Smart House Project

ELECTRICAL MEASURING INSTRUMENTS

Contents

A smart house project can be classified into many modules three of which we are going to talk about :

1- A temperature-controlled cooling system monitored on an LCD display monitor.

2- A motion sensing circuit for door openers and garages.

3- A light dependent system that will overthrow the manual control of lighting system in houses.

4- A variable power supply that will deliver variable voltage to all necessary modules.

Each module will be specified in detail with components, simulation and datasheet for the used prices.

Introduction

Since the breakthrough of the discovery of semiconductors, the world has been using semiconductor applications endlessly, and why not?. Semiconductors facilitates automatic control in many applications some of which we are going to discuss in this project. Using sensors, relays ,microprocessors, LEDS and many more is used endlessly so we thought of combining a few applications to bring comfort to the regular customer buying a house and we will talk about them in brief.

First: temperature-controlled cooling system module.

High temperature in summer and very low temperature in winter where people have to manually open the air conditioner, or the fan is now a thing of the past. Now you can just adjust an automatic system with the desired temperature range, and it can work independently with the intervention of the user.

Components:

	A	B	C	D	E	F
1	Name	Quantity	Component			
2	U1	1	Temperature Sensor [TMP36]			
3	U8	1	Arduino Uno R3			
4	Rpot3	1	1 kΩ Potentiometer			
5	R3	1	220 Ω Resistor			
6	U9	1	LCD 16 x 2			
7	MFAN	1	DC Motor			
8	R1	1	1 kΩ Resistor			
9	D1	1	Red LED			
10	P2	1	5 , 5 Power Supply			
11	K1	1	Relay SPDT			
12						
13						

Temperature sensor TMP36

What is TMP 36?

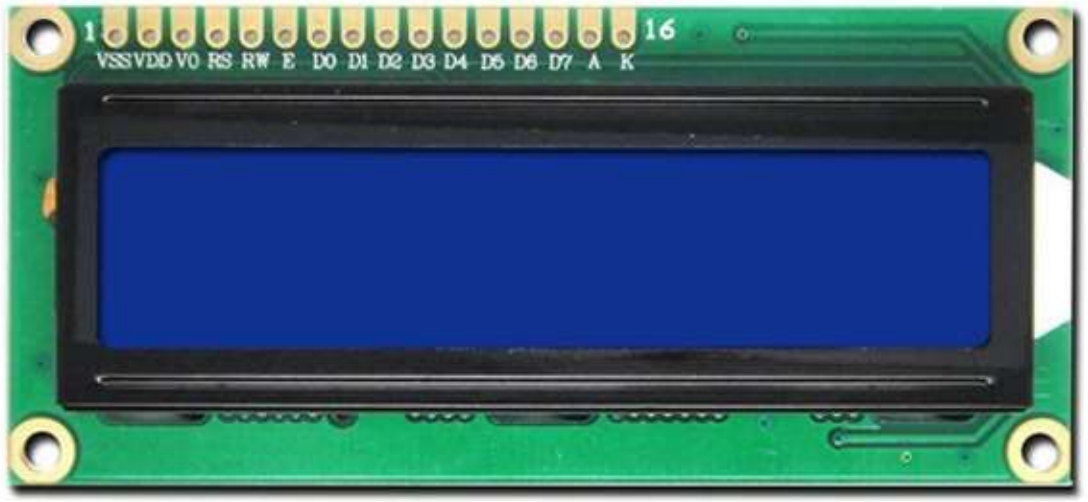
The TMP36 is **a low voltage, precision centigrade temperature sensor**. It provides a voltage output that is linearly proportional to the Celsius temperature. It also doesn't require any external calibration to provide typical accuracies of ±1°C at +25°C and ±2°C over the −40°C to +125°C temperature range.

Arduino UNO R3

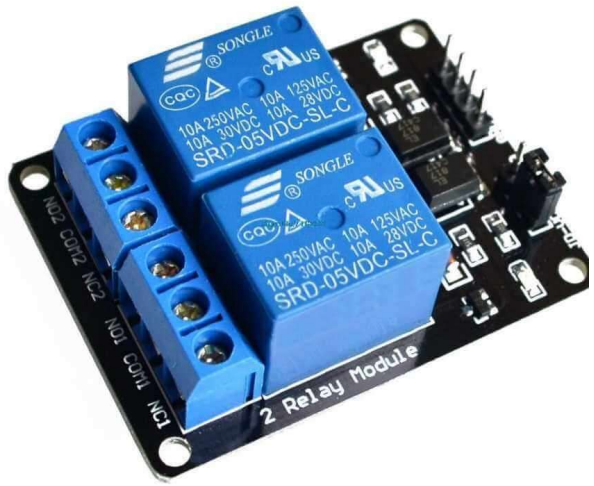
Arduino UNO is a low-cost, flexible, and easy-to-use programmable open-source microcontroller board that **can be integrated into a variety of electronic projects**. This board can be interfaced with other Arduino boards, Arduino shields, Raspberry Pi boards and can control relays, LEDs, servos, and motors as an output.

LCD 16*2 monitor

A 16x2 LCD display is very basic module and is very commonly used in various devices and circuits. A 16x2 LCD means **it can display 16 characters per line and there are 2 such lines**. In this LCD each character is displayed in 5x7 pixel matrix.



Single or Double channel relay

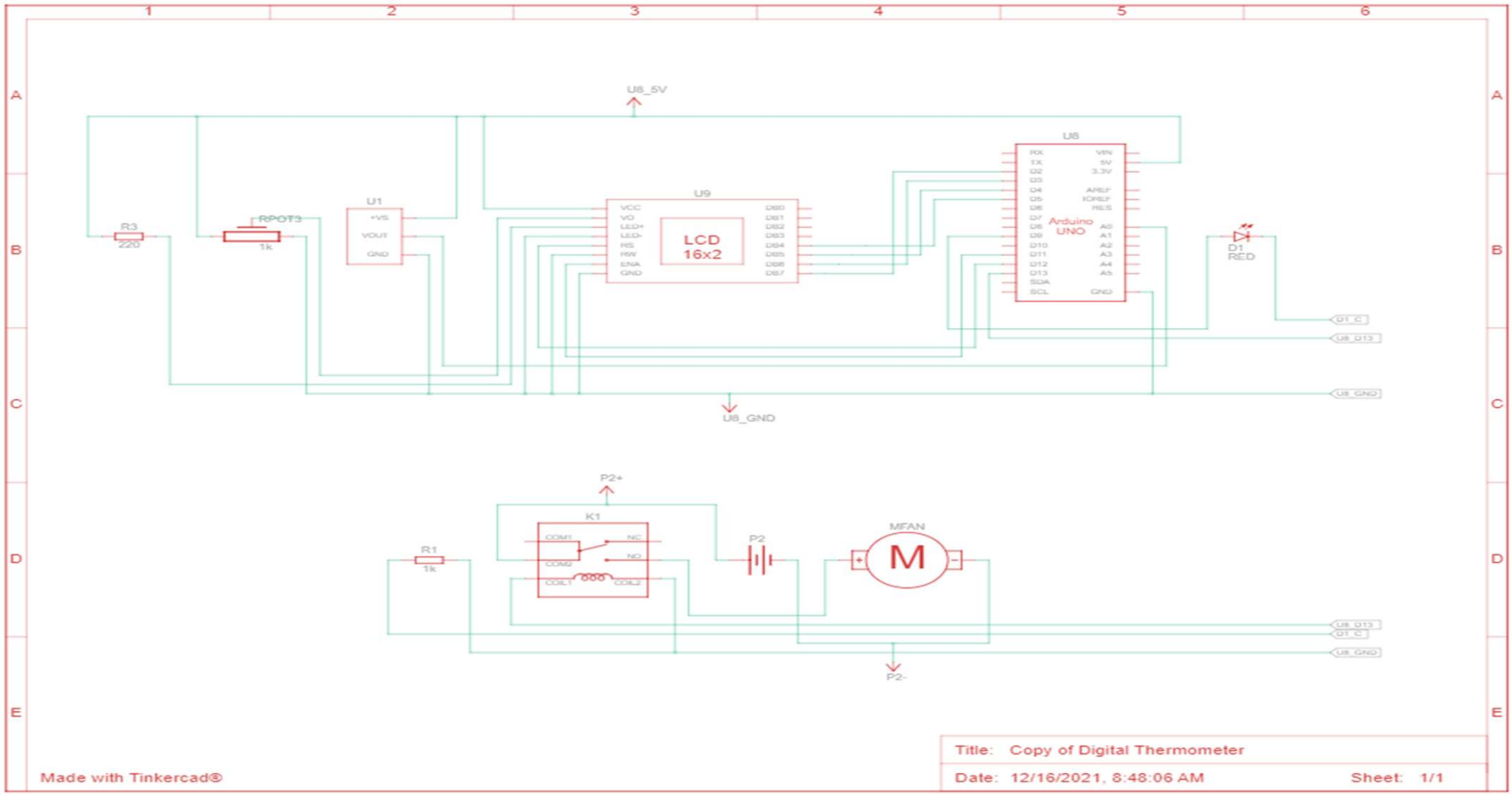


The SPDT Relay(30A) is a **high-quality Single Pole Double Throw Relay**(SPDT). The Relay consists of a coil, 1 common terminal, 1 normally closed terminal, and one normally open terminal. When the coil of the relay is at rest (not energized), the common terminal and the normally closed terminal have continuity. 2-Channel 5V Relay Module is **a relay interface board**, it can be controlled directly by a wide range of microcontrollers such as Arduino, AVR, PIC, ARM and so on. ... Triggering the relay operates the normally open or normally closed contacts. It is frequently used in an automatic control circuit.

Let's walk through the wiring

Other indispensable components like resistors, LEDs, fans and jumper wires etc. are also used for the wiring of the module.

First, a code is programmed on Arduino software to determine the procedures taken and set the desired range of temperatures, where for starters, power coming from the Arduino is installed on the bread board warrying 5 V dc power. Of course, each part is set alone so we add the temperature sensor first connecting the power the ground and the taking the analog output to a pin on the Arduino and monitor the change in temperature once the measured temperature exceeds a certain predetermined value it triggers the lamp to light indicating the increase of temperature and operating the fan that cools the sensor until it drops under the limit. Thus, the fan shuts down ready to be operated once more on similar conditions. The fan tuns on 12 V while the Arduino only gives five that’s why we use the relay that separates the control circuit and power circuit of the fan. Power comes from an external power supply giving 12v and only the control circuit includes the Arduino that controls the relay based upon the desired code.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U8
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U9
R3
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RPOT3
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LCD
16x2
Arduino
UNO
D1
RED
U8_GND
P2+
K1
R1
1k
P2
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Title: Copy of Digital Thermometer
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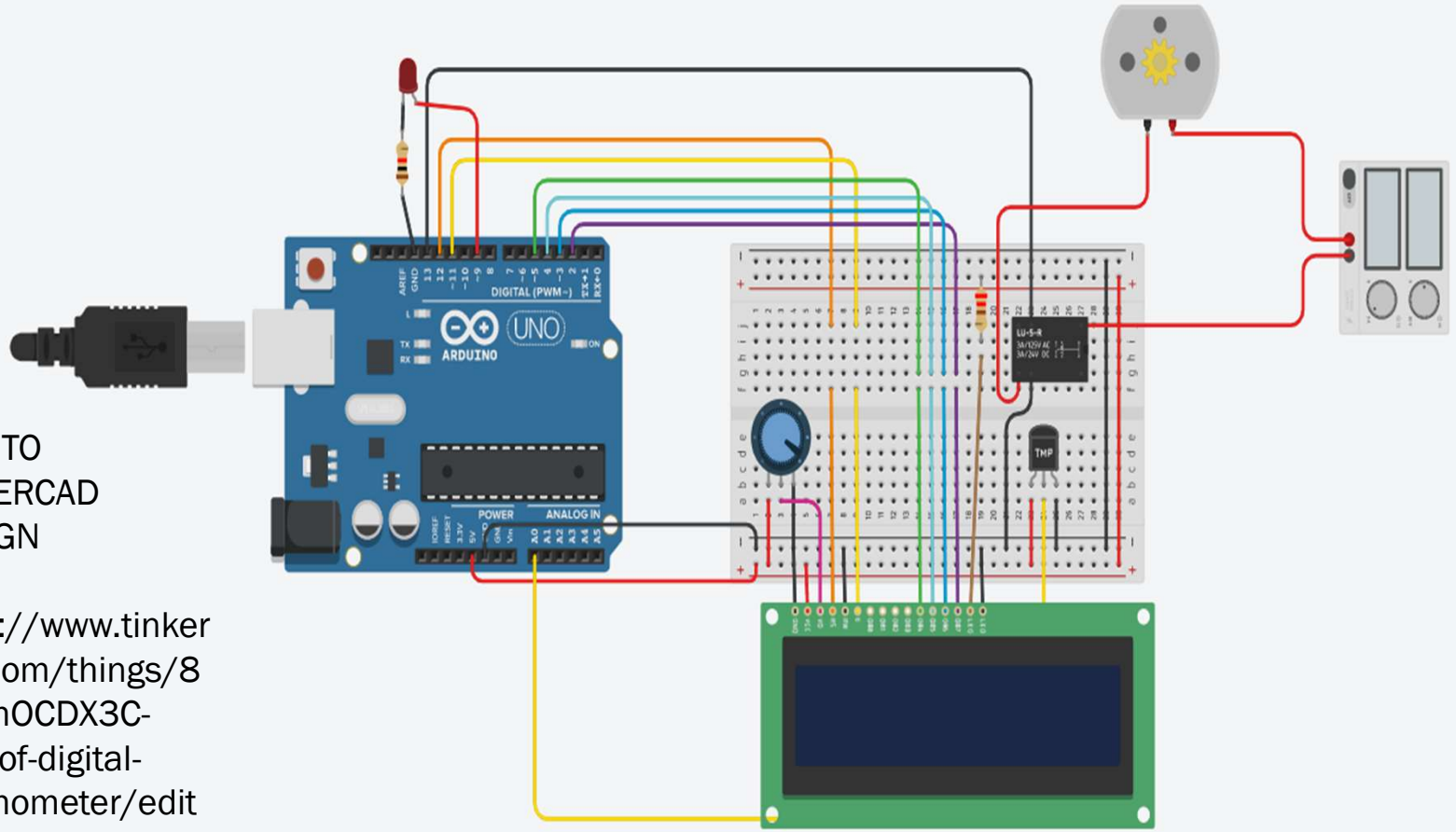


LINK TO TINKERCAD DESIGN

https://www.tinkercad.com/things/846ZmOCDX3C-copy-of-digital-thermometer/editel

A copy of the digital code:

```
// include the library code:
#include <LiquidCrystal.h>

// initialize the library with the numbers of the interface pins
LiquidCrystal lcd(12, 11, 5, 4, 3, 2);
int degree;
double realDegree;
double fahrenhite;
String lcdBuffer;
void setup() {
  // set up the LCD's number of columns and rows:
  pinMode(13,OUTPUT);
  pinMode(10,OUTPUT);
  Serial.begin(9600);
  lcd.begin(16, 2);
  degree = 0;
  realDegree = 0;
  lcd.setCursor(0,0);
  lcd.print("Temp is :");
  digitalWrite(13,LOW);

  // Print a message to the LCD.

}

void loop(){
  lcd.print("                ");
  degree = analogRead(0);
  realDegree = (double)degree/1024;
  realDegree *= 5;
  realDegree -= 0.5;
  realDegree *= 100;
  lcd.setCursor(0,1);
  fahrenhite = (9.0/5)*(realDegree) + 32;
```

```
fahrenhite = (9.0/5)*(realDegree) + 32;

if(realDegree<=29)
{
  digitalWrite(13,HIGH);
  digitalWrite(10,HIGH);


}
if(realDegree>=29)
{
  digitalWrite(13,LOW);
  digitalWrite(10,LOW);


}


String output = String((-1)*realDegree)+String(" ")+"c ," +String((-1)*fahrenhite)+ String(" f");
delay(1000);
lcd.print(output);
Serial.print(output);
Serial.println();


  // set the cursor to column 0, line 1
  // (note: line 1 is the second row, since counting begins with 0):
}
// poteniometer is for contrast of LCD
```

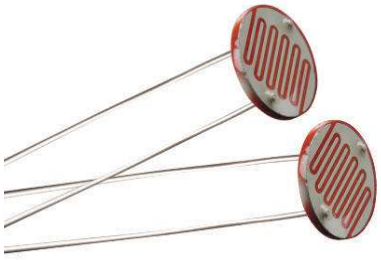
Second : A light dependent system that will overthrow the manual control of lighting system in houses

A good lighting design includes a good controls design. Lighting controls play a critical role in lighting systems, enabling users manually or automatically to reduce lighting ON time, intensity . lighting controls reduce both demand and energy consumption. According to a Lawrence Berkeley National Laboratory (LBNL) study, popular lighting control strategies produce 24 – 39 % average lighting energy savings, which reduces building operating costs.

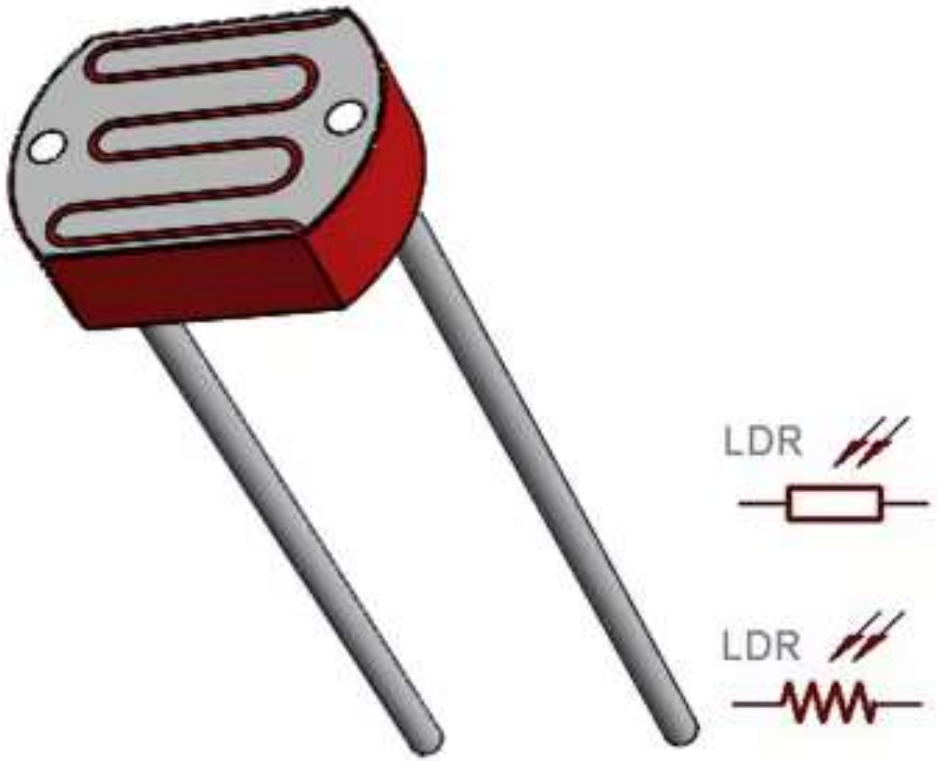
Components:

	A	B	C	D
1	Name	Quantity	Component	
2	U1	1	Arduino nano	
3	D1	1	Red LED	
4	R1, R2	2	1 kΩ Resistor	
5	R3	1	Photoresistor	

LDR (LIGHT DEPENDENT RESISTOR)

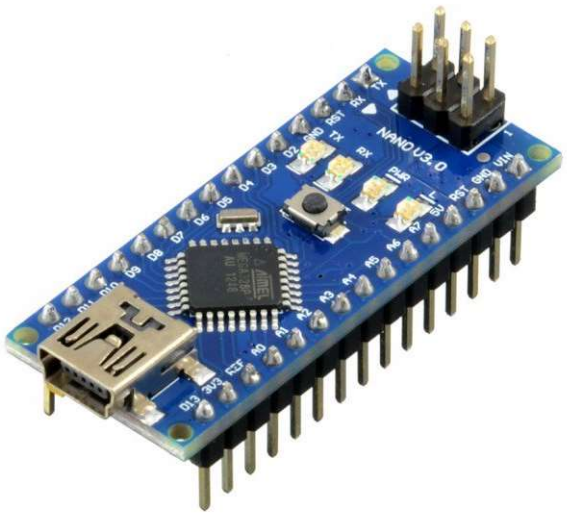


An LDR is a component that has a variable resistance that changes with the light intensity that falls upon it. This allows them to be used in light sensing circuits. It is made of a high resistance semiconductor. In the dark, it can have a resistance as high as several megohms (MΩ), while in the light, a photoresistor can have a resistance as low as a few hundred ohms. If incident light on a photoresistor exceeds a certain frequency, photons absorbed by the semiconductor give bound electrons enough energy to jump into the conduction band. The resulting free electrons (and their hole partners) conduct electricity, thereby lowering resistance. This example demonstrates the use of a LDR as a switch. Each time you cover the photocell, the LED (or whatever) is turned on or off.



LDR has two terminals. Terminal one is the signal pin which should be connected according to the code. Another terminal is considered as the ground pin which should be connected to the ground of the system.

Arduino Nano

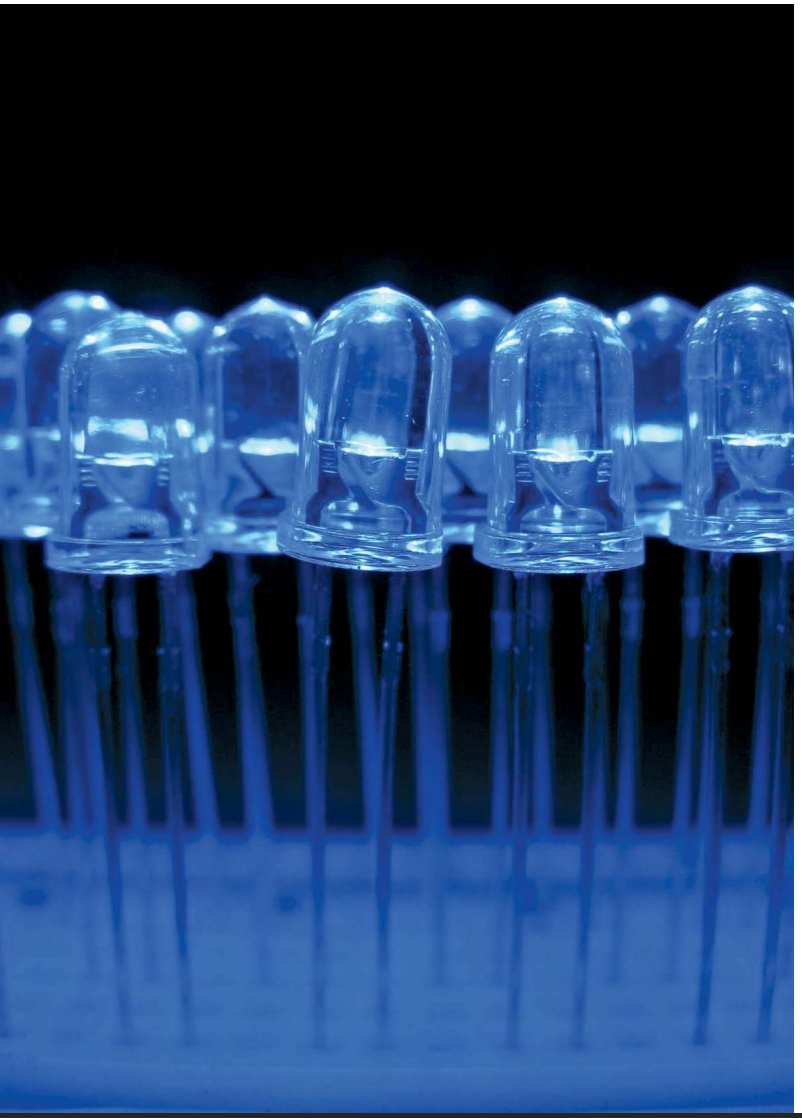


Arduino Nano is a small complete chip board based on ATmega 328 (v3.0) or Atmega 168 (v2.0). Every Arduino has the same functionality and the same features except the number of pins and size

