CHITTAGONG UNIVERSITY OF ENGINEERING AND TECHNOLOGY
DEPT OF ELECTRICAL AND ELECTRONIC ENGINEERING

COURSE NO: EEE 242

Simple Dual Axis Tracker By Arduino And Angle Display

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Simple Dual Axis Solar Tracker By Arduino

Abstract:

The solar tracking system is the most common method of increasing the efficiency of solar photomodule. This study presents the efficiencies of energy conversion of photo module with solar tracking system and fixed photo module. The proposed sun tracking system uses 4 photo resistors, which are mounted on the sides of the photo module. By these photo resistors the solar tracking system becomes more sensitive and it allows to determining a more accurate location of the sun. A comparative analysis was performed between fixed and dual-axis tracking systems. The results showed that the dual-axis solar tracking system produced 31.3% more power compared with stationary photo module.

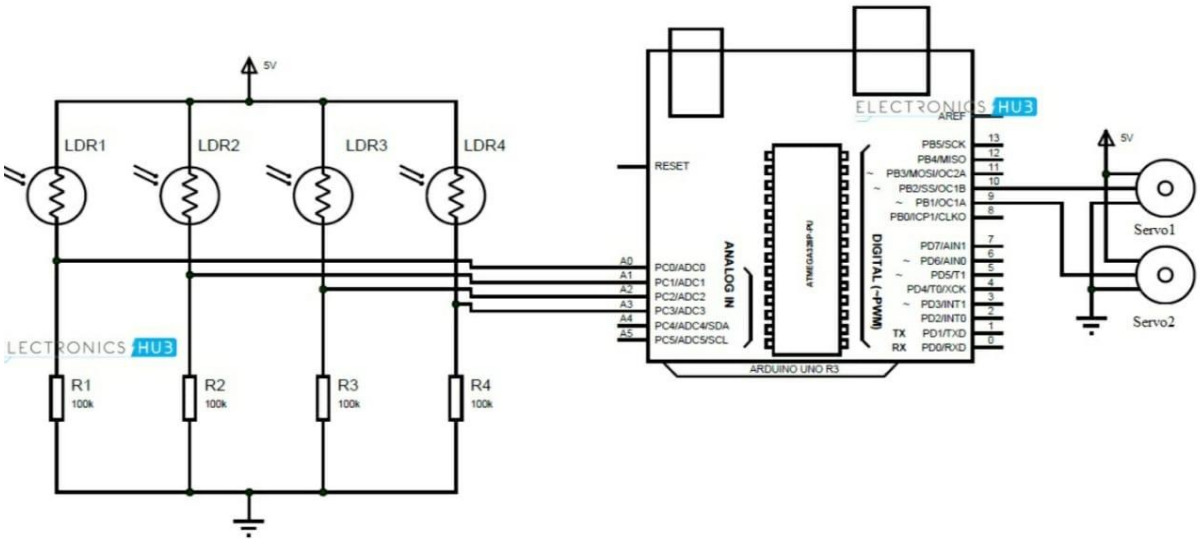
Introduction:

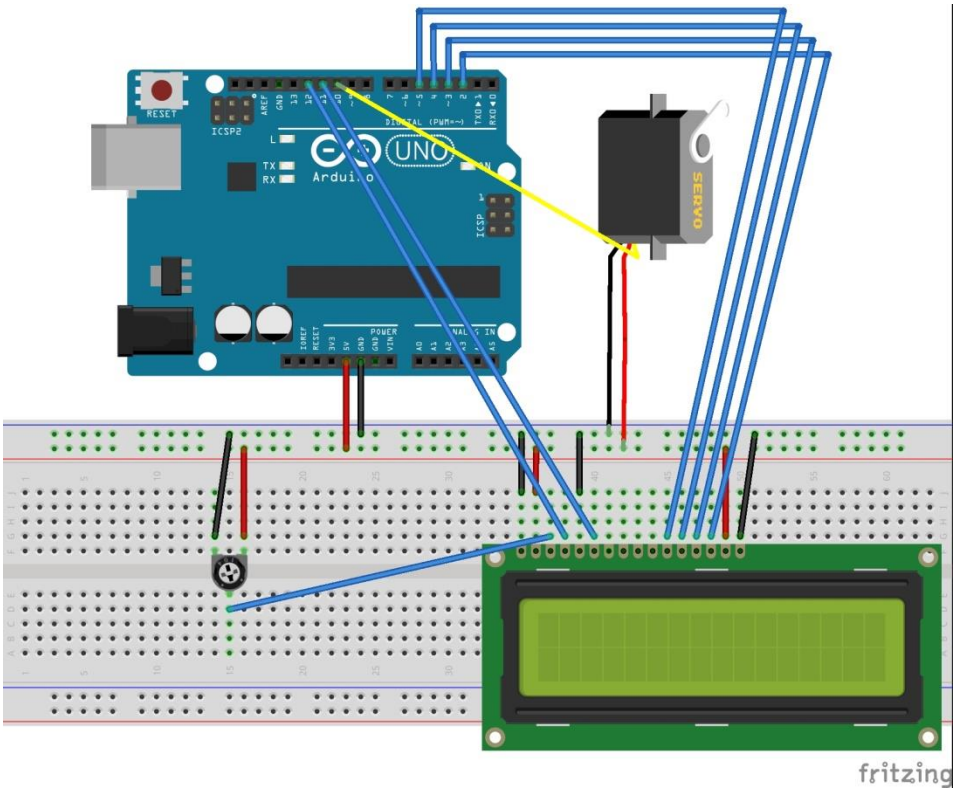
Our project is to implement a dual axis solar tracker. It means it tracks in both X and Y axix.To put it into even more simple terms , it goes left , right , up and down. It is a active tracker which is controlled by computer program (via an Arduino) .This means that we use sensors to find the brightest source of light at all times.

Component List:

- MPU6050 3 Axis Gyro +3 Axis Accelorometer.
- Breadboard
- Line jumper.
- 4 LDR
- SG90 1.5 kg/ 0.3 sec 9 gm micro servo.
- 100 KΩ carbon film resistor.
- 6V 1W mini solar panel
- 16*2 LCD display

Circuit Diagram:

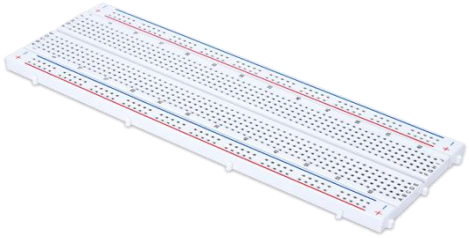




Component Description :

1) **Breadboard:**

A breadboard is a construction base for prototyping of electronics. Originally the word referred to a literal bread board, a polished piece of wood used for slicing bread.[1] In the 1970s the solderless breadboard (a.k.a. plugboard, a terminal array board) became available and nowadays the term "breadboard" is commonly used to refer to these.



3) LDR:

