with unfiltered water, and the battery can recycle water to generate battery or power. If three panels are put together, these can produce enough electrical energy to power a home with a family of four to eight people living within the structure it is powering. It also allows a vehicle to run on solar power. In addition, a typical solar panel produces 200 watts of power or more. To power

a building like a bank, for example, a five kilowatt-hour array, which is about 25 solar panels, is necessary. The solar panels will absorb 1,000 watts of sunlight per square meter on the panels' surfaces. To power a high school building, a 6.25 megawatt capacity, equivalent to 24 solar panels, is needed.

Advantages and Disadvantages of Solar Power

According to research, the sun is now halfway in its lifetime. It is predicted to consume its energy in another 4.5 billion years which is still way beyond a normal person's lifetime, thus making the sunlight a renewable source of energy. This form of energy is reliable and sustainable; it will not run out for a very long time. Using solar panels to produce electrical power is ecosystem friendly; they do not emit greenhouse gases that can increase the warming of the Earth that have been studied to be the main cause of the drastic climate changes. In the long run of using solar panels to produce power, people who go solar will save thousands of dollars since the sun will keep on providing energy that is more than enough throughout their lifetime. Finally, utilizing solar power can save people from fossil fuel dependence. Fossil fuels are not only nonrenewable but are also the main source of carbon dioxide emissions, the primary greenhouse gas in the atmosphere.

Using solar panels has its downfall such as when the weather is cloudy, it makes the technology unreliable. Also, the cost and placement of the solar panels can be very high mostly because the solar panels require a very large area

that has a significant amount of sunlight to give energy to a lot of people.

Types of solar cells

1- Monocrystallinepanel

Pronounced "Mono-Crystal-Line" Mono is the traditional checkered type solar panel which has been commercially developed since the 1960's. These panels tend to have the best space efficiency, meaning they take up less space than the other technologies (a great advantage if you want to generate lots of power). The cells in mono-crystalline modules are made by a single silicon crystal. This crystal is cut into wafers roughly 0.2mm thick before the wafers are chemically treated and electrical contacts added. The fact that they are cut from a single crystal means that they are highly efficient, with modules in production converting up to 15% of the energy from the sun into electricity, and test models over 20%.

Advantages:

- Best Space efficiency (Less space on roof).
- Minimal framing needed (Saving Energy).
- More potential power generation from your house.

Disadvantages:

- Performance drop in shaded areas. (5% of panel can be covered).

2 –Polycrystallinepanel

Pronounced "Poly-Crystal-Line". Poly panels have been in mass production since the late 70's and have become more popular over time. They're the 'blue sparkling' looking panels. Traditionally their goal was to be more cost effective than Mono-crystalline, which at one stage did happen (However it is now again 'neck & neck'). Polycrystalline (also known as multi-crystalline) modules are made from cells containing lots of small silicon crystals. This makes them cheaper to produce but also slightly less efficient than mono-crystalline modules. The many small crystals give polycrystalline modules a frosted look.

Advantages:

- A pretty nice 'Blue' look - Better Heat Tolerance than Mono (Depending on Manufacturer).
- Good space efficiency.
- Better shade tolerance than Mono (15% of panel can be covered).

Disadvantages:

-Not quite as space friendly as Mono panels (10% more room needed).

3 - Thin Film Silicon (Amorphous) panel

Thin-Film OR "A-amorphous" panels are the latest panels to be mass produced (this however does not necessarily make them the best). Since the 80's Thin film has been used in calculators and watches because they perform better than others in low light. Thin film panels however take up almost DOUBLE the space of other panels, which can be a

problem, is you need to avoid areas or want to have a big system. While the 0.2mm wafers in crystalline cells are already incredibly thin, the layers making up thin-film modules are about 40 times thinner than a strand of human hair, at just 2 microns (a micron is one-millionth of a meter). The layers can be deposited on glass forming a panel similar to crystalline modules, but many other materials can also be used and even flexible panels can be made. Although the efficiency of thin-film panels is only about 10%, they use less material and are cheaper than crystalline modules.

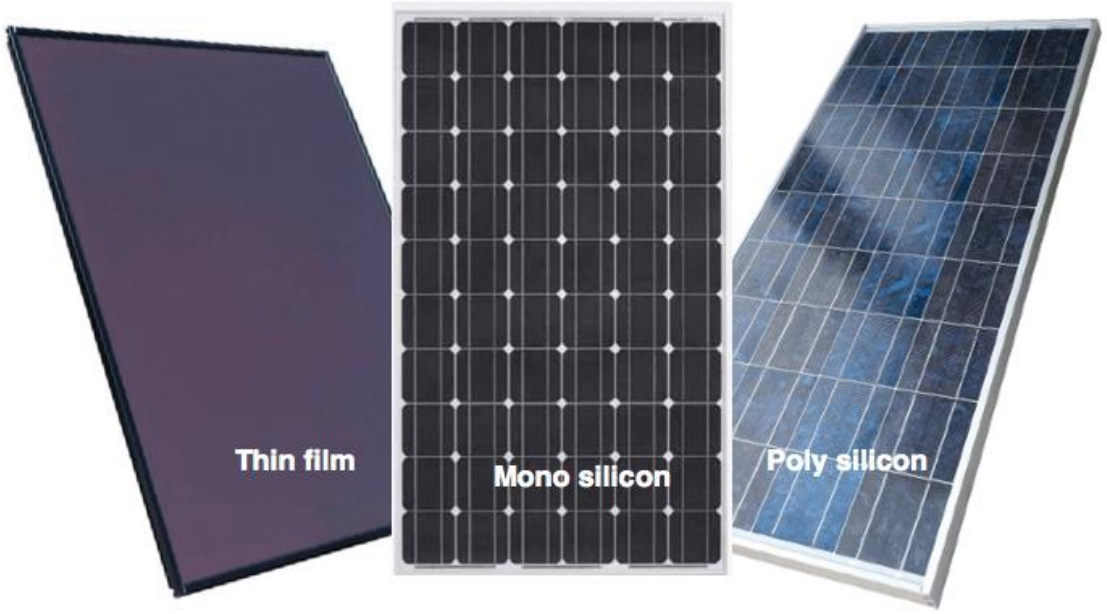
Advantages:

- Less silicon & energy needed to manufacture.
- Work well in low light.
- More average energy produced per kilowatt peak.
- Better in shade conditions

Disadvantages:

- More framing needed to install (therefore more energy).
- Greater surface area needed for the same kilowatt power (about double).

Types of Solar Panels



Types of Solar Panel Mountings

Research shows that there are three types of solar panel mountings. These are fixed, adjustable, and tracking.

1-Fixed Solar Panel mounting

The fixed solar panel mounting system is completely stationary. This is the simplest and cheapest type of solar panel. The solar panels are installed in such a way that they are always facing the equator.

2 - The adjustable solar panel mounting

This system includes adjusting the angle of inclination of the solar panel mount two or more times a year to account for the lower angle of the sun in the winter season. This system is more expensive than the fixed mount but it increases the solar panel power output by approximately 25%, thus making it more efficient.

3 - The tracking solar panel mounting

This system is the most expensive of the three types of mounting. It tracks and follows the path of the sun (east to west) during the day as well as the seasonal declination movement of the sun. The tracking solar panel output increases by approximately 25% - 30%. It cannot be denied that this type of mounting is the most efficient in producing the greatest amount of solar power.

2. Charge Controller...

The Function of Charge Controller

A charge controller, or charge regulator is basically a voltage and/or current regulator to keep batteries from overcharging. It regulates the voltage and current coming from the solar panels going to the battery. Most "12 volt" panels put out about 16 to 20 volts, so if there is no regulation the batteries will be damaged from overcharging. Most batteries need around 14 to 14.5 volts to get fully charged.

General Types of Charge Controller

Charge Controllers come in 3 general types:

a. Simple 1 or 2 stage controls

Which rely on relays or shunt transistors to control the voltage in one or two steps. These essentially just short or disconnect the solar panel when a certain voltage is reached. For all practical purposes these are dinosaurs, but you still see a few on old systems - and some of the super cheap ones for sale on the internet. Their only real claim to fame is their reliability - they have so few components, there is not much to break.

b. (3-stage and/or PWM)

Such Morningstar, Anthrax, Blue Sky, steca , and many others. These are pretty much the industry standard now, but you will occasionally still see some of the older shunt/relay types around, such as in the very cheap systems offered by discounters and mass marketers.

c. Maximum power point tracking (MPPT)

Such as those made by Midnite Solar, Xantrex, Outback Power, Morningstar and others. These are the ultimate in controllers, with prices to match - but with efficiencies in the 94% to 98% range, they can save considerable money on larger systems since they provide 10 to 30% more power to the battery. For more information, see our article on MPPT.

Note:

Charge Controller Used In the Project Is 10A 12V Solar Charge Controller (ST- G1210)

Features:

- MCU control with high speed and high performance.
- PWM charging mode.
- The intuitive LED tubes indicate normal battery status of the battery for helping customer understand the using condition.
- Charging can be stopped when battery voltage, reaching the highest, HVD can be set up.

- Discharging can be stopped when battery voltage reaching the lowest, LVD can be set up.
- Load turns on work; LVR can be set up.
- Potentiometer adjustment and control point sets are cancelled, flash memorizer is taken to record all work control sites.
- Using Industrial-grade chips, it can operate in cold, high temperature and moist place.

Protection:

This PWM Solar Charge controller has six protections, which are overloading protection, over discharge protection, short circuit protection, reverse polarity connection protection, thunder and lightning protection and reverse discharge protection.

Application:

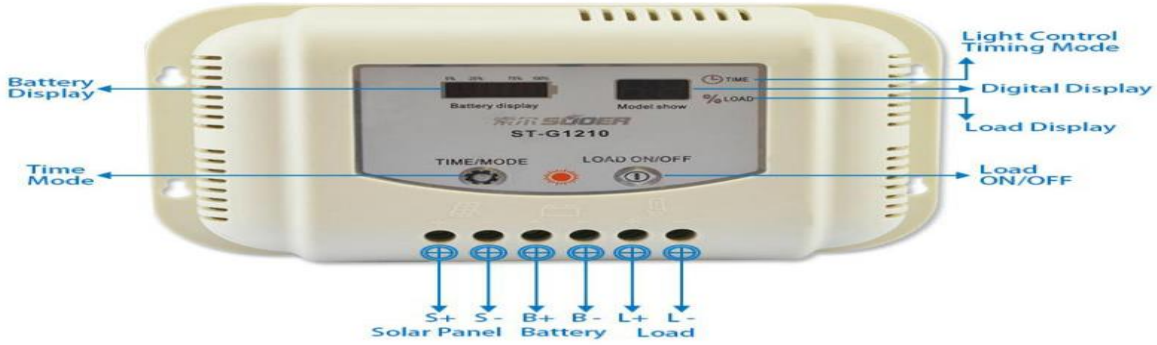
Solar Power Controller of light and night away less than 10 ma power flow, ideal for small power solar products, such as solar street lamp light, streetlight, DC Load, illumination, solar power system and so on.

Technical Parameters:

Model	ST-G1205	**ST-G1210**	ST-G1215	ST-G1220	ST-G1230
Rated charging power	60W	120W	180W	240W	360W
Charging current rating	5A	5A	15A	20A	30A
Battery voltage	12V/24V				
Charging voltage	13.6V/27.2V				
Float charging voltage	13.8V/27.6V				
Discharge cut-off voltage	10.5V/21V				
Battery over-voltage protection	17V/34V				
Output protection	>1.25 times rated current 60s protection >1.5 times rated current 5s protection >3 times rated current straightway protection				

	>short circuit immediately protection
Discharge cut-off voltage	10mA
Standby loss	0.2mA
Charging circuit pressure drop	≤0.26V
Discharge circuit voltage drop	≤0.15V
Charging control mode	PWM pulse width modulation
Size(mm)	167x124x50

PRODUCT DETAILS

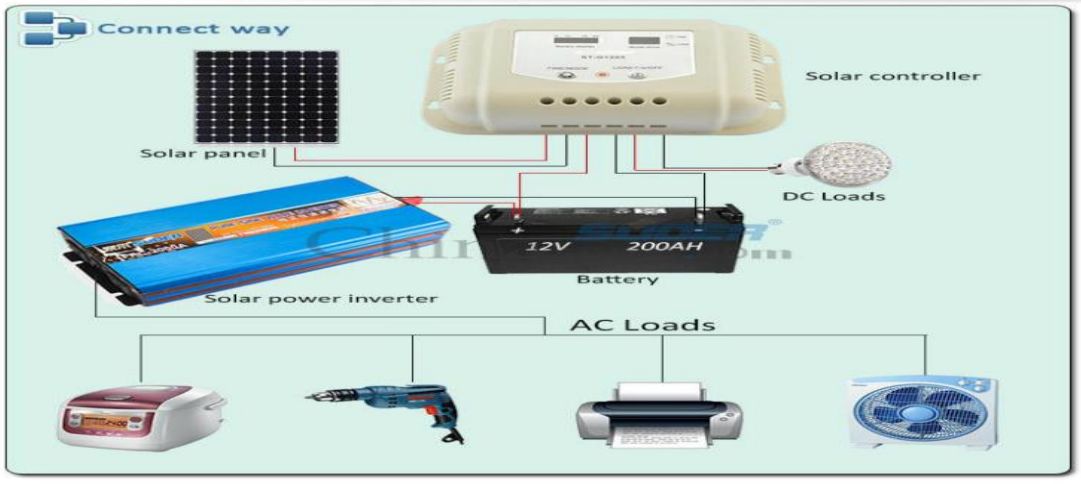


PRODUCT PARAMETERS

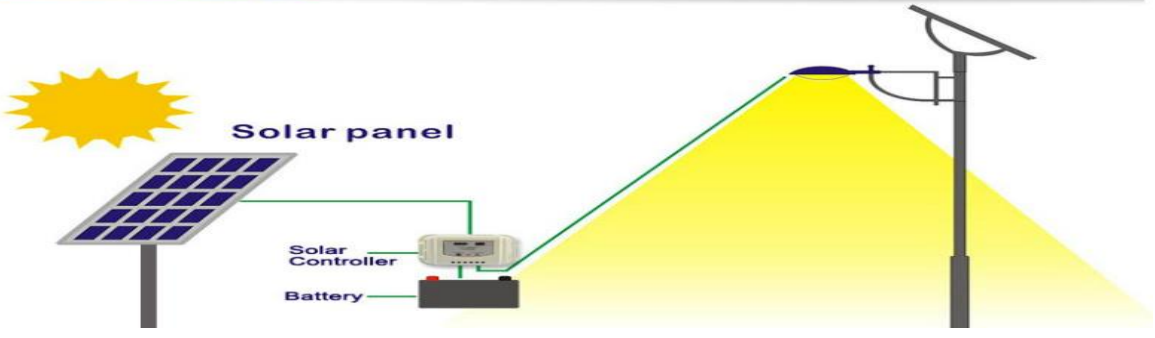
Technical Data

Model	ST-G1205	ST-G1210	ST-G1220	ST-G1230
Rated Charging Power	60W	120W	240W	360W
Charging Current Rating	5A	10A	20A	30A
Battery Voltage	12V / 24V			
Charging Voltage	13.6V / 27.2V			
Float Charging Voltage	13.8V / 27.6V			
Discharge Cut-off Voltage	10.5V / 21V			
Battery Over-voltage Protection	17V / 34V			
Output Protection	Short circuit immediately protection			
Excitation Loss	10mA			
Standby Loss	0.2mA			
Charging Circuit Pressure Drop	≤0.26V			
Discharge Circuit Voltage Drop	≤0.15V			

PRODUCT METHOD OF USE



PRODUCT USING RANGE



3. Battery...

Introduction

The battery is an essential component of almost all aircraft electrical systems. Batteries are used to start engines and auxiliary power units, to provide emergency backup power for essential avionics equipment, to assure no-break power for navigation units and fly-by-wire computers, and to provide ground power capability for maintenance and preflight checkouts. Many of these functions are mission critical, so the performance and reliability of an aircraft battery is of considerable importance. Other important requirements include environmental ruggedness, a wide operating temperature range, ease of maintenance, rapid recharge capability, and tolerance to abuse.

Battery Fundamentals

(1) Batteries operate by converting chemical energy into electrical energy through electrochemical discharge reactions. Batteries are composed of one or more cells, each containing a positive electrode, negative electrode, separator, and electrolyte.

Cells can be divided into two major classes:

- Primary cells
- Secondary cells

Primary cells

They are not rechargeable and must be replaced once the reactants are depleted.

Examples of primary cells:

- carbon-zinc (Leclanche or dry cell)
- alkaline-manganese
- Mercury zinc, silver-zinc.
- Lithium cells (e.g., lithium-manganese dioxide lithium-sulfur dioxide, and lithiumthionyl chloride).

Secondary cells

Secondary cells are rechargeable and require a DC charging source to restore reactants to their fully charged state.

Examples of secondary cells:

- Lead-lead dioxide (lead-acid)
- Nickel-cadmium
- Nickel-iron
- Nickel-hydrogen
- Nickel-metal hydride
- Silver-zinc
- Silver-cadmium
- Lithium-ion

For aircraft applications, secondary cells are the most prominent, but primary cells are sometimes used for

powering critical avionics equipment (e.g., flight data recorders).

(2) Batteries are rated in terms of their nominal voltage and ampere-hour capacity. The voltage rating is based on the number of cells connected in series and the nominal voltage of each cell (2.0 V for lead acid and 1.2 V for nickel-cadmium). The most common voltage rating for aircraft batteries is 24 V.

(3) A24-V lead-acid battery contains 12 cells, while a 24-V nickel-cadmium battery contains either 19 or 20 cells(the U.S. military rates 19-cell batteries at 24 V). Voltage ratings of 22.8, 25.2, and 26.4 V are also common with nickel-cadmium batteries, consisting of 19, 20, or 22 cells, respectively. Twelve-volt lead-acid batteries, consisting of six cells in series, are also used in many general aviation aircraft.

(4) The ampere-hour (Ah) capacity available from a fully charged battery depends on its temperature, rate of discharge, and age. Normally, aircraft batteries are rated at room temperature (25°C), the C-rate (1-hour rate), and beginning of life. Military batteries, however, often are rated in terms of the end-of life capacity, i.e., the minimum capacity before the battery is considered unserviceable. Capacity ratings of aircraft batteries vary widely, generally ranging from 3 to 65 Ah.

(5) The maximum power available from a battery depends on its internal construction. High rate cells, for example, are designed specifically to have very low internal impedance as required for starting turbine engines and auxiliary power units (APUs). Unfortunately, no universally accepted standard exists for defining the peak power capability of an aircraft battery. For lead-acid batteries, the peak power typically is defined in terms of the cold-cranking amperes, or CCA rating. For nickel-cadmium batteries, the peak power rating typically is defined in terms of the current at maximum power, or Imp rating. These ratings are based on different temperatures (18°C for CCA, 23°C for Imp), making it difficult to compare different battery types. Furthermore, neither rating adequately characterizes the battery's initial peak current capability, which is especially important for engine start applications. More rigorous peak power specifications have been included in some military standards. For example, MIL-B-8565/15 specifies the initial peak current, the current after 15 s, and the capacity after 60 s, during a 14-V constant voltage discharge at two different temperatures (24 and - 26°C).

(6) The state-of-charge of a battery is the percentage of its capacity available relative to the capacity when it is fully charged. By this definition, a fully charged battery has a state-of-charge of 100% and a battery with 20% of its capacity removed has a state of-charge of 80%. The state-

of-health of a battery is the percentage of its capacity available when fully charged relative to its rated capacity. For example, a battery rated at 30 Ah, but only capable of delivering 24 Ah when fully charged, will have a state-of-health of 24/30 *100 = 80%. Thus, the state-of-health takes into account the loss of capacity as the battery ages.

In our project; we use Lead Acid battery.

3. Inverter...

A DC-AC/DC power inverter is a circuit which modifies an input varying or non-varying direct current (DC) to an alternating current (AC) of a specified voltage and frequency, and a regulated DC voltage. In the case of this project, the input DC voltage source will be a battery, which is being supplied by photovoltaic (PV) panels and a wind turbine. As such, the DC voltage will likely be inconsistent, and considerations will need to be made in order to produce the desired output. This desired AC output is a 120Vrms, 60Hz pure sine wave, or what would be seen out of a

standard US wall socket. The desired DC output is a 12V regulated. This will allow the system to output power which is usable by any load.

The only input to the inverter subsystem is from the battery, the battery is being charged from the PV panels through the charging subsystem and from the wind turbine through its integrated system.

4. Electrical Loads...

Definition of Load:

The Electrical Load is the part or component in a circuit that converts electricity into light, heat, or mechanical motion. Examples of loads are a light bulb, resistor, or motor.

Electrical Load Classification and Types

Normal load: the load which is used in presence of the grid and the charged batteries

Emergency load: the loads used in case of absence of the grid in this case the batteries supply the loads only

Design and Results

To convert the tradition system in to green system like solar power and wind power

Our topic about solar power system at first to design solar power system we must know the overall loads

This is table of the loads

Assume power factor =0.85

Load	power	Time(hour)	energy
light	1908	6	11448
refrigerator	150	12	1800
heater	1500	3	4500
mixer	500	0.5	250
oven	1000	0.5	500
computer	200	6	1200
laundry	1000	1.5	1500
iron	1000	0.5	500
Vacuum cleaner	1000	1	1000
TV& receiver	400	5	2000
Communication device	50	1	50
Air condition	2500*2*.85=425	5	23375

First step:

We must calculate the total energy as shown as we use it in the sizing of panels

Power total = power of (light+ +communication device +air condition) refrigerator +heater +mixer +oven+ computer +laundry +iron+ vacuum cleaner+ TV +receiver

Power total= 12958 watt

Energy Total = energy of (light+ communication device +air condition) refrigerator +heater +mixer +oven +computer +laundry +iron +vacuum cleaner +TV +receiver

Total energy = 45998 wh

Second step:

we must know the location of the system (Latitude, longitude)

Location: Zigzag

The latitude of the project located in zigzag = 30.75

The longitude of the project located in zigzag =31.503

Third step:

(1) Calculate (δ) , (Where δ is the declination angle)

Declination angle (δ) : is the angle between symmetrical axis of the sun and symmetrical axis of earth

- δ = 23.5*sin((no of longitudes/no of year days)*(284+d)
- d =355At 21 December

  Where (d) is the day number of year
- δ = 23.5*sin((360/365)*(284+355))
- δ = -23.5

(2) using (δ) in determination (α) ,(Where α is the elevation angle)

The angle (α) between the intercept of the sun and the earth which is called elevation angle as we use it in PSH calculation

(φ) Is latitude angle equal =30.75

$\alpha = 90 - \varphi + \delta$

$\alpha = 90 - 30.75 - 23.5 = 36^o$

(3) Then we should have the angle (β) between the horizontal and the panel which is called tilted angle as we use it in panel installation and in (PSH) calculation

$\beta = 90 - \alpha$

- The angle (α) between the intercept of the sun and the earth which is called elevation angle as we use it in PSH calculation

This the angle between them

$\beta = 90 - \alpha$

$\beta = 90 - 36 = 54^o$

$\beta_{standard} = 45^o$

(4) Then we have to calculate PSH "Peak Sun Hour" to use it in panel sizing

-PSH(Sm) = S_h * (Sin (α+β) / Sin (α))

Sh: horizontal irradiation

We get S_h from this table

Lat	Lon	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
31	32	3.24	4.08	5.46	6.79	7.77	8.44	8.10	7.54	6.53	5.02	3.68	2.96	5.80

The table we need

The full table seen for link (1)

Sh: from table at (Ann)

- PSH(SM) = S_h* (Sin(α +β) / Sin(α))

= 5.8 * (Sin(36+45) / Sin(36)) = 9.746 hours

Efficiency

We calculate efficiency of the system as we need it in sizing of panels

μ = 100% - Losses

Losses

1- Temperature

As the system efficiency decrease by 0.5% when the temperature increase by one degree over 25°

By using nominal operating cell temperature (NOCT) at 46°

Temp (NOCT=46°)>>(46-25)*0.45 = 9.45%

2- (Dust & (AC&DC) Cables) >> 3%

In addition to the effect of the dust on panels the voltage drop and power losses of (AC&DC) Cables decrease the efficiency of the system by3%

3- Inverter

The important factor involves the wave form and inductive loads (i.e. an appliance where an electrical coil is involved, which will include anything with a motor). Any waveform that is not a true sine wave (i.e. is a square, or modified square

wave) will be less efficient when powering inductive loads - the appliance may use 20% more power than it would if using a pure sine wave. Together with reducing efficiency, this extra power usage may damage, or shorten the life of the appliance, due to overheating.

Inverter losses >>15%

4- Charger Controller

A solar panel with a nominal voltage of 12 volts would normally have 36 cells, resulting in a constant current up to about 18 volts. Above this voltage, current drops off rapidly, resulting in maximum power output being produced at around 18 volts.

Charger Controller losses>> 5%

Losses = 9.45%+3%+15%+5% = 33%

Efficiency $_{syst}$ = 100%-33% = 67%

Sizing*:*

In our project, we make sizing for:

- ❖ Panels
- ❖ Battery
- ❖ Inverter

Panels sizing:

- Total Power Of Panels = (Energy / (PSH*μ_{syst})
- P_T = (45998/(9.746*0.67)) =7042.7

- Power Of One Panel = 350 w
- No. of Panels = (Total Power Of Panels / Power Of One Panel)

  = (7042.7/350)=20.122 = 21 panels

Battery Sizing:

- Volt of the battery is constant = 12 V

  So (12V , 200AH / 20 HR at 25^{o} C)

  charging: 200 AH >>> 20 HR

  Discharging: 180 AH >>20HR

  As we get less AH in case of heavy load discharger

- μ = (AH discharge/AH charge)
- μ = (180 / 200) = 0.9
- Total AH at Battery = ((Energy * A.D) / (V * D.D * μ_{Bat})

- A.D : The number of days when the sun does not shine
- D.D : depth of discharge(the zone of the battery used)
- It mostly equal 75% from the total charged quantity
- = (45998* 1.5) / (12*0.75*0.9)=8518.14 AH
- =8518.14 AH

No of batteries = (Total A.H / Single A.H of Batteries
= (8518.4 / 200) = 43Batteries

For Battery (200 AH & 12 V)

The batteries not connected directly to the panels but the chargers supply it and protect it from large current

The charger protect the batteries from over charger and over discharger

Charger Sizing

- min Current = (Power of panels / Bus Volt)
- min Current = ((21*350) / 24) = 306.25A
- We Choose charger (80A)

- NO OF Charger = (306.25/80) = 4 Charger
- Charger(4*80 &24v)

(Pure sine wave& 4*80 &24v)

The loads not connected to batteries but the inverters supply them and

They convert dc power to ac from batteries to loads.

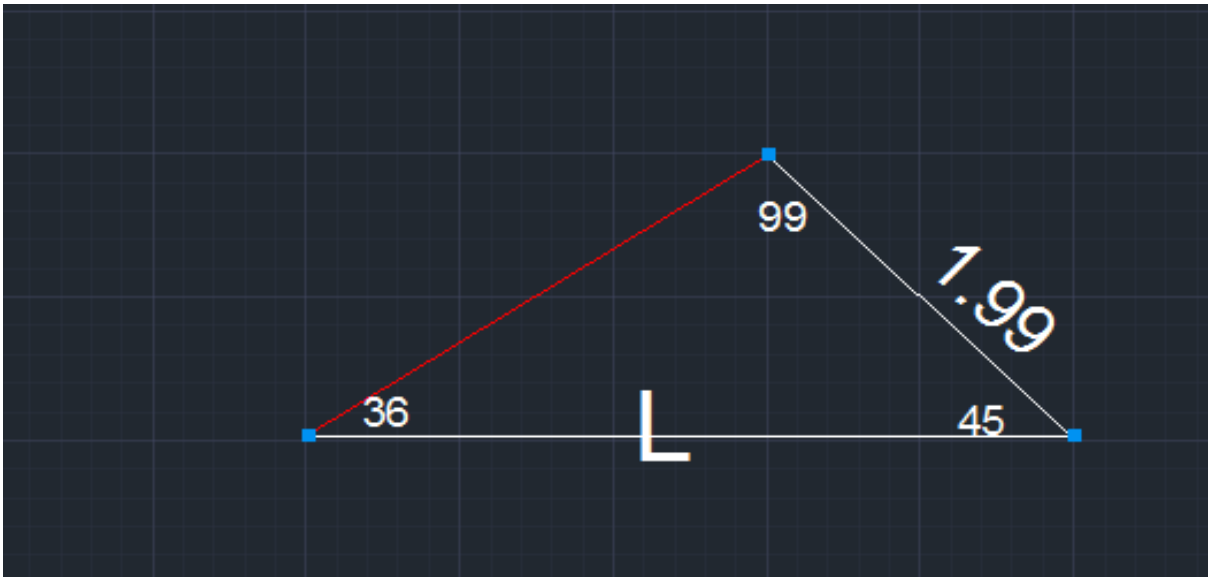
Inverter Sizing:

- Inverter sizing = sizing factor * P_L
- = 1.25 * 12958 = 16197.5 watt
- =19.055KVA = 20kva

Inverter (20KVA &24VDC/220VA)

Installation of panels:

Size of solar panel of 350watt (1.996*0.99)



We take the area of the shadow of panels to ensure that the shadow do not cover any part of the panels

If any part of the panels is covered this make a short circuit on it

We can calculate the length of shadow from sine law

- L / sin (99) =1.996/sin (36)

L: The length of the shadow

L = 3.35

- Area of solar panel take = 3.35*0.99 =3.3165 m^2
- Total Area = 21*3.3165 = 69.6465 m^2

The Interface Module

Aim of circuit:

Selection between grid and batteries

Why?

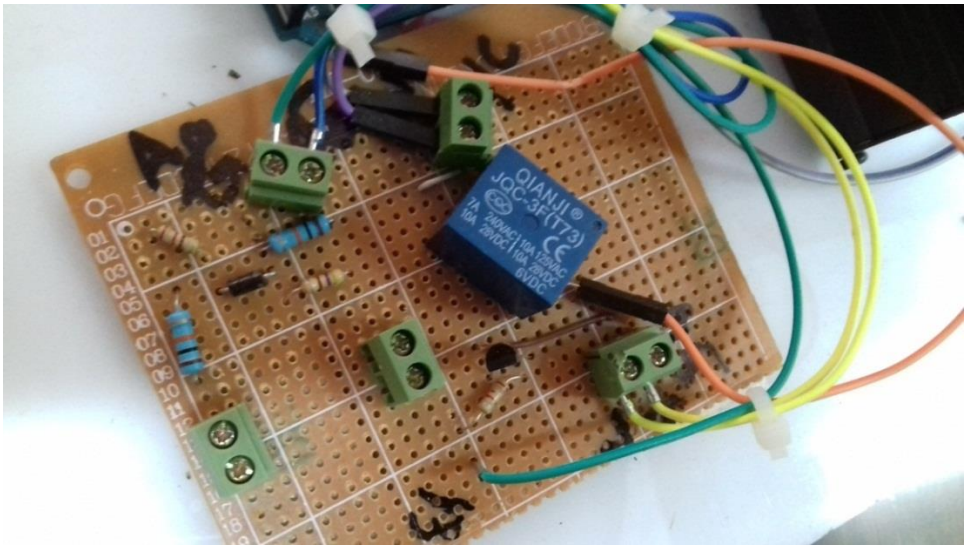
As in our smart and green house we want to use solar cells and use grid. When batteries are charged full we start our selection and batteries start to supply home.

When batteries reach to final voltage we return back to Grid.

Consists of The circuit of interface module

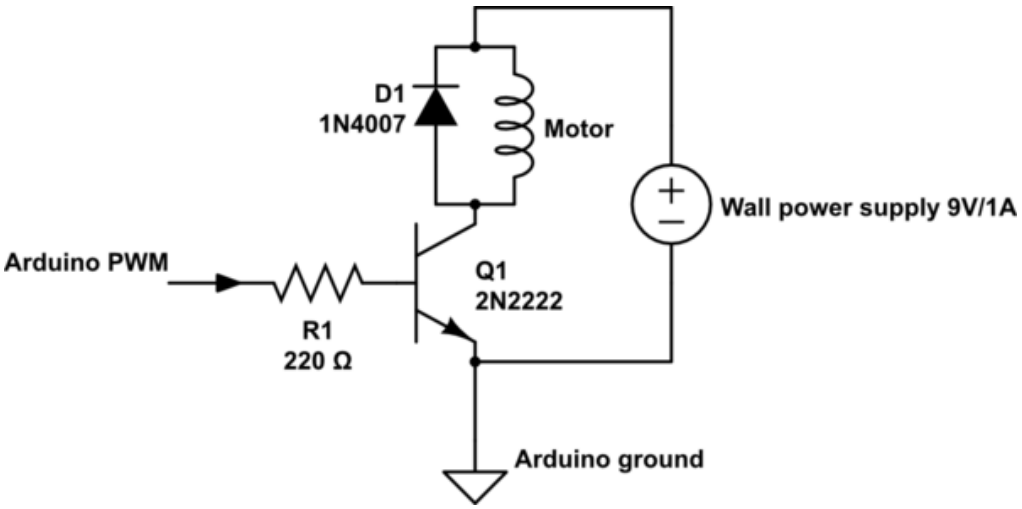
- connect and disconnect between batteries and grid circuit
- Voltage drop circuit (1) (voltage sensor).
- Arduino.
- Voltage drop circuit (2)

No (1) the first circuit: - connect and disconnect circuit



It is consist of relay and do connect and disconnect between grid (12v dc power supply) and batteries we connect grid on normally close pin on relay and connect load for normally open pin on relay then we connect load on common pin on relay .the (-ve) terminal for grid and for batteries is common .

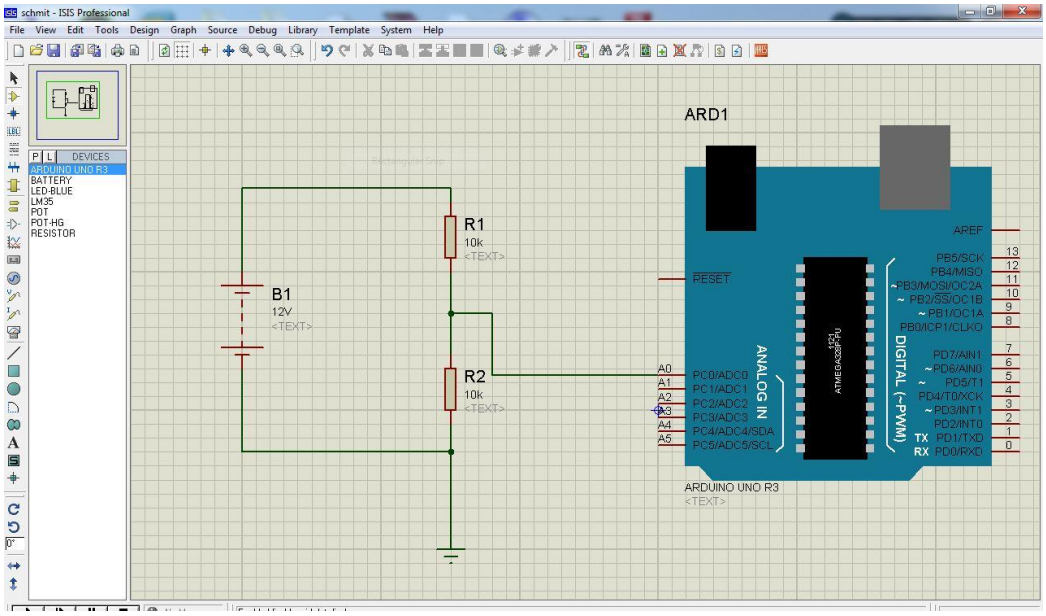
We use transistor (2n2222) to do interface between relay coil and arduino



We connect coil of relay with emitter and connect power supply with collector then connect base with 220 ohm resistance then we connect block diode to protect Arduino from inductance of coil of relay that may damage Arduino .we connect other terminal to Arduino

On pin (13) that give signal relay to start connect or disconnect grid and batteries .the aim of connect 220 ohm resistance is protect base of transistor from burn as signal of Arduino reach to 5v and damage transistor base.

No (2) the second circuit: - voltage drop circuit (1)



We design that circuit as there is no sensor found to do that job so we design that circuit to receive signal.

That shown percentage of volt on battery as according to that percentage we do selection and determine the source that will supply load. We do linear scale for volt

If battery volt is 12 volt that opposite on arduino terminal 5 volt .that mean battery is full charged and

We start to supply load if battery volt reach to 9.5 volt that opposite on arduino input about (4.3 volt or4.1) depending on electrical noise surroundings arduino.

As shown that circuit consists of resistance. The values of resistance determined by empirical experiment .by adding multi resistance and measure output value to reach max value don't access (5volt dc) as it's max value that arduino can measure it .above that value arduino don't read any value .

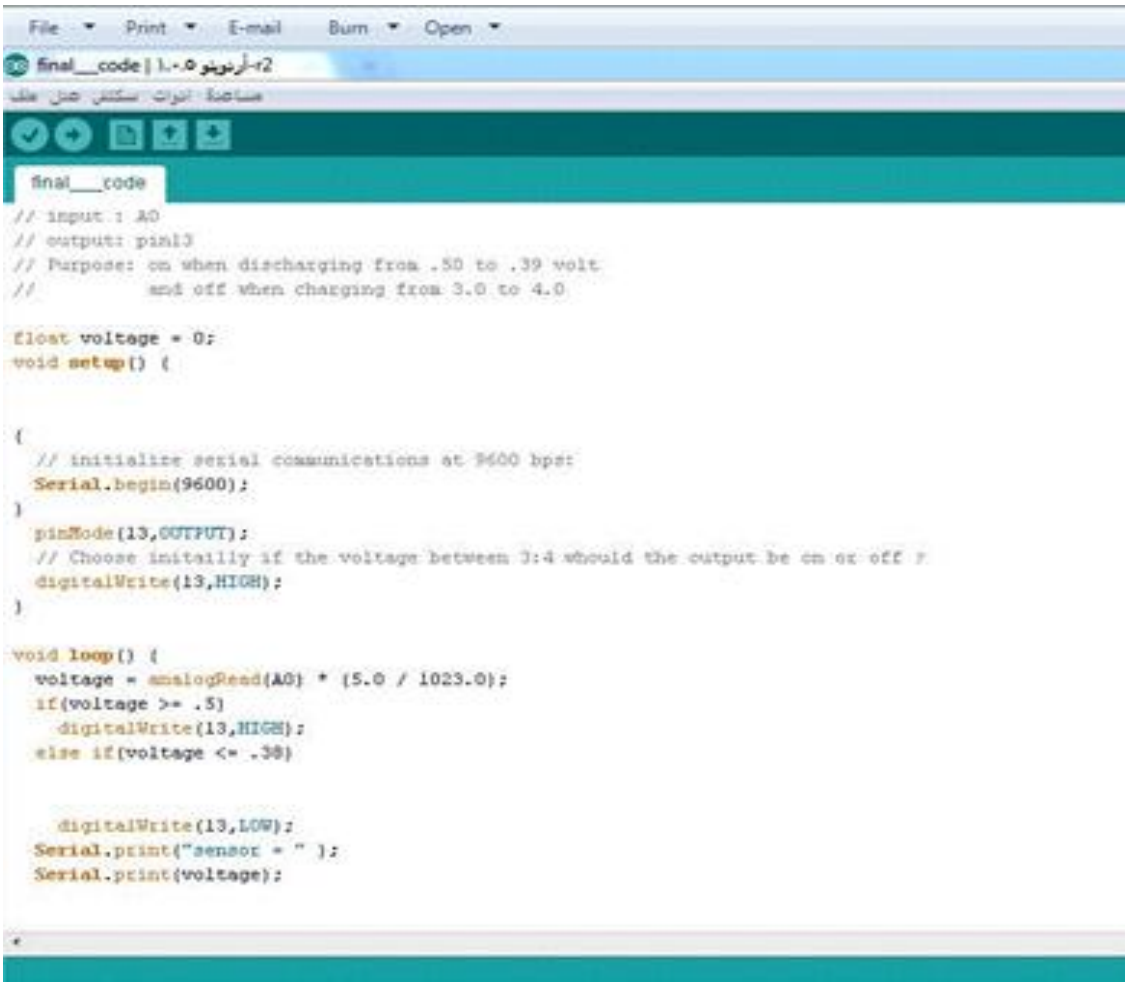
The value of resistance is

- (2) resistance (9k ohm)
- (1) resistance (450 ohm)
- diode

We try a lot of designs before that design by using bank of diodes but because of nonlinear behavior for diodes cause distortion for volt and value of volt isn't constant so we use that design.

No (3) The third circuit is Arduino Microcontroller

That figure showed our final code



The Arduino microcontroller is an easy to use software and hardware.

The Arduino is open-source, which means hardware is reasonably priced and development software is free.

Components You Need for a Working System:

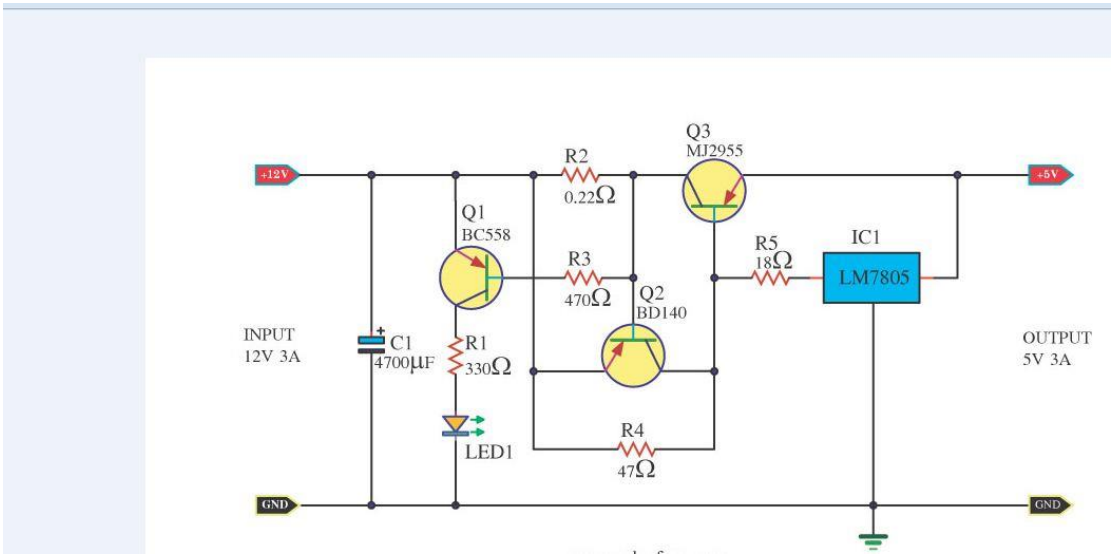
- Arduino board
- USB programming cable
- 9V battery or external power supply (for stand-alone operation)
- Solder fewer breadboards for external circuits, and 22 g solid wire for connections
- Host PC running the Arduino development environment. Versions exist for Windows, Mac and Linux.

For stand-alone operation, the board is powered by a battery rather than through the USB connection to the computer.

Warning: Do not put your board down on a conductive surface; you will short out the pins on the back.

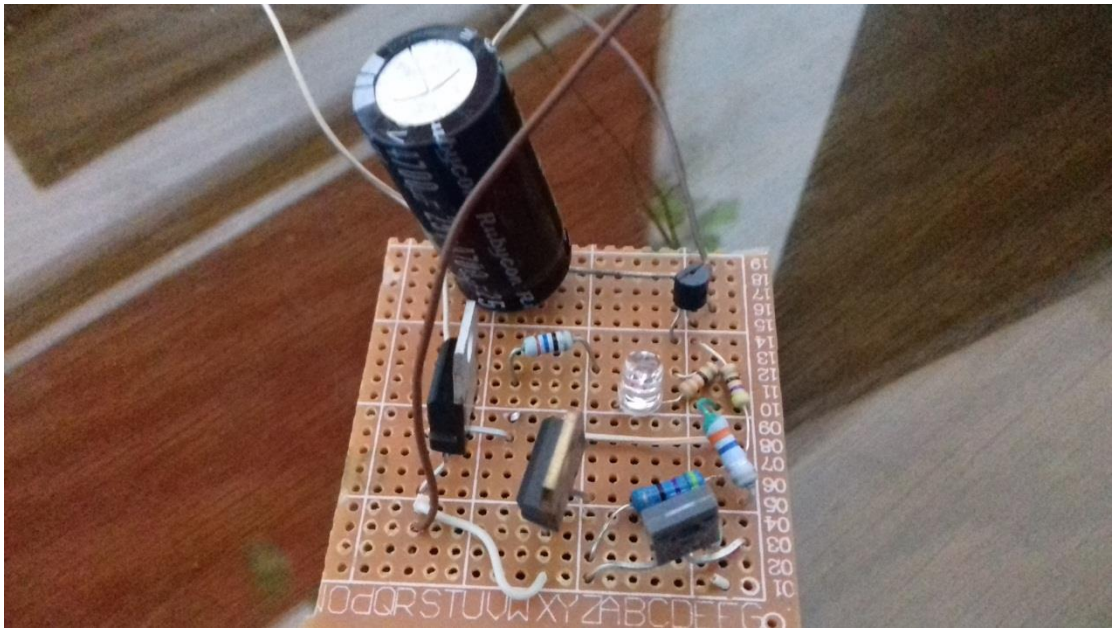
We may connect Bluetooth module then send and receive data Wi-Fi using mobile.

N0 (4) voltage drop circuit (2)



In our model we use 5 volt dc but batteries are 12 volt dc so we design that circuit to do voltage drop to supply our module

The practical design of circuit on bread board shown in that circuit



Distribution system

Distribution system is one of the greatest industrial systems in the world. With the progress of human civilization, there has been a rapid increase in the production and use of electrical energy.

Design of electrical system is very important. None of electrical or electronic equipment will operate without electrical power.

Design of electrical system is very Complex because it need team work of all fields.

And it is Responsible because the electrical engineer is responsible for the electrical power

The scope of the project; the objective of this project is to present the different schemes adopted in the process of distribution of management and commercial buildings.

Lighting

Introduction

Light is a form of energy represented by electromagnetic radiation, which may affect the human eye, and is produced in many ways, depending on the causes that provoke?

There are three primary colors: Red, green and violet any color produced by combining the light of two or three of this primary color. Rays of light travel in straight lined unless interfered with some medium that absorbs or reflects

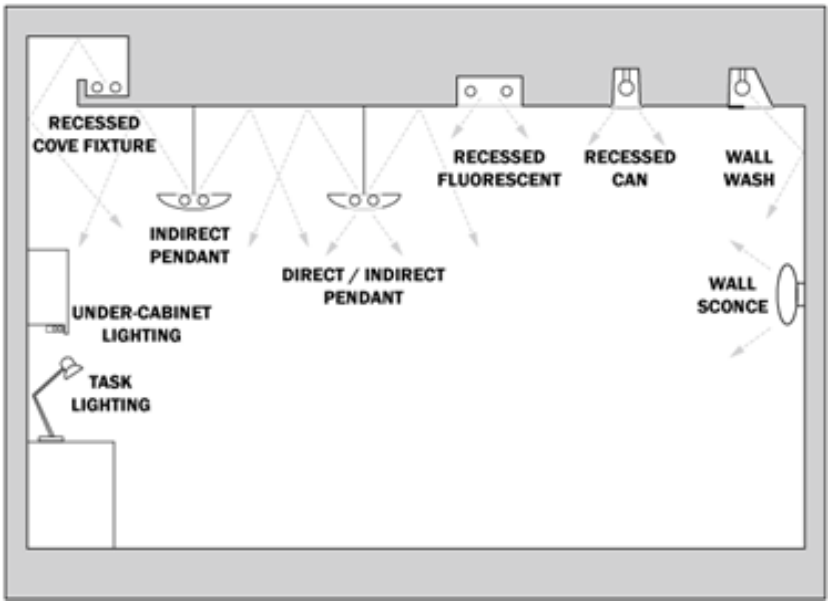
Importance of lighting:

Proper lighting can enhance task performance, improve the appearance of an area, and have positive psychological effects on occupants. One of the core tenets of proper lighting is uniform illumination, which is required in many applications such as projection displays, LCD backlights, medical lighting, microscopy, solid-state lighting, and general lighting.

Lighting also contributes to the safety of occupants and the security of buildings.

Indoor lighting is usually accomplished using light fixtures, and is a key part of interior design. Lighting can also be an intrinsic component of landscape projects

Types of Luminance fixtures



i. General lighting:

General artificial lighting is provided by ceiling fixtures that are installed in a regular pattern. General lighting is mostly soft in nature with few shadows and differences in brightness.

ii. Direct Lighting:

In this type of lighting the light from the source falls directly on the object or the surface to be illuminated.

A direct and aimed general lighting produces an even illumination on the horizontal working plane. The architecture is visible and it is possible to orientate oneself and work in the room.

The directed light produces good modeling and brilliance. The uniformity on the working plane increases as the room height increases or as the beam angle widens. Directed light enables good appreciation of form and surface texture. The visual comfort increases as the cut-off angle increases. A feature of direct illumination is its highly efficient use of energy. At the work place, secondary glare must be taken into consideration.

iii. Semi-direct Lighting

Only 60-90 % of the flux reaches the working plan directly while the rest is reflected to illuminate the ceiling and walls.

iv. Indirect Lighting

In this form of lighting, light dose not reach the surface directly from the source but indirectly as the ceiling work as light source and reflect the light: 90% of light upwards, 10% downwards. An indirect general lighting uses a ceiling, wall or other surface as a secondary reflector. The brighten-ing of these surfaces that delineate the room or area gives an open spatial impression. The diffuse light produces limited shadows and a weak modeling. Using indirect illumination alone gives a lower spatial differentiation. Compared to direct illumination, a considerably higher luminous flux is necessary for achieving the same illuminance on the working plane. The secondary reflector should boast a high reflectance. Direct and secondary glare are extensively avoided.

v. Semi-Indirect Lighting

Like the pervious method but 75% of light upwards and 25% downwards

Lighting terminology

- Light
- Luminous flux (ø) (lm)
- Luminous intensity
- Luminance
- Maintenance factor
- Utilization Factor (UF)

- Depreciation Factor
- Absorption Factor
- Reflection Factor

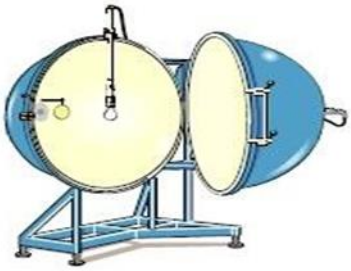
i. Light

The human eye is sensitive for electromagnetic radiation with a wavelength between 380 and 720 nm. If the wavelength is less than 380 nm, it is called ultraviolet light; if the wavelength is higher than 720 nm, it is called infra-red light (thermal radiation).

ii. Luminous flux (ø) (lm)

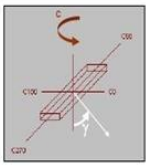
The luminous flux is the amount of visible electromagnetic radiation, measured in lumens (lm).

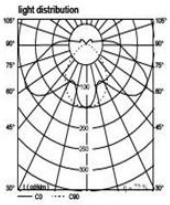
The lamp manufacturers specify the rated luminous flux of their lamps. The luminous flux is expressed in lumens (lm).



iii. Luminous intensity

The luminous intensity always relates to a certain direction and is connected with the operation of reflectors and diffusers. The luminous intensity is the luminous flux radiated in a certain solid angle .divided by this solid angle.





iv. Luminance

Luminance indicates the degree of brightness with which the human eye perceives a light source or an illuminated surface.

v. Maintenance factor

As a result of contamination of the lamp and fixture, plus degradation of the lamp, the luminance reduces in the course of time. This must be taken into account during the lighting design. With normal maintenance, the maintenance factor should be 0.8 or higher.

vi. Utilization Factor (UF)

The utilization factor indicates how well a lighting installation uses the luminous flux of the lamps. This is indicated as the ratio between the luminous flux that reaches the working

plane and the light source of the „bare" lamps, expressed as a percentage.

vii. Depreciation Factor

This is merely the reverse of the maintenance factor and defined as the ratio of initial meter-candles to the ultimate maintained meter-candles on the working plane. Its value is varies from 0.80 to 1.00.

viii. Absorption Factor

It is the ratio of total lumens available after absorption to the total lumens emitted by the source of light. Its value varies from unity for clean atmosphere to 0.50 for foundries.

ix. Reflection Factor

It is the ratio of reflected light to the incident light. It is always less than unity.

Factors affecting the intensity of illumination

There are many factors that affect the intensity of light at the design , these factors AS the accumulation of dust on the surfaces of light with the passage of time and also Room type affects the distribution of lighting because the intensity of the lighting in the bathrooms differ from the bedrooms and offices also in the office the distance from the work surface and lighting affects the intensity of illumination and also the colors of the walls in the room and background affect on the intensity and type of lighting and the foundation and its size of the rooms in all of these factors affect it and

the degree of intensity of illumination and should be taken in consideration when styling.

Sources of lighting

i. *Natural sources*

- Sun (direct & indirect)
- Wind (indirect).

The main advantages of natural sources are the clean and available.

ii. Artificial Light sources

- Filament lamps
- Gas Discharge lamps

Filament lamps:

i. Incandescent
ii. Halogen
iii. Reflector

Gas Discharge lamps:

i. Fluorescent lamps
ii. High pressure sodium lamps
iii. Low pressure sodium lamps
iv. Metal halide lamp

Note:

Most of projects in Egypt use luminaires lux according to Egyptian standard.

ملحق رقم (م1) :معايير شدة الإضاءة

جدول رقم (م1): مستوى شدة الإضاءة فى الفراغات المختلفة للمبانى

المكان		شدة الإضاءة (لوكس)
المبانى السكنية	سـلالم	120
	ممرات	60
	غرفة معيشة :	
	عـام	150
	قراءة	300
	غرفة طعام	120
	غرفة نوم	120
	مطبـخ :	
	عام	120
	أسطح العمل	500
	حمام	300
	حجرة مكتب :	
	- عام	300
	- سطح المكتب	500

Using software program (Dialux)

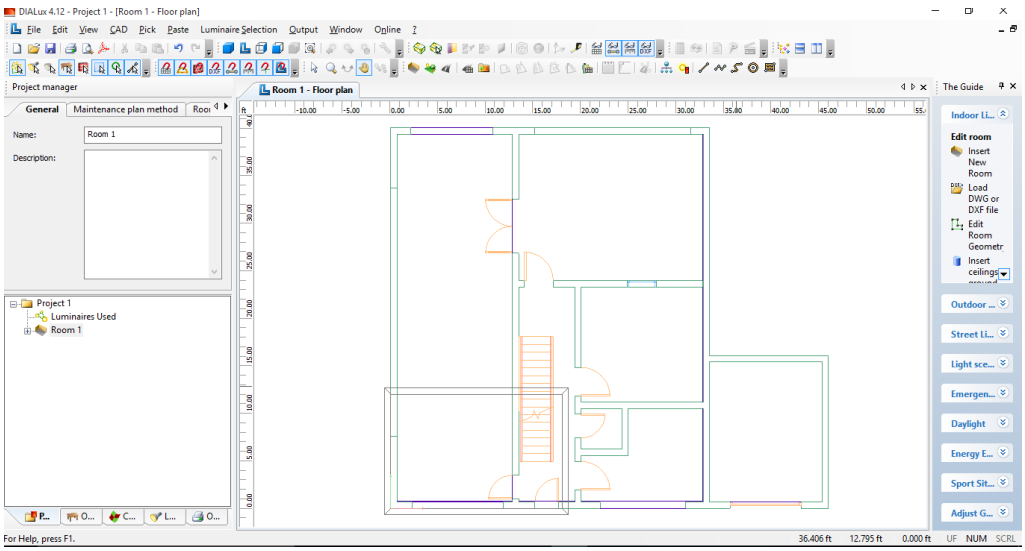
In this method we use a software program (Dialux) to make the required calculations to get the number of lamps and their spacing layout for specified room by using data given by the user such as:

- Room dimensions.
- Types of luminaires to be used.
- The value of illumination required.
- Reflection factors of walls, ceiling and floor.
- Maintenance factors for the lamp.
- Working plane height…etc.

Dialux steps

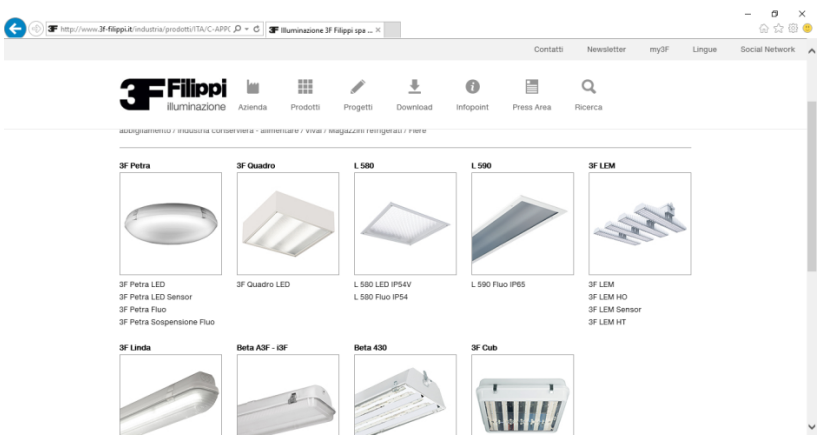
(1) Choose the intensity of lighting rooms by the Egyptian code from the table shown below.

(2) We import the cad design on the dialux to take the room diminution as shown below.

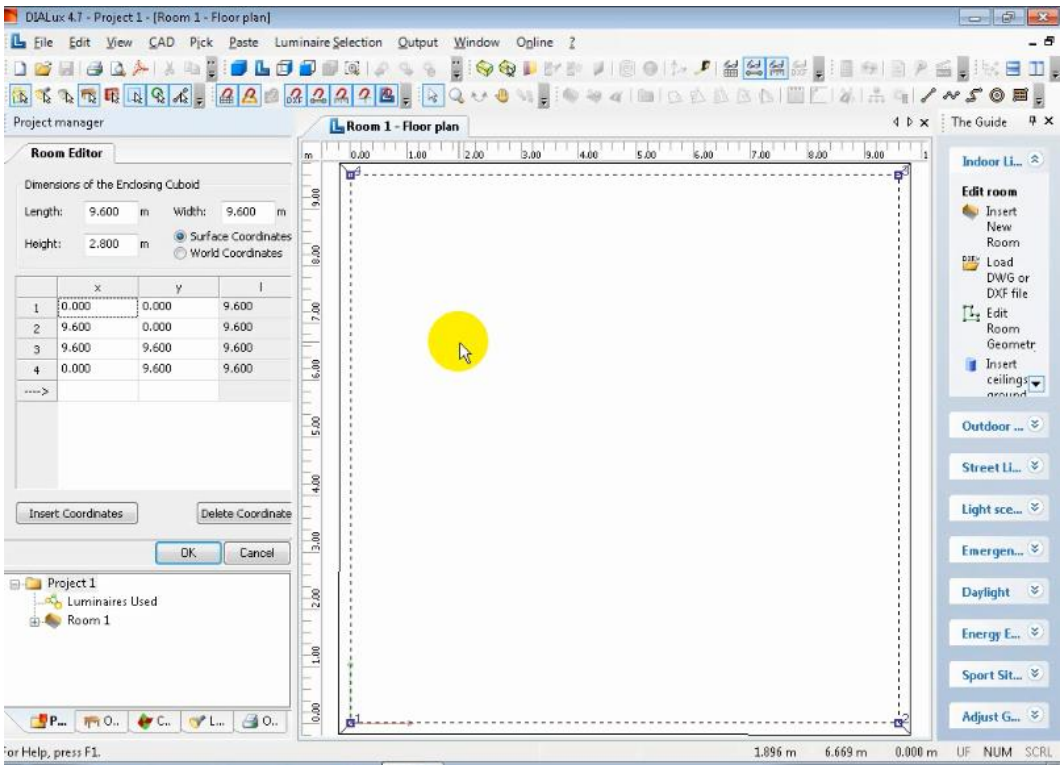


(3) Open catalog files of the company which we will deal with it to choose and know codes and names of bulbs which will be used in interior lighting for the room as on the picture.

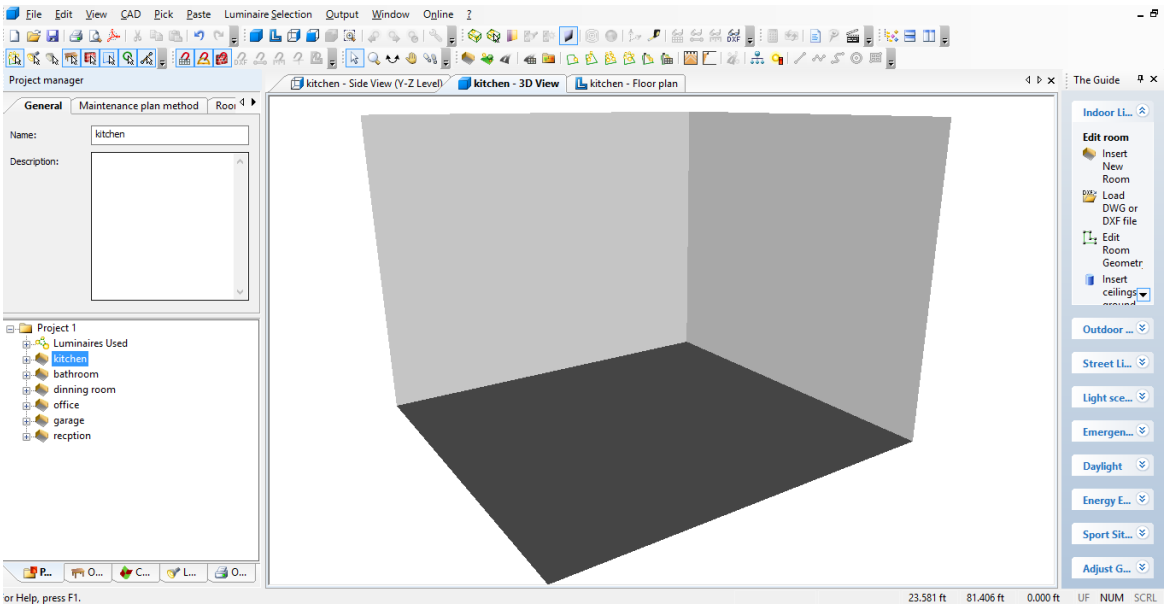
We will use 3F catalog and we will download it to choose bulbs we will use.



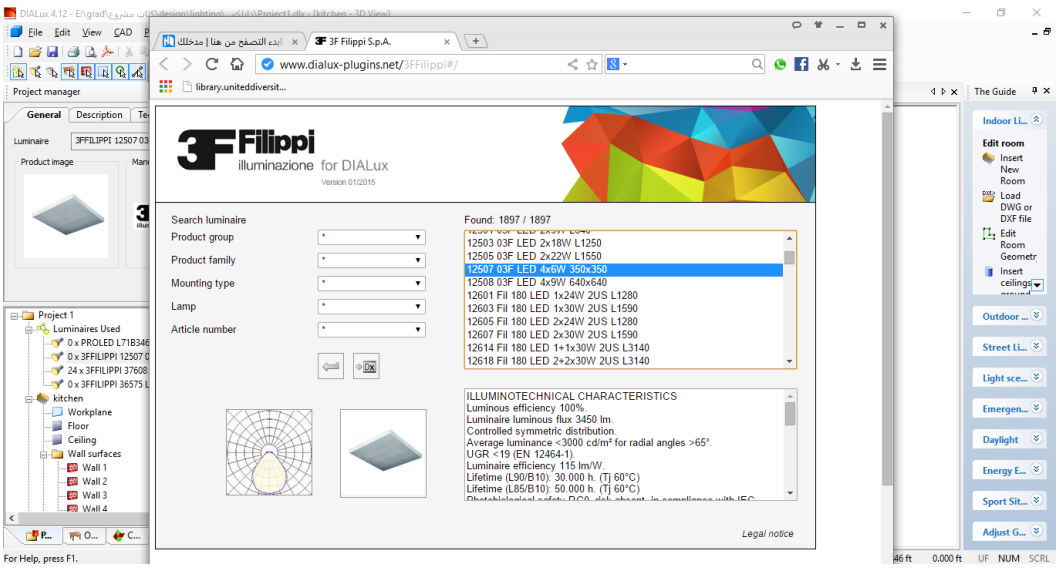
(4) open character of the program and draft pick interior lighting to open the page shown below



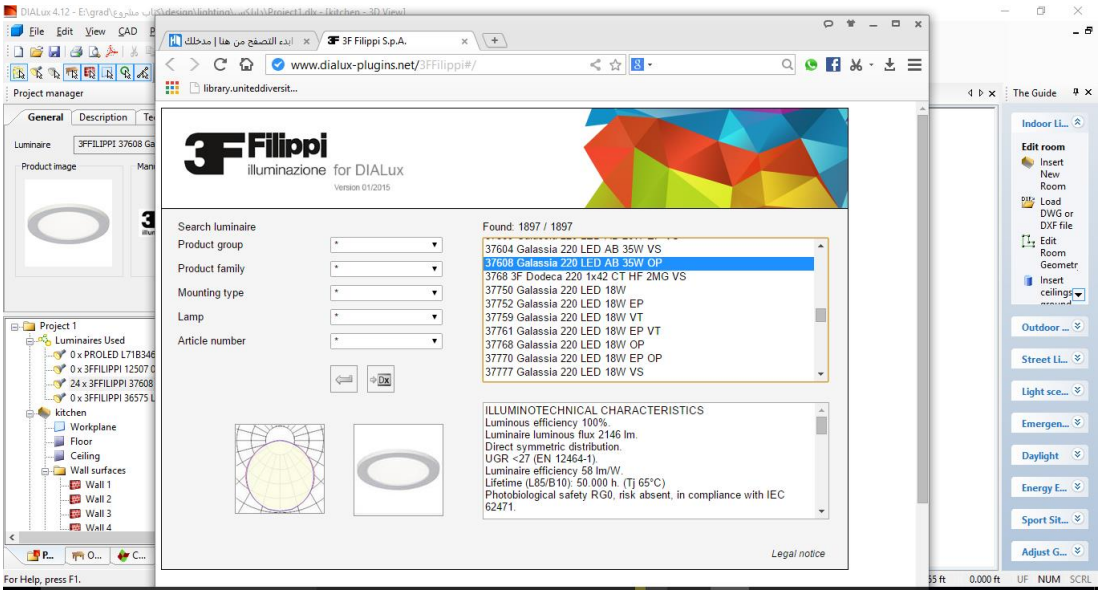
(5) After entering the dimensions of the room and once you enter the room dimensions and approval is the appearance of a room on the work surface and as described.



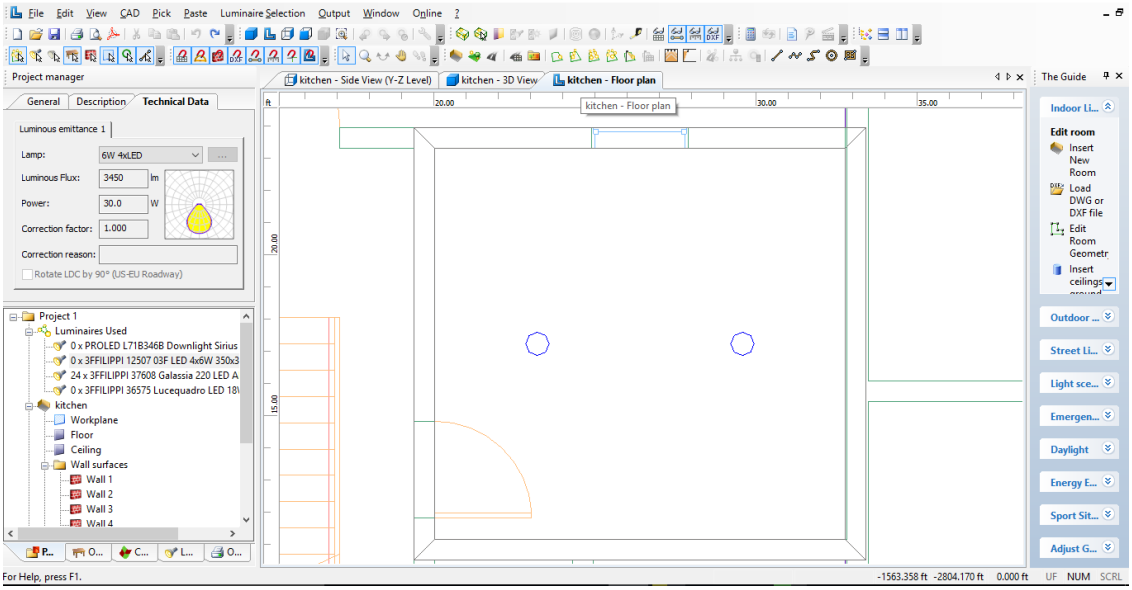
(6) From the list of luminaire selection choose catalog company, which will deal with it and we took from them bulbs code in the previous step and catalog will appear as shown us the name



(7) Enter the required lamps and interior lighting, and choose her as the codes that have been previously identified and are approved intervened automatically to the program



8-Go back to the status of the project or the room you want to regulate the intensity of the light bulbs, and we choose to be used, then the income and to list and define the intensity of room lighting and then click on Ok appears distribution of lighting in the room.



(9) Enter the project list and choose the name of the room, including the summary and choose the type of lighting and the list is shown for each required and we will show in the file summary of the results of our project.

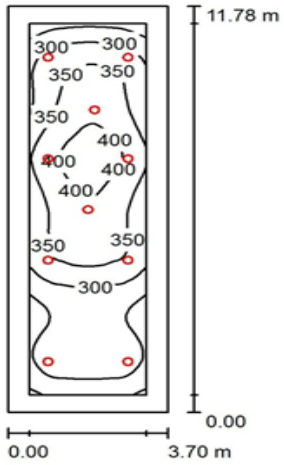
Note:

- Our project consists of two floors every floor consists of many rooms we will using data given and layout for the dialux to calculation number of lamps we will use.
- The program give us pdf file of all calculations.
- We will show the summary of first floor as the second floor is the same as the first.