One of the major flaws of this board is that it doesn't have any power jack. So, you can't supply power from any external power source like a battery. Apart from this, more or less this board is quite similar to any Arduino board

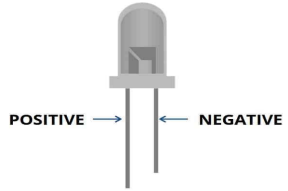
Difference between Arduino UNO and Arduino Nano

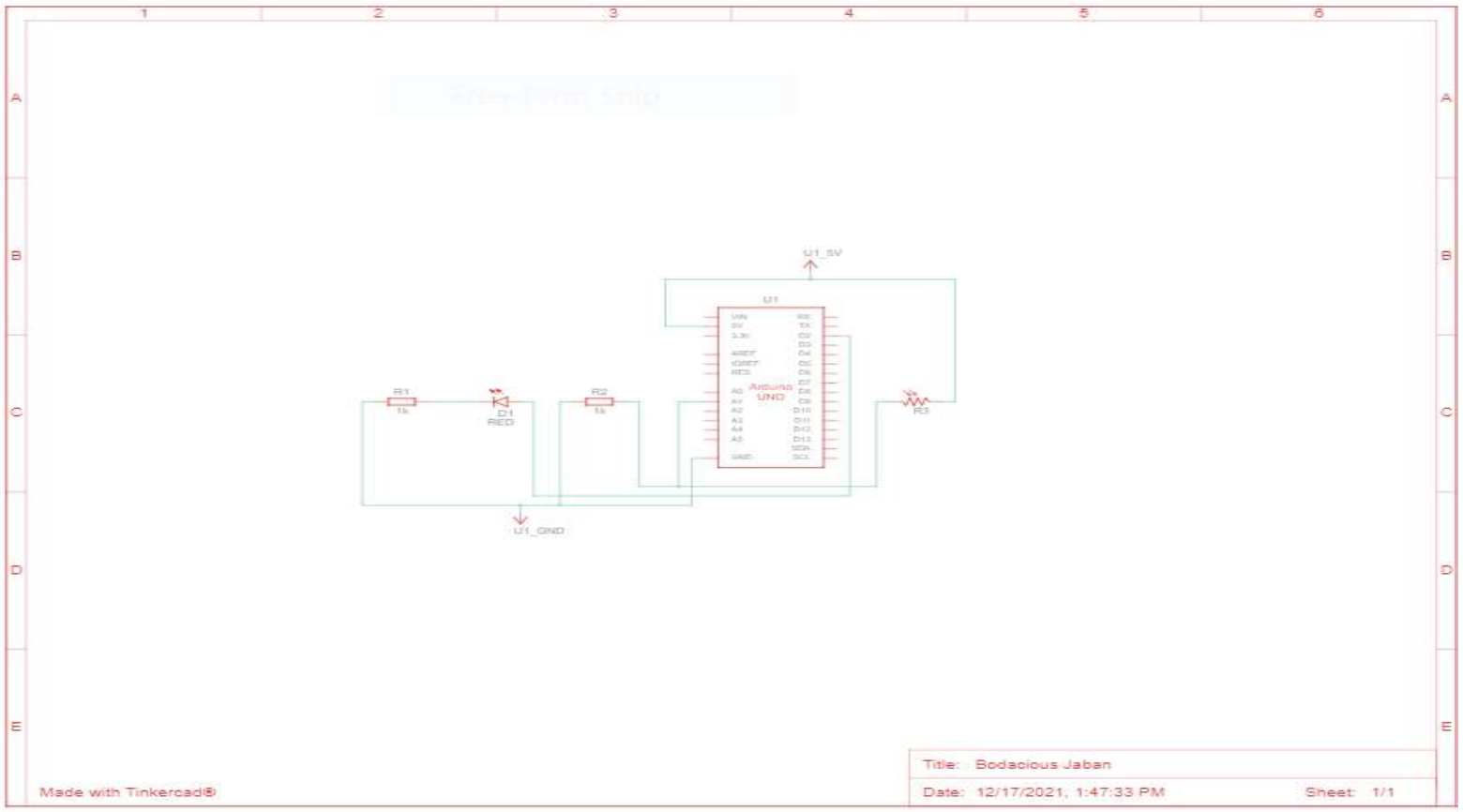
The Arduino Nano board is similar to an Arduino UNO board including similar microcontroller like Atmega328p. Thus, they can share a similar program. The main difference between these two is the size. Because Arduino Uno size is double to nano board. So, Uno boards use more space on the system. The programming of UNO can be done with a USB cable whereas Nano uses the mini-USB cable .



LED

In the simplest terms, a light-emitting diode (LED) is a semiconductor device that emits light when an electric current is passed through it. Light is produced when the particles that carry the current (known as electrons and holes) combine together within the semiconductor material.

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U1_5V
U1
Arduino UNO
R1
1k
D1
RED
R2
1k
R3
U1_GND
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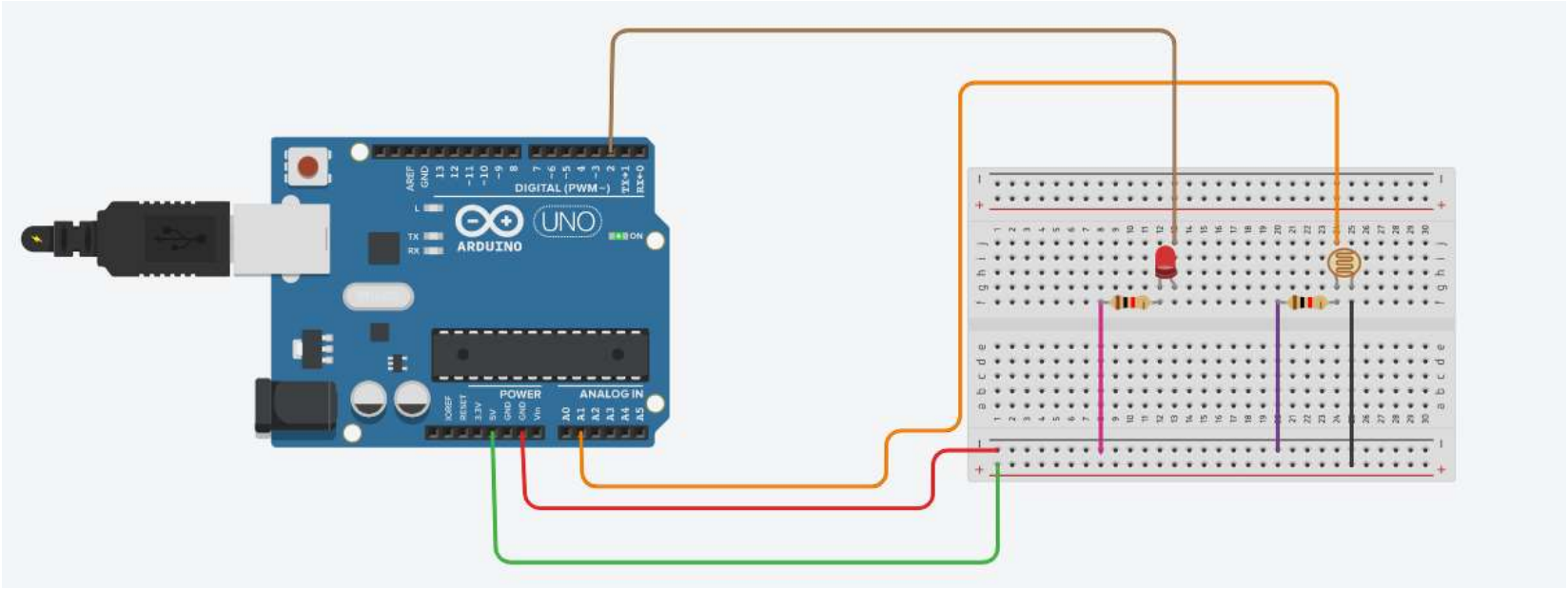
Let's walk through the wiring….

Other indispensable components like resistors and jumper wires etc. are also used for the wiring of the module.

First, a code is programmed on Arduino software to determine the procedures taken and set the desired function, where for starters, power coming from the Arduino is installed on the bread board warrying 5 V dc

Power Connections of LDR sensor : First terminal should be connected to analog pin 1 (A1) of Arduino. Second terminal should be connected any one led pf the resistor. Another leg of resistor should be connected to Gnd of Arduino.

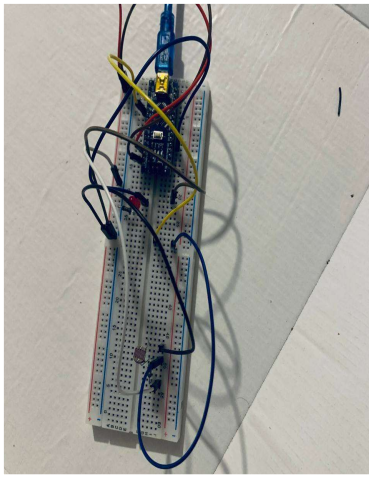
Led connections : Positive pin should be connected to digital pin 2 of Arduino. Negative pin should be connected any one led pf the resistor. Another leg of resistor should be connected to Gnd of Arduino

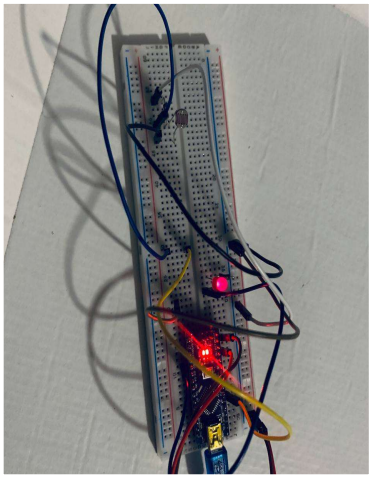


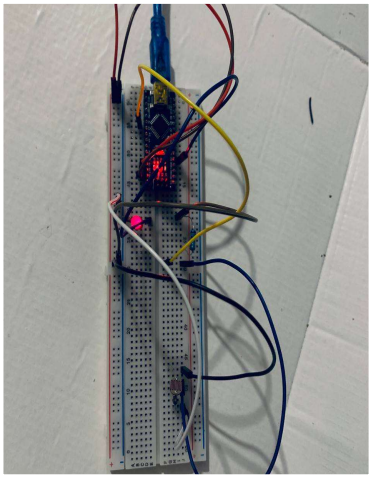
LINK TO TINKERCAD DESIGN

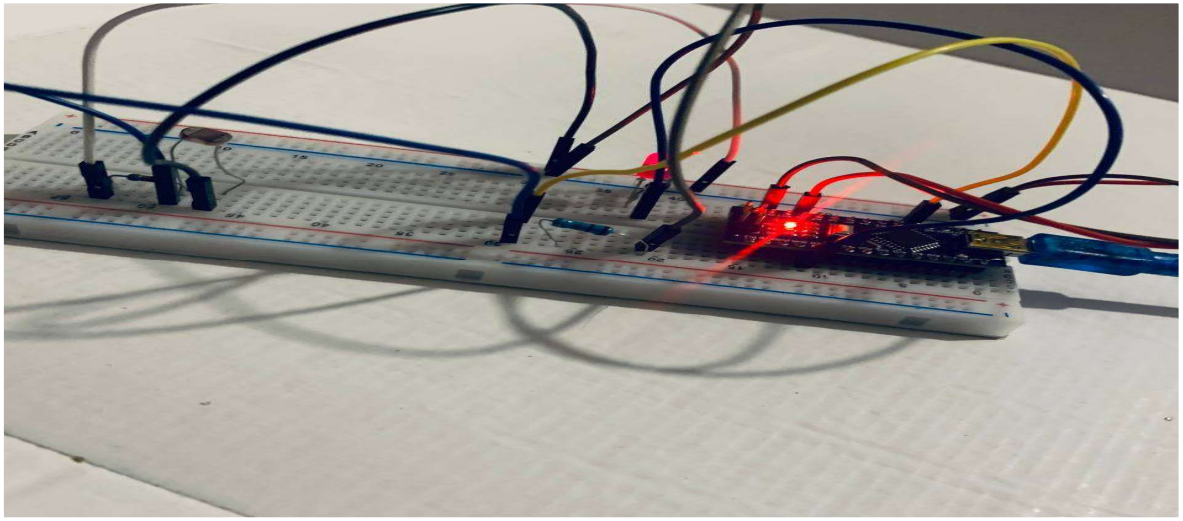
https://www.tinkercad.com/things/apjc72tqD8a-bodacious-jaban