First floor consists of:

- Reception
- Dining room
- Kitchen
- Office
- Bathroom
- Garage

Reception Summary



Height of Room: 3.000 m, Maintenance factor: 0.80 Values in Lux, Scale 1:152

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0
Workplane	/	323	190	421	0.588
Floor	20	250	136	339	0.543
Ceiling	70	67	44	80	0.647
Walls (4)	50	161	50	335	/

Workplane:
Height: 0.750 m
Grid: 32 x 128 Points
Boundary Zone: 0.500 m
Illuminance Quotient (according to LG7): Walls / Working Plane: 0.523, Ceiling / Working Plane: 0.209.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	10	3FFILIPPI 37608 Galassia 220 LED AB 35W OP (1.000)	2146	2146	37.0
			Total: 21460	Total: 21460	370.0

Specific connected load: 8.49 W/m² = 2.63 W/m²/100 lx (Ground area: 43.59 m²)

Reception Luminaire parts list

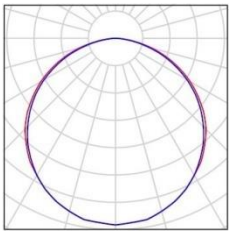
10 Pieces 3FFILIPPI 37608 Galassia 220 LED AB 35W OP

Article No.: 37608

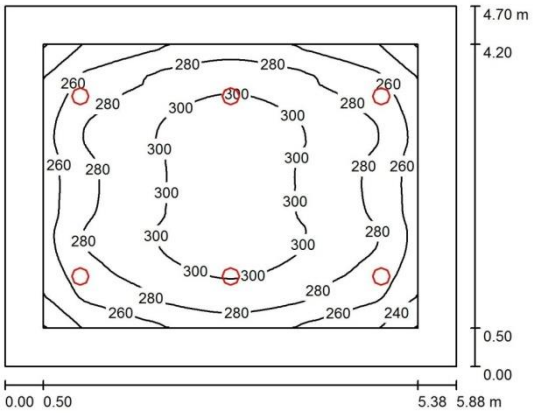
Luminous flux (Luminaire): 2146 lm Luminous flux (Lamps): 2146 lm Luminaire Wattage: 37.0 W

Luminaire classification according to CIE: 100 CIE flux code: 46 78 96 100 100

Fitting: 1 x 35W 1xLED C (Correction Factor 1.000).



Dinning roomSummary



Height of Room: 3.000 m, Mounting Height: 3.151 m, Maintenance factor: 0.80 — Values in Lux, Scale 1:61

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0
Workplane	/	282	219	314	0.779
Floor	20	217	145	263	0.671
Ceiling	70	65	49	76	0.749
Walls (4)	50	155	60	259	/

Workplane:
Height: 0.750 m
Grid: 64 x 64 Points
Boundary Zone: 0.500 m

UGR (CIE, SHR = 1.00.)

	Lengthways-	Across
Left Wall	24	24
Lower Wall	25	25

to luminaire axis

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.592, Ceiling / Working Plane: 0.231.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	6	3FFILIPPI 37608 Galassia 220 LED AB 35W OP (1.000)	2146	2146	37.0
			Total: 12876	Total: 12876	222.0

Specific connected load: 8.03 W/m² = 2.85 W/m²/100 lx (Ground area: 27.64 m²)

Dinning room Luminaire parts list

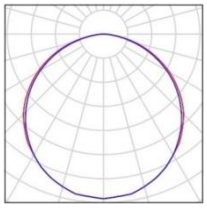
6 Pieces 3FFILIPPI 37608 Galassia 220 LED AB 35W OP

Article No.: 37608

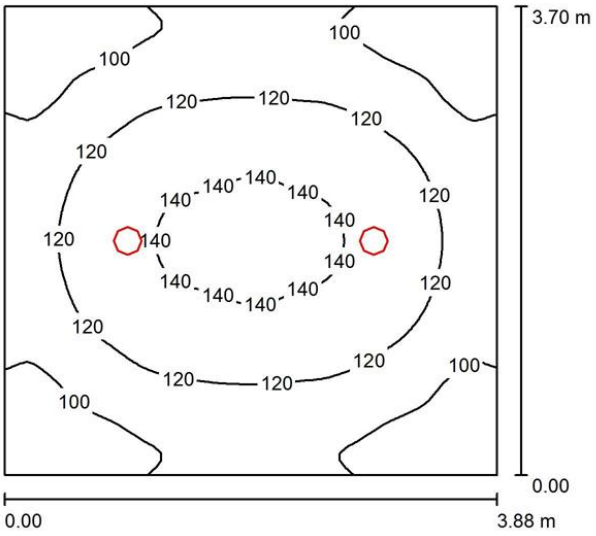
Luminous flux (Luminaire): 2146 lm Luminous flux (Lamps): 2146 lm Luminaire Wattage: 37.0 W

Luminaire classification according to CIE: 100 CIE flux code: 46 78 96 100 100

Fitting: 1 x 35W 1xLED C (Correction Factor 1.000).



Kitchen Summary



Height of Room: 3.000 m, Mounting Height: 3.151 m, Maintenance factor: 0.80 — Values in Lux, Scale 1:48

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0
Workplane	/	115	78	144	0.681
Floor	20	115	78	144	0.676
Ceiling	70	37	24	47	0.649
Walls (4)	50	85	31	223	/

Workplane:
Height: 0.000 m
Grid: 64 x 64 Points
Boundary Zone: 0.000 m

UGR (CIE, SHR = 1.00.)

	Lengthways-	Across	to luminaire axis
Left Wall	23	22	
Lower Wall	23	22	

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.736, Ceiling / Working Plane: 0.326.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	2	3FFILIPPI 37608 Galassia 220 LED AB 35W OP (1.000)	2146	2146	37.0
			Total: 4292	Total: 4292	74.0

Specific connected load: 5.15 W/m² = 4.48 W/m²/100 lx (Ground area: 14.36 m²)

Kitchen Luminaire parts list

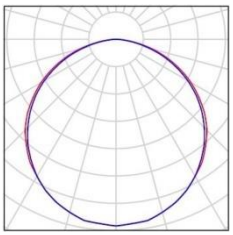
2 Pieces 3FFILIPPI 37608 Galassia 220 LED AB 35W OP

Article No.: 37608

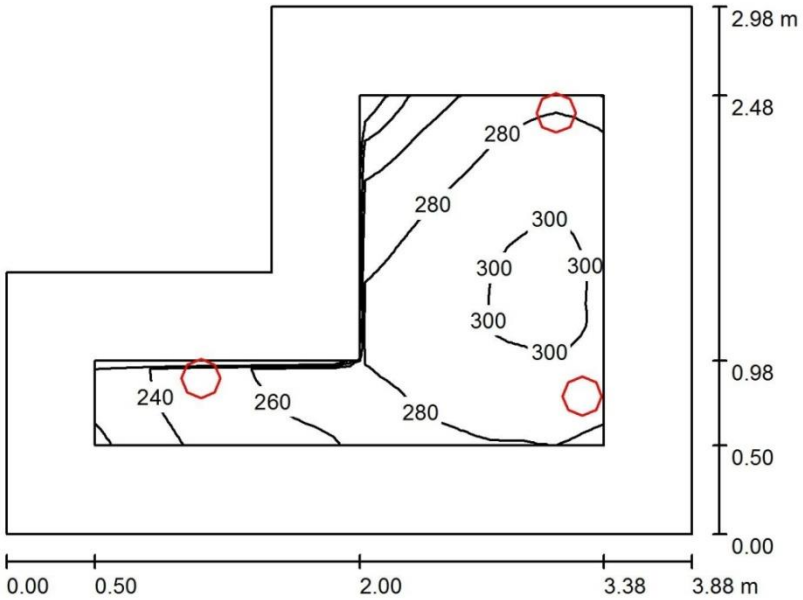
Luminous flux (Luminaire): 2146 lm Luminous flux (Lamps): 2146 lm Luminaire Wattage: 37.0 W

Luminaire classification according to CIE: 100 CIE flux code: 46 78 96 100 100

Fitting: 1 x 35W 1xLED C (Correction Factor 1.000).



Office Summary



Height of Room: 3.000 m, Mounting Height: 3.151 m, Maintenance factor: 0.80 Values in Lux, Scale 1:39

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0
Workplane	/	278	207	306	0.747
Floor	20	184	122	222	0.666
Ceiling	70	86	57	139	0.655
Walls (6)	50	171	61	581	/

Workplane:
Height: 0.750 m
Grid: 32 x 32 Points
Boundary Zone: 0.500 m
Illuminance Quotient (according to LG7): Walls / Working Plane: 0.713, Ceiling / Working Plane: 0.311.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	3	3FFILIPPI 37608 Galassia 220 LED AB 35W OP (1.000)	2146	2146	37.0
			Total: 6438	Total: 6438	111.0

Specific connected load: 11.92 W/m² = 4.29 W/m²/100 lx (Ground area: 9.31 m²)

Office Luminaire parts list

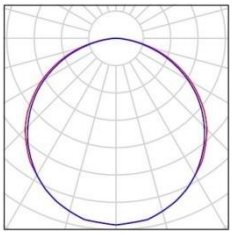
3 Pieces 3FFILIPPI 37608 Galassia 220 LED AB 35W OP

Article No.: 37608

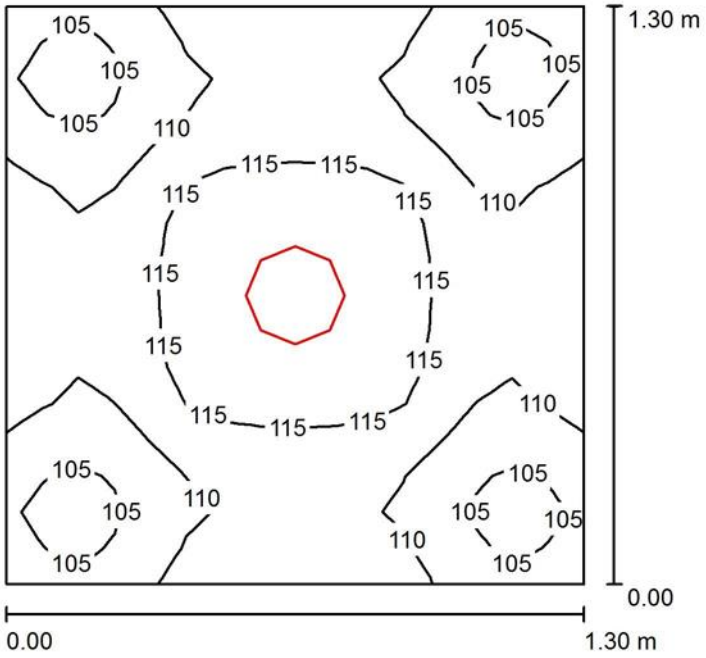
Luminous flux (Luminaire): 2146 lm Luminous flux (Lamps): 2146 lm Luminaire Wattage: 37.0 W

Luminaire classification according to CIE: 100 CIE flux code: 46 78 96 100 100

Fitting: 1 x 35W 1xLED C (Correction Factor 1.000).



Bathroom Summary



Height of Room: 3.000 m, Mounting Height: 3.151 m, Maintenance factor: 0.80 — Values in Lux, Scale 1:17

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0
Workplane	/	111	101	118	0.913
Floor	20	111	102	119	0.920
Ceiling	70	135	96	153	0.710
Walls (4)	50	192	47	556	/

Workplane:
Height: 0.000 m
Grid: 16 x 16 Points
Boundary Zone: 0.000 m

Illuminance Quotient (according to LG7): Walls / Working Plane: 1.737, Ceiling / Working Plane: 1.218.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	1	3FFILIPPI 37608 Galassia 220 LED AB 35W OP (1.000)	2146	2146	37.0
			Total: 2146	Total: 2146	37.0

Specific connected load: 21.89 W/m² = 19.74 W/m²/100 lx (Ground area: 1.69 m²)

Bathroom Luminaire parts list

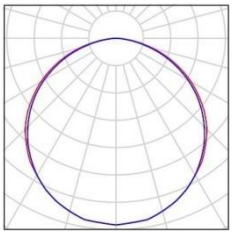
1 Pieces 3FFILIPPI 37608 Galassia 220 LED AB 35W OP

Article No.: 37608

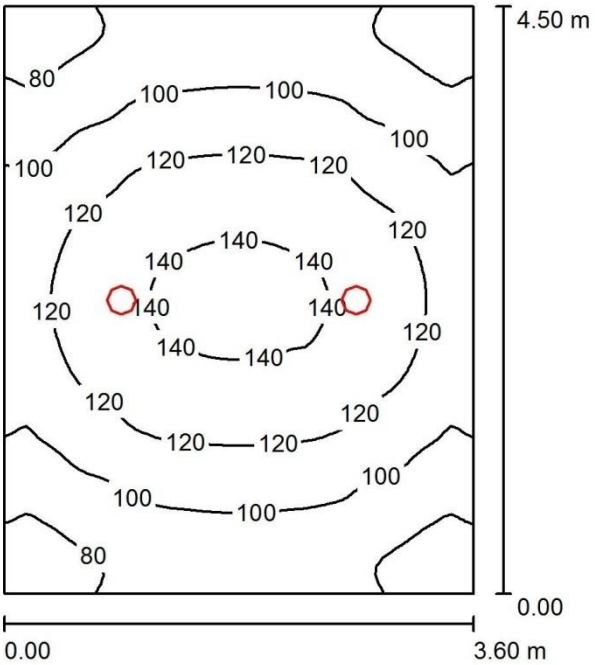
Luminous flux (Luminaire): 2146 lm Luminous flux (Lamps): 2146 lm Luminaire Wattage: 37.0 W

Luminaire classification according to CIE: 100 CIE flux code: 46 78 96 100 100

Fitting: 1 x 35W 1xLED C (Correction Factor 1.000).



Garage Summary



Height of Room: 3.000 m, Mounting Height: 3.151 m, Maintenance factor: 0.80 Values in Lux, Scale 1:58

Surface	ρ [%]	E_{av} [lx]	E_{min} [lx]	E_{max} [lx]	u0
Workplane	/	108	68	145	0.627
Floor	20	108	70	145	0.651
Ceiling	70	34	20	47	0.600
Walls (4)	50	76	26	261	/

Workplane:
Height: 0.000 m
Grid: 64 x 64 Points
Boundary Zone: 0.000 m

UGR Lengthways- Across to luminaire axis
Left Wall 23 22
Lower Wall 23 22
(CIE, SHR = 1.00.)

Illuminance Quotient (according to LG7): Walls / Working Plane: 0.704, Ceiling / Working Plane: 0.314.