Real Time images for circuit design in breadboard

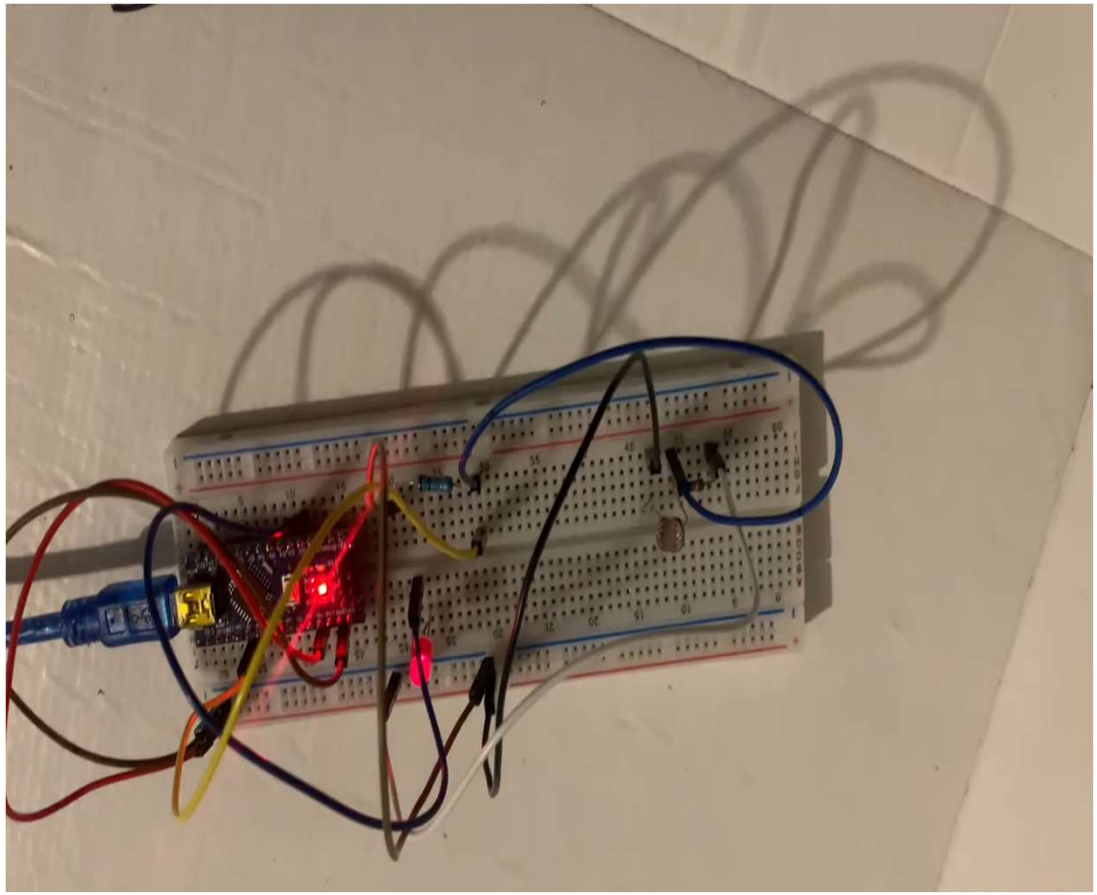




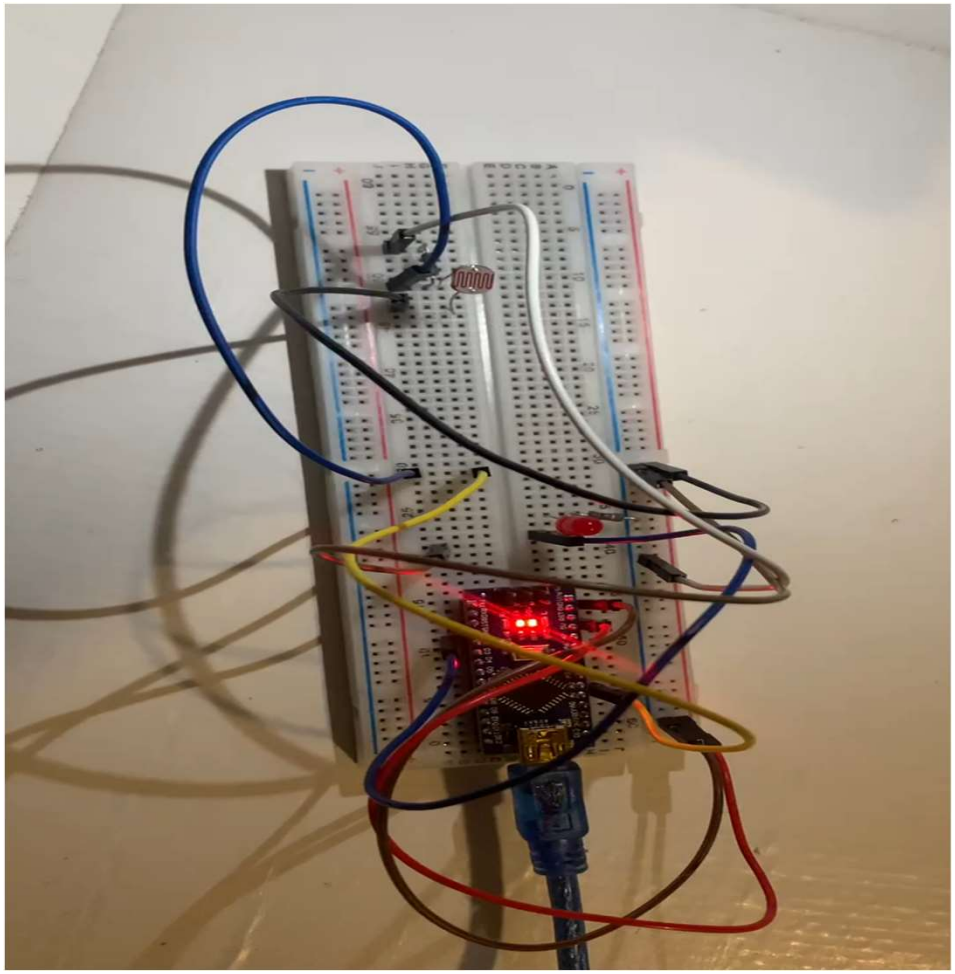




Real Time Video for circuit design in breadboard



Real Time Video for circuit design in breadboard



A copy of the digital code:

```
// Interfacing Arduino nano with LDR sensor
const int ledPin = 2; // digital pin 5
const int ldrPin = A1; // analog pin 0
void setup() {
  // The setup() function will only run once, after each powerup or reset of the Arduino board.
Serial.begin(9600);
pinMode(ledPin, OUTPUT); // Here LED is determined as an output or an indicator.
pinMode(ldrPin, INPUT); // Here LDR sensor is determined as input.
}
void loop() {
  // Void loop is ran again and again and contains main code.
int ldrStatus = analogRead(ldrPin);
if (ldrStatus <= 200)
{
  digitalWrite(ledPin, HIGH); // If LDR senses darkness led pin high that means led will glow.
  Serial.print("Darkness over here,turn on the LED :");
  Serial.println(ldrStatus);
  delay(200);
}
else
{
  digitalWrite(ledPin, LOW); // If LDR senses light led pin low that means led will stop glowing.
  Serial.print("There is sufficient light , turn off the LED : ");
  Serial.println(ldrStatus);
}
}
```

Third : a motion sensing circuit for controlling doors and garages.

Nowadays people use technology in order to make their life easier and save time in order to increase productivity and the idea of opening and closing everything (doors, windows, garages, etc.) is a thing of the past . These things are now operated by circuits that feel and sense any motion and react towards this motion according to their instructions (code). The covid-19 pandemic has also increased the awareness of the people towards NOT touching public materials such as doors and windows and now everyone is using sensors in order to reduce physical contact and save health and time.

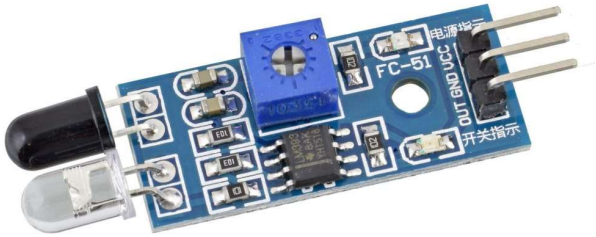
Components:

	A	B	C	D
1	Name	Quantity	Components	
2	U1	1	Arduino UNO	
3	I1	1	IR Sensor	
4	M1	1	Servo motor	
5	L1	1	Red led	
6	O1	1	1K ohmic resistance	

Arduino UNO R3

Arduino UNO is a low-cost, flexible, and easy-to-use programmable open-source microcontroller board that **can be integrated into a variety of electronic projects**. This board can be interfaced with other Arduino boards, Arduino shields, Raspberry Pi boards and can control relays, LEDs, servos, and motors as an output.

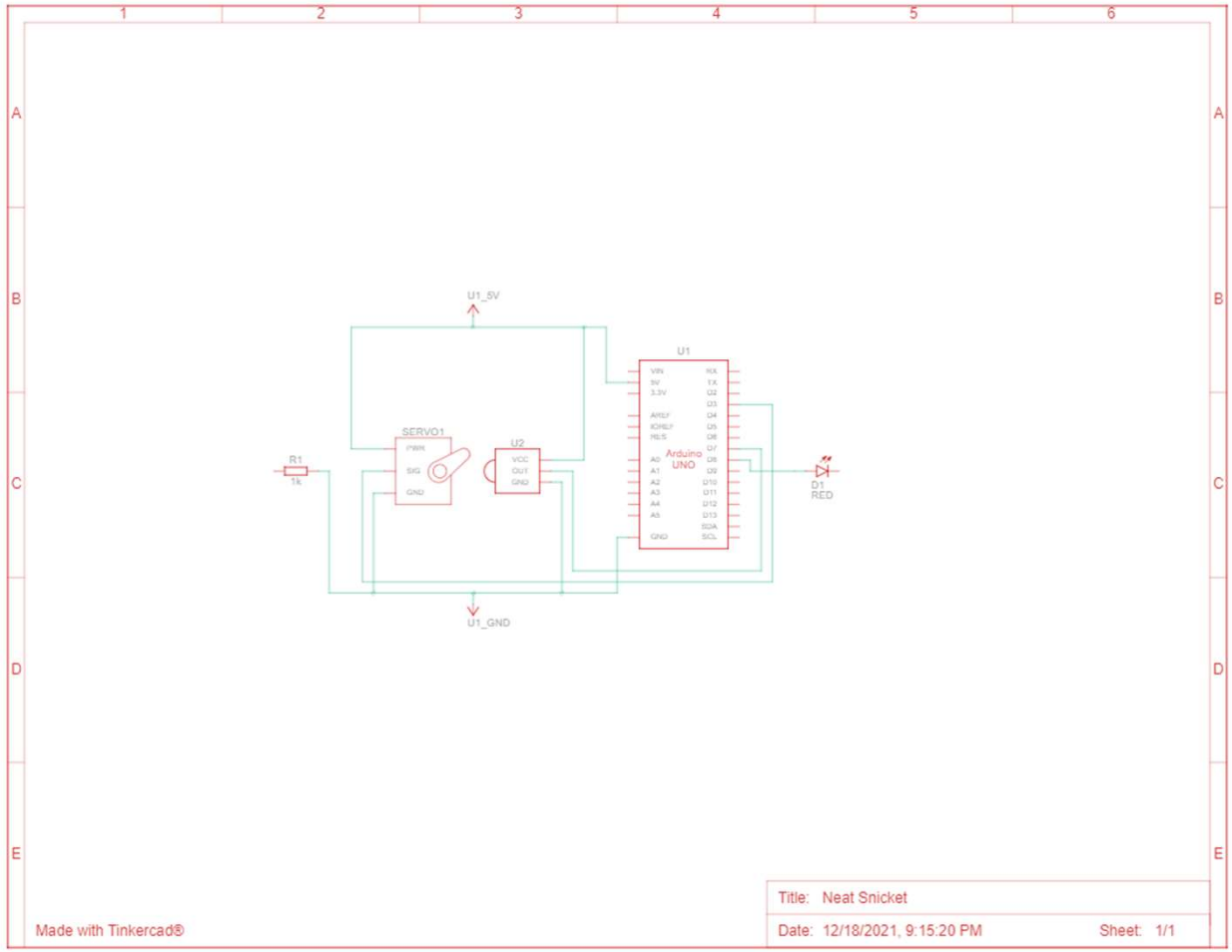
IR sensor



An infrared sensor (IR sensor) is a radiation-sensitive optoelectronic component with a spectral sensitivity in the infrared wavelength. IR sensors are now widely used in motion detectors, which are used in building services to switch on doors or in garage systems to detect presence of objects. In a defined angle range, the sensor elements detect the heat radiation (infrared radiation) that changes over time and space due to the movement of people.

Servo motor

It is a 5 volt dc motor that can be interfaced with an Arduino . It's rotation angle can be controlled from the code as it receives it through the control signal . It must be connected on a PMW signal port as it is only functionable with this type of ports which are present on the Arduino.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U2
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Arduino
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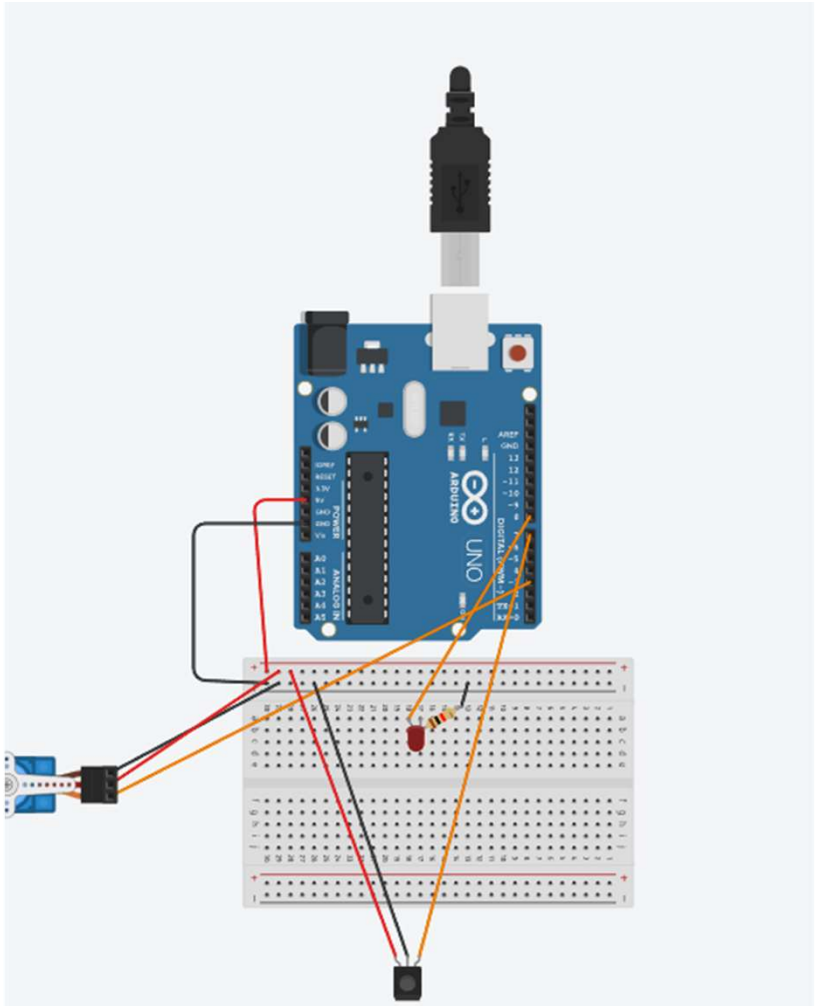
Let's walk through the wiring

Jumpers are used in order to connect all the components to each other alongside with a bread board where the operation will be carried.

First of all , the sensitivity of the sensor is adjusted to the required range , Then a code of the required instruction is programmed and uploaded to the Arduino.

The used code programs the Arduino to receive one INPUT and send two OUTPUTS . The input is the signal coming from the IR sensor this signal is considered to be activation key to our servo and led.

The first output is a PWM signal to the servo if motion is detected by the sensor this signal will cause the servo to move to certain that is specified in the code . The servo will remain in its new position until the body is removed and second output is given to the led as it starts blinking before the servo motor returns back to its original state.



LINK TO TINKERCAD DESIGN

HTTPS://WWW.TINKERCAD.COM/THINGS/7IV25ISLAFD-NEAT-SNICKET/EDITEL?TENANT=CIRCUITS

Project §

```
    digitalWrite(ledgreen, LOW);
    delay(100);
  }
}
void setup() {
   // We need to attach the servo to the used pin number
   door.attach(servoPin);
   Serial.begin(9600);
   pinMode(sensorPin,INPUT);
   pinMode(ledgreen,OUTPUT);
}
void loop(){
   bool reading = !digitalRead(sensorPin);
   if(reading)
   {
      Servo1.write(open);
      digitalWrite(ledgreen,HIGH);
      delay(2000);
      blink();            // blink led on pin 6

   }
   else
   {
      Servo1.write(close);
   }
}
```

A copy of the digital code:

```
// Include the Servo library
#include <Servo.h>

#define open 180
#define close 0

// Declare the Arduino pins
int servoPin = 3;
int sensorPin = 13;
int ledgreen = 6;

// Create a servo object
Servo door;

void blink()
{
   for(int i=0; i<10; i++)
  {
    digitalWrite(ledgreen, HIGH);
    delay(100);
    digitalWrite(ledgreen, LOW);
    delay(100);
  }
}
void setup() {
   // We need to attach the servo to the used pin number
   door.attach(servoPin);
   Serial.begin(9600);
   pinMode(sensorPin,INPUT);
```

Fourth: A variable voltage power supply

Different components and modules of any electronic system (e.g., computers) require different voltages to run optimally or run at all. It would be tiresome and foolish to use a different adapter for each voltage, so we integrated them all into a single power supply that’s easy to use and reliable.