Luminaire Parts List

No.	Pieces	Designation (Correction Factor)	Φ (Luminaire) [lm]	Φ (Lamps) [lm]	P [W]
1	2	3FFILIPPI 37608 Galassia 220 LED AB 35W OP (1.000)	2146	2146	37.0
			Total: 4292	Total: 4292	74.0

Specific connected load: 4.57 W/m² = 4.22 W/m²/100 lx (Ground area: 16.20 m²)

Garage Luminaire parts list

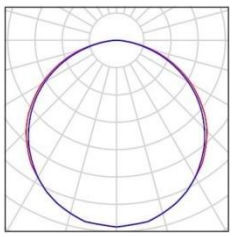
2 Pieces 3FFILIPPI 37608 Galassia 220 LED AB 35W OP

Article No.: 37608

Luminous flux (Luminaire): 2146 lm Luminous flux (Lamps): 2146 lm Luminaire Wattage: 37.0 W

Luminaire classification according to CIE: 100 CIE flux code: 46 78 96 100 100

Fitting: 1 x 35W 1xLED C (Correction Factor 1.000).



Lighting specifications:

1) All lighting wires are of 3*3 mm^2 copper, insulated by PVC/PVC, protected by 10A C.B and the provided circuit loading limited by 2000VA.

Luminaires lux according to Egyption standard.

2) luminaires specifications:

For programmed calculations using dialux program, uniform factor (U_o=Emin/Emax) for uniform rooms must be greater than 0.5.

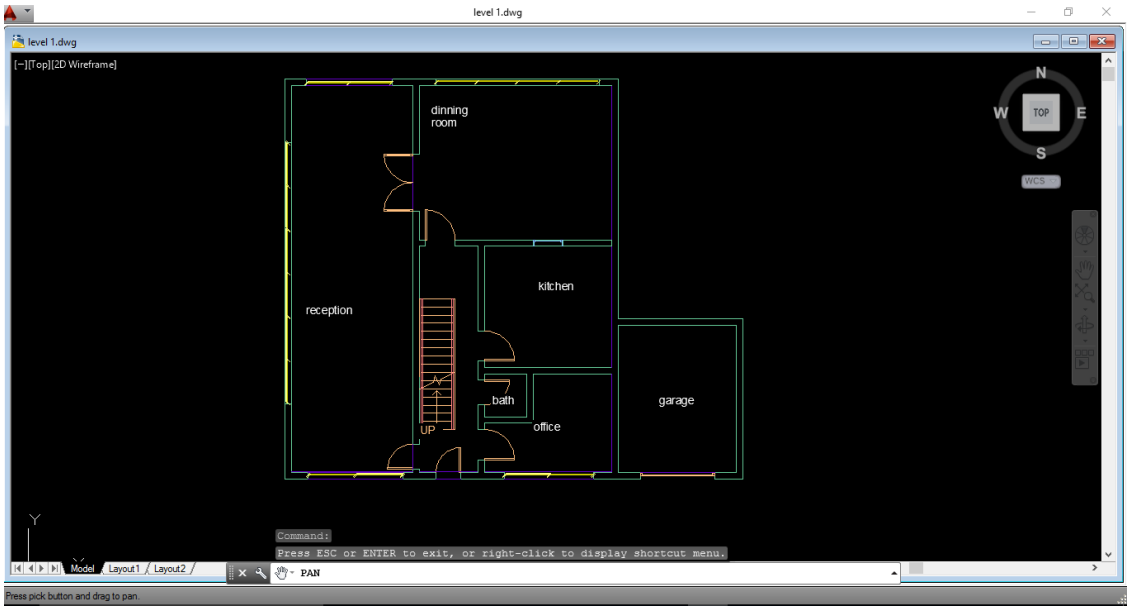
3) Catalogues of luminaires used in our project:

1) Philips
2) ERCO
3) Wila
4) 3F

Relation between autocad and dialux

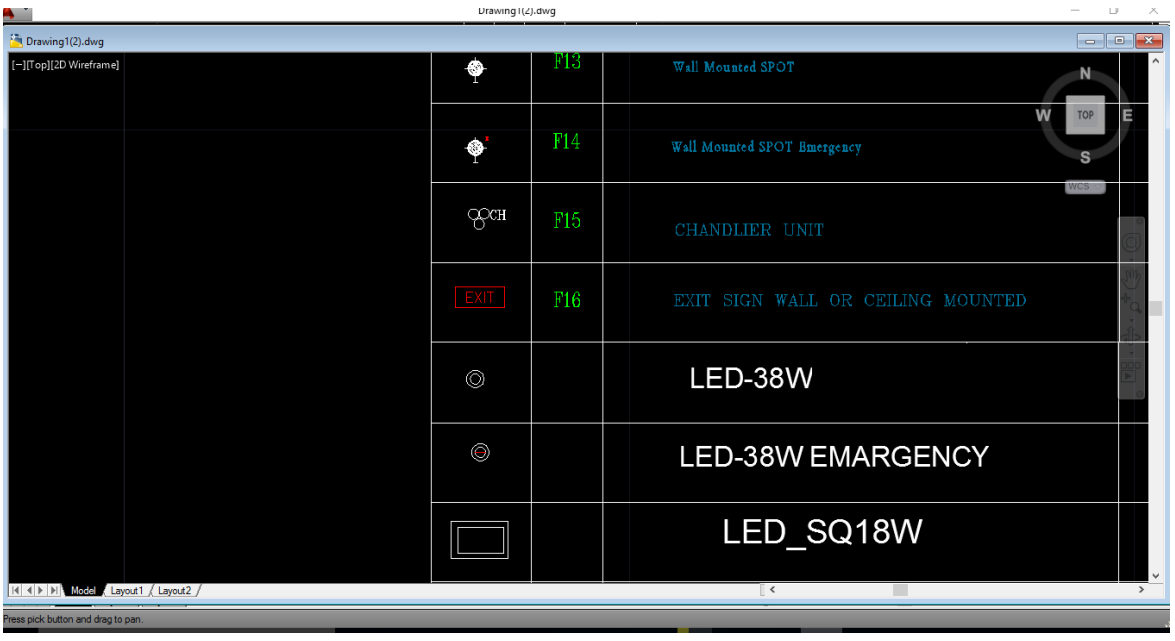
After the completion of dialux program we used autocad software through which is clarified everything required in the distribution of lighting for professionals on the application and where cleared places bulbs and there is also exits control panels and its locations and the number of lighting lines and everything related to electrical technician works and show him all the requirements and as it is used in the formulation of single power diagram for the whole building

(1) We take the panel of cad desgin of the structural engineer after design and it will be at this shape .



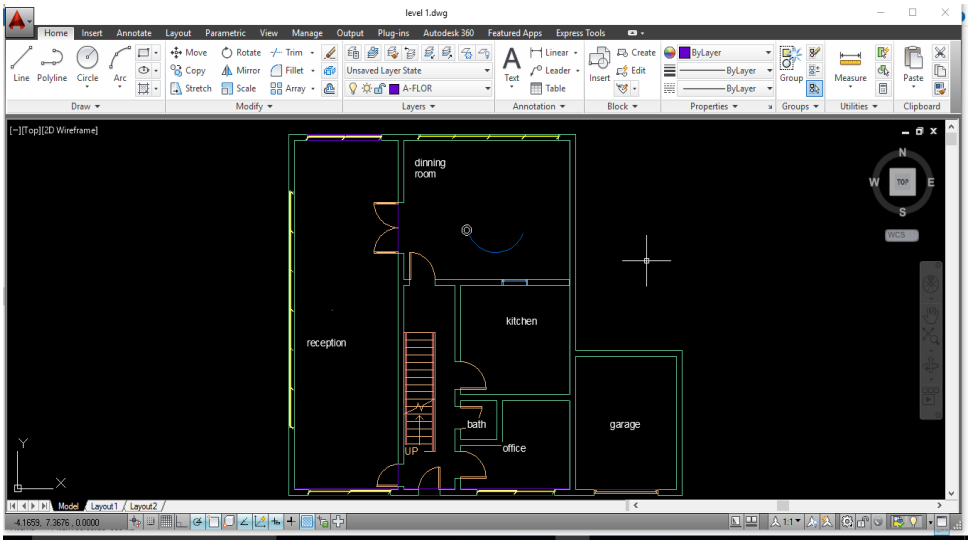
(2) It will Be attached with the file is distributed special illumination required construction office tools

We used on our project this items .

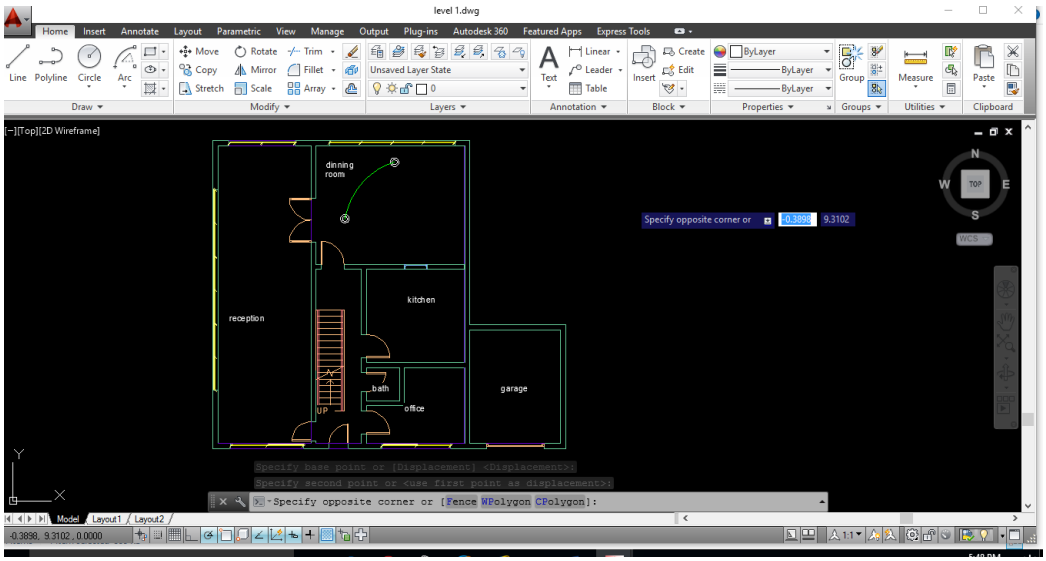


(3) after choosing objects of the attachment show above clearing the lighting steps and al bulbes on cad design as on the next step.

(4) we applied the panels dilaux on cad and then connected between lamps by lines each line has aspecific color determines the line is tye as the blue color represent the normal lighting line.

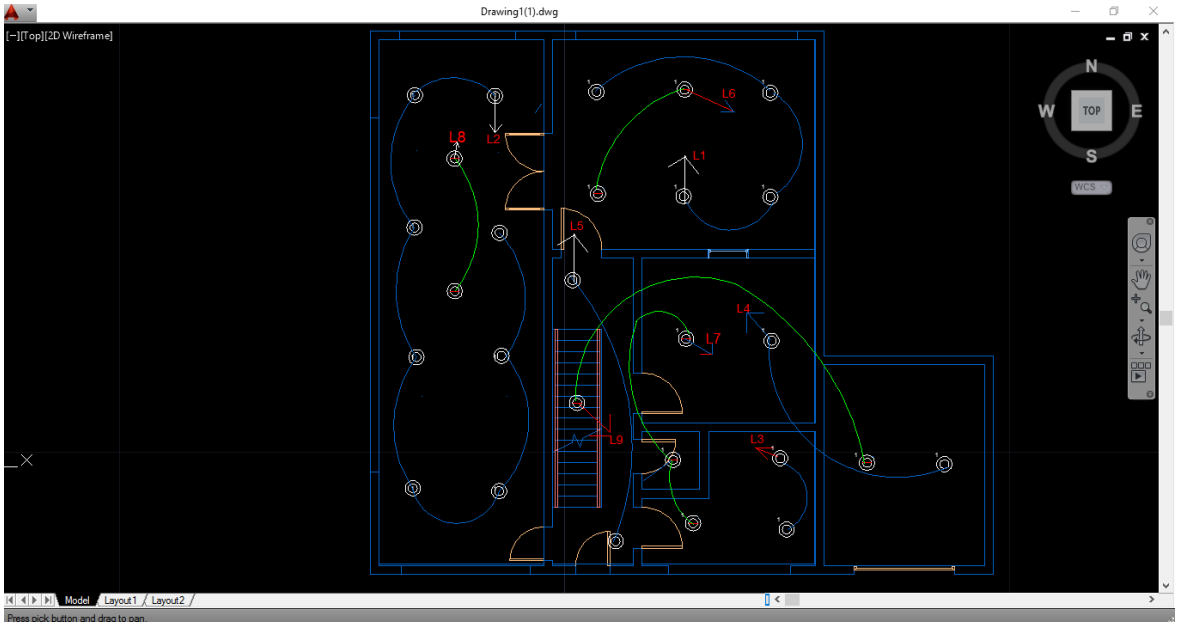


(5) the red color represent emergency light and. And apply this desgin on each afloor like on our project desgin show below .