Components:

	A	B	C
1	Name	Quantity	Components
2	D1 , D2	2	Diode
3	T1	1	12-volt 1000 mA transformer
4	C1	1	1000 micro-Farad 25-volt capacitor
5	C2:C7	6	1 micro-Farad 50-volt capacitor
6	U1	1	7812 voltage regulator
7	U2	1	7809 voltage regulator
8	U3	1	7805 voltage regulator
9			

12-volt step down transformer

Transformers are the main cause for our choice of using AC current. The ability to control the voltage and current of a system easily without altering the source is considered as a breakthrough rivaling that of the transistor.

The power which the transformer draws from the wall socket is important because it’s a specification of the transformer and cannot be changed.

Thus, a 1000mA transformer is used to supply all possible power needs of the circuit

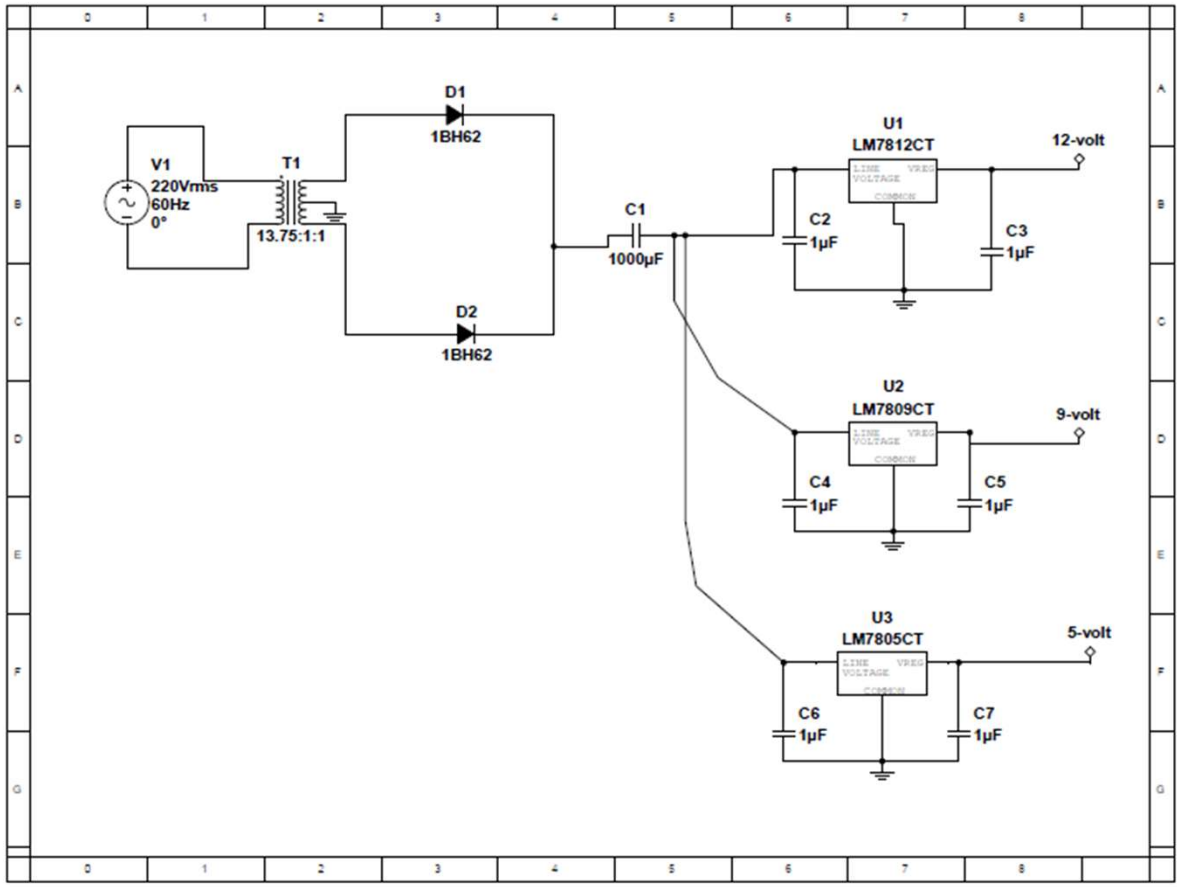
78XX voltage regulator

Voltage regulators differ from transformers in that where the transformer changes the voltages without altering the power, the voltage regulator changes the voltage and alters the power by diffusing the remaining power as heat (hence the built-in heat sink) that's why our made power supply has variable power not constant as in most (if not all) variable voltage adapter.

Capacitors

Capacitors uses are very limited unlike inductors with the most popular use as a softener of signals and occasionally, a substitute to the battery.

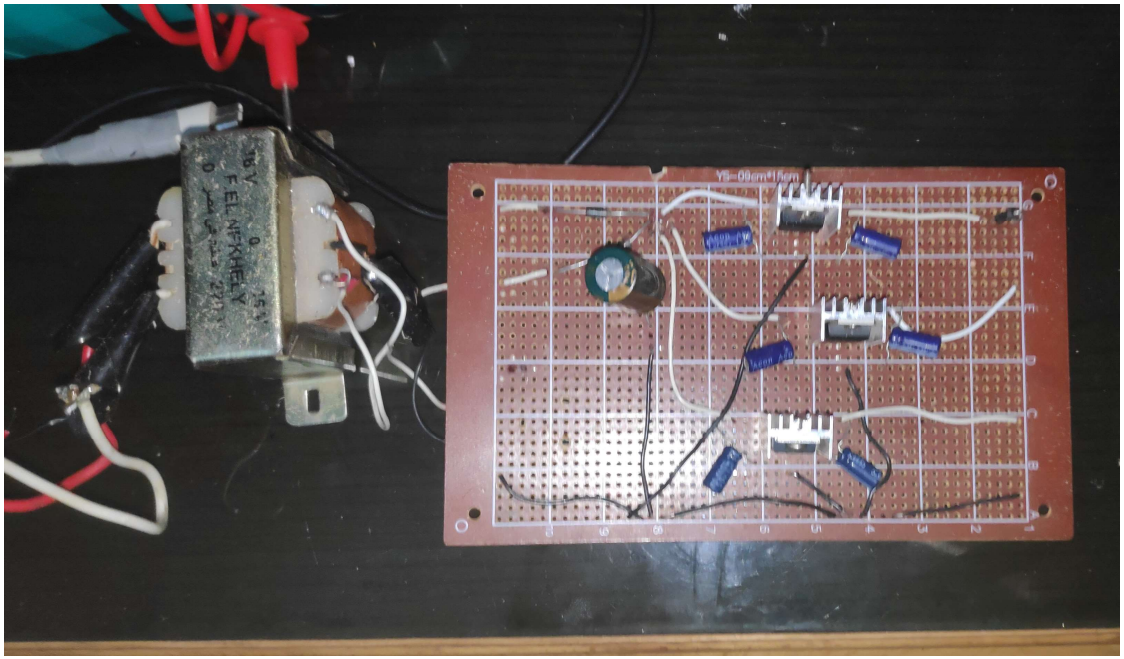
With that we used one capacitor with high capacitance to smoothen the voltage curve and 6 other low capacitance capacitors to further smoothen any leftover ripple in the curve.


D1
1BH62
V1
220Vrms
60Hz
0°
T1
13.75:1:1
D2
1BH62
C1
1000µF
U1
LM7812CT
12-volt
C2
1µF
C3
1µF
U2
LM7809CT
9-volt
C4
1µF
C5
1µF
U3
LM7805CT
5-volt
C6
1µF
C7
1µF

Let's walk through the wiring

- Using a perforated circuit board, first all components are threaded in their locations, then thin single strand (0,5 mm) is used to link them together, lastly solder is used to fuse the parts together in their location permanently as shown in the circuit photo.
- Other parts like the output port are soldered in a special location in the PCB marked in the accompanying photo.
- The fan is connected in series with a diode to prevent the load from accidently powering the fan.
- All of this is then put into a wooden case that can be easily modified for additional maintenance or adding additional features.

Photo of PCB



Students

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- محمود مصطفى عطية مصطفى
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Thank You