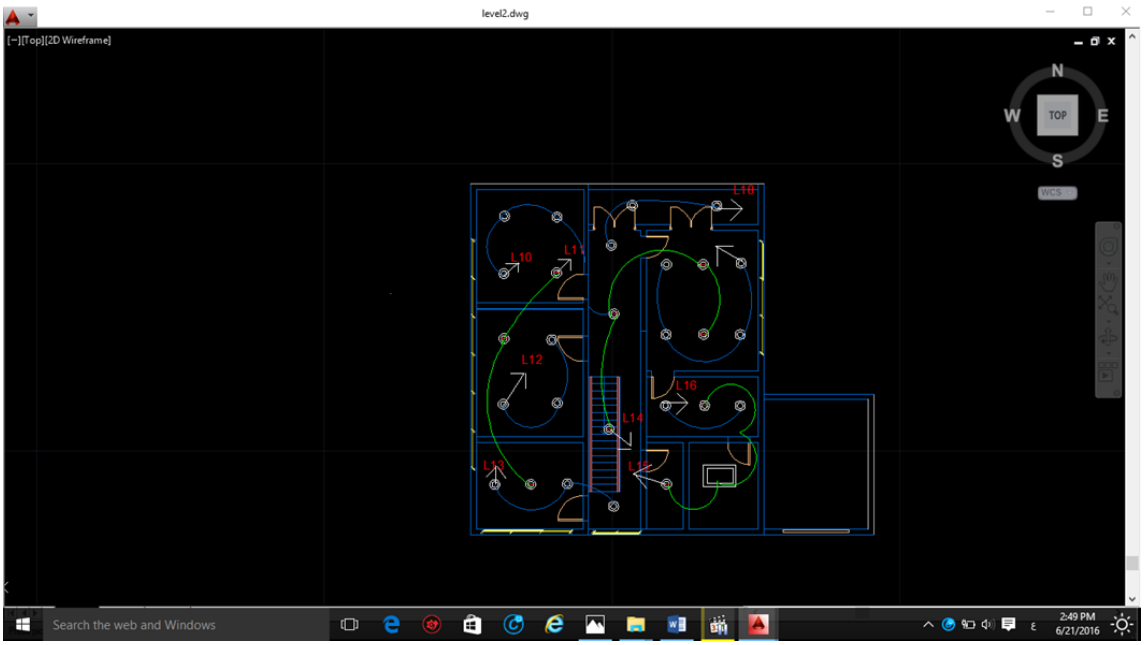
autocad design

1- autocad design for the first floor



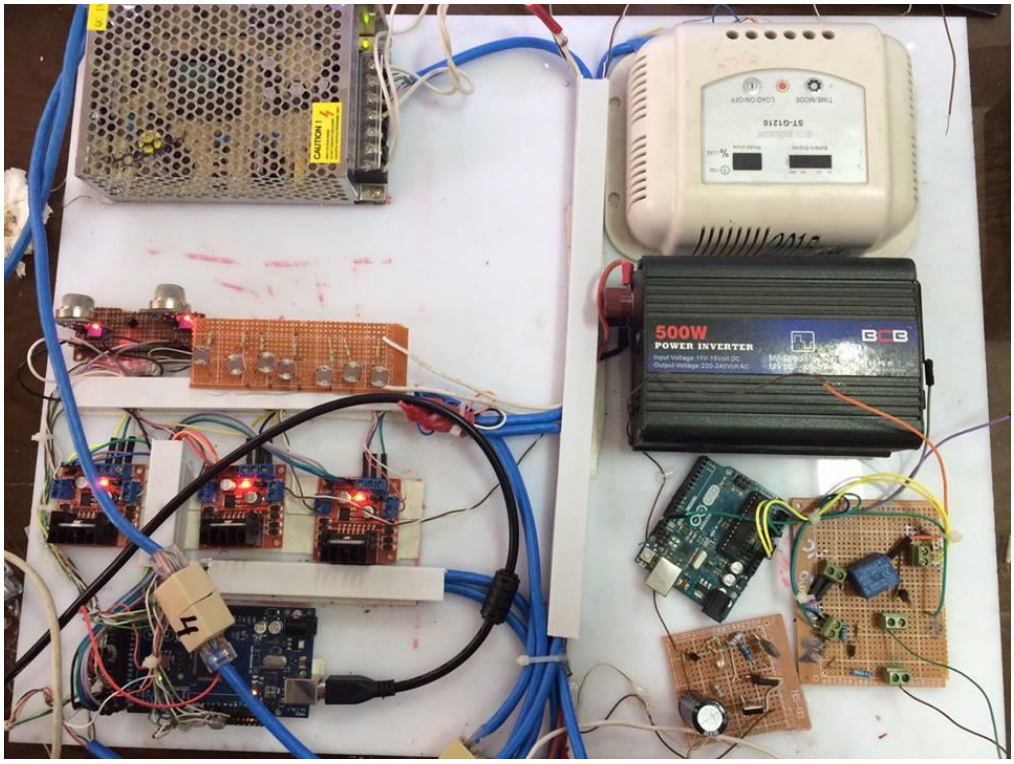
There is in this building a control panel and a number of feeder lines from 1 to 10.

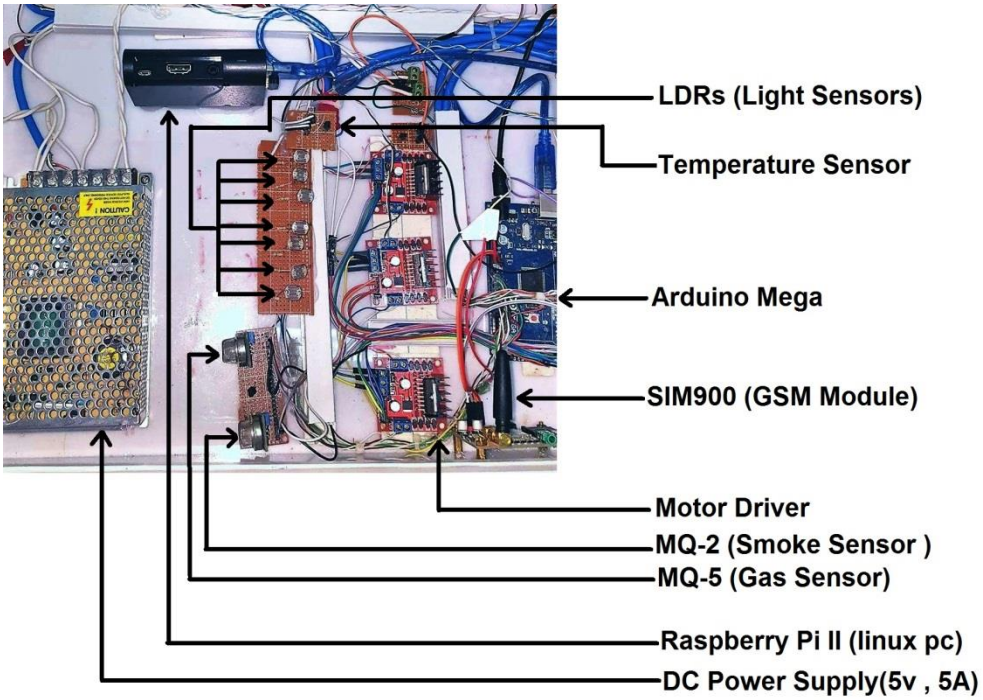
2- autocad design for the second floor

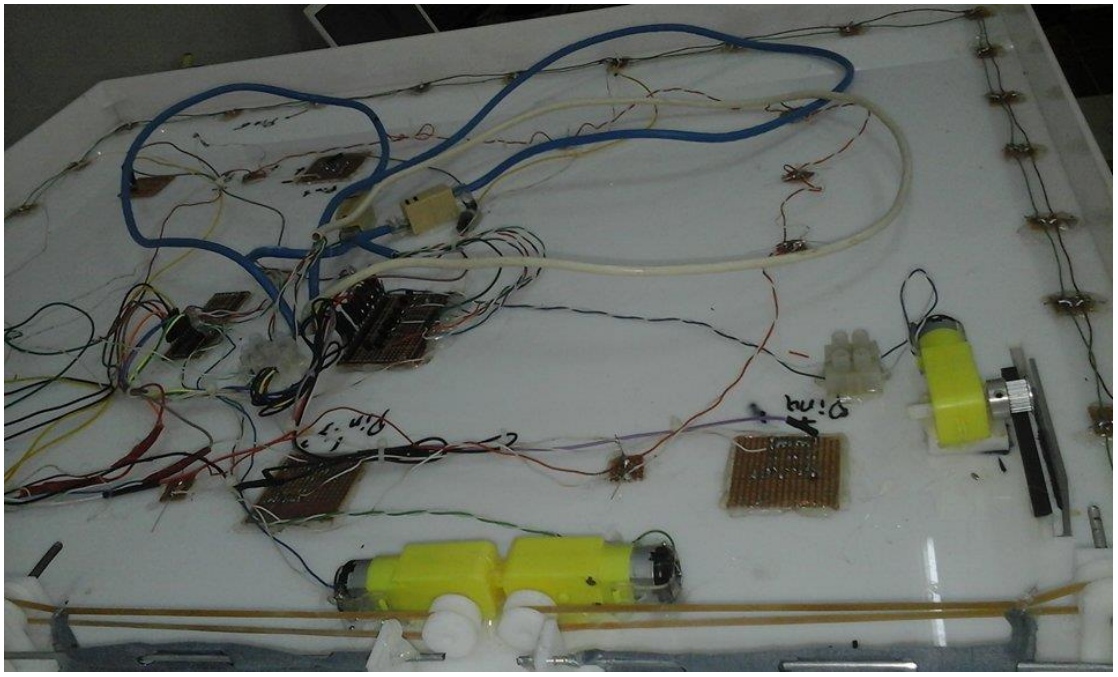


There is in this building a control panel and a number of feeder lines from 11 to 18.

Connections and final result:







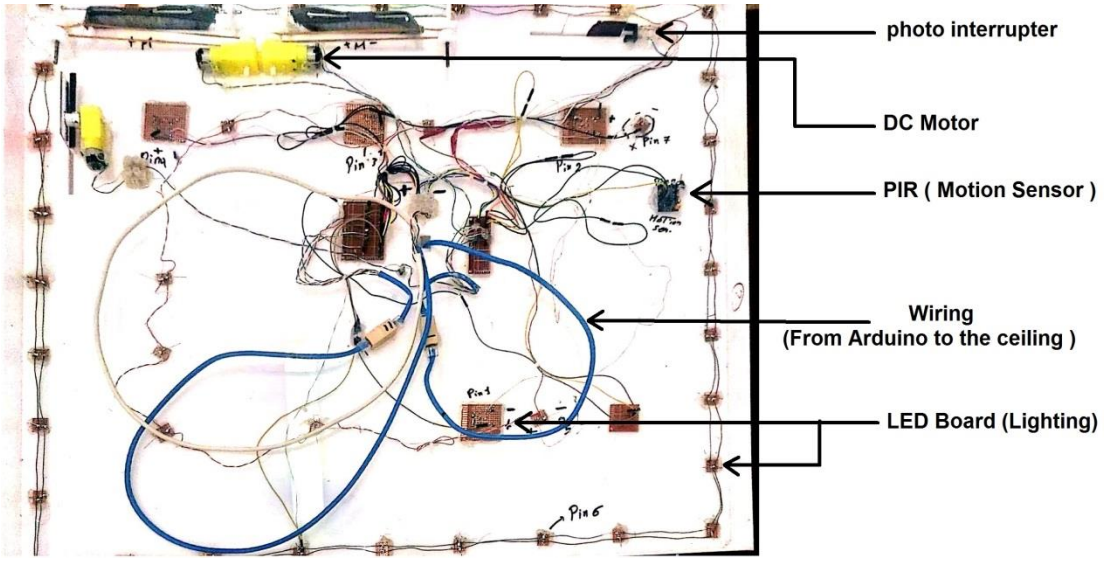
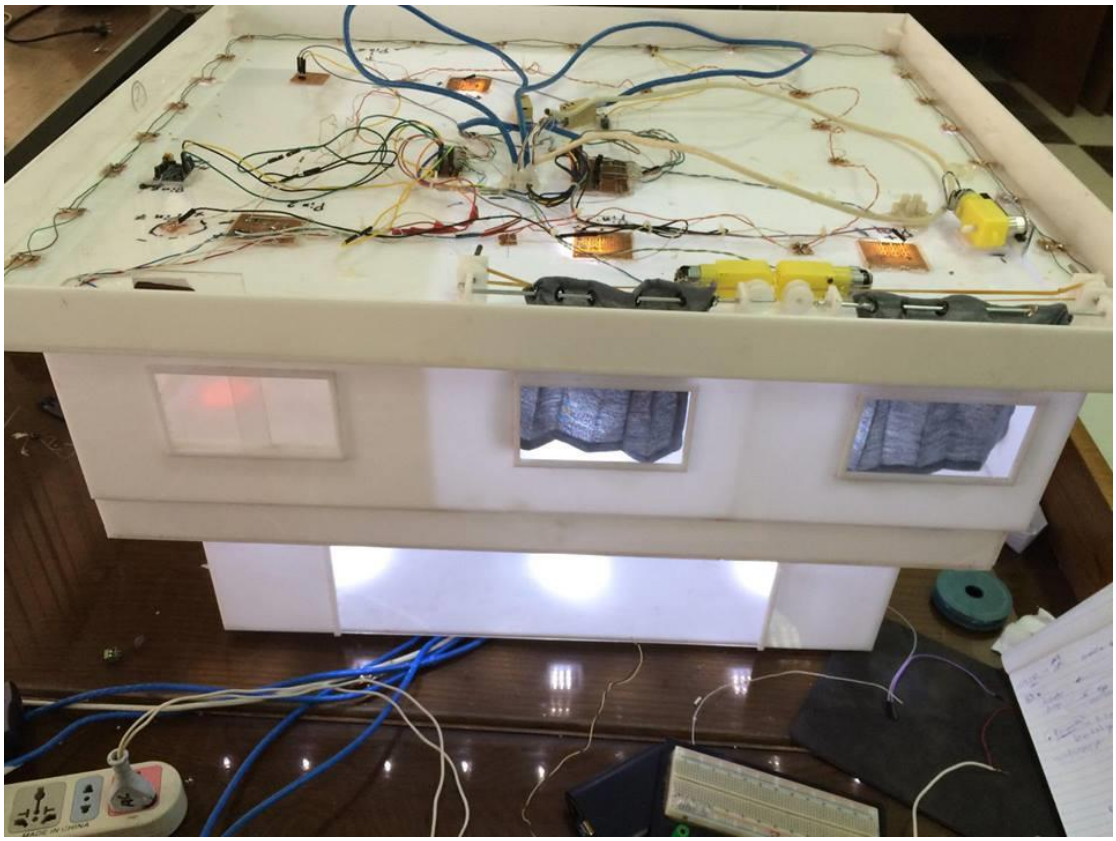


photo interrupter
DC Motor
PIR (Motion Sensor)
Wiring
(From Arduino to the ceiling)
LED Board (Lighting)



Reference:

- https://store.arduino.cc/product/MK00629
- http://pyqt.sourceforge.net/Docs/PyQt4/
- https://github.com/pyserial/pyserial
- stackoverflow.com
- https://www.luminpdf.com/viewer/8ymR85KmZsSyZWNFm
- https://eosweb.larc.nasa.gov/.../text/global_radiation
- https://drive.google.com/file/d/0B3NaAD8stzlIOFc1c0k3cW5QaUE/view?pref=2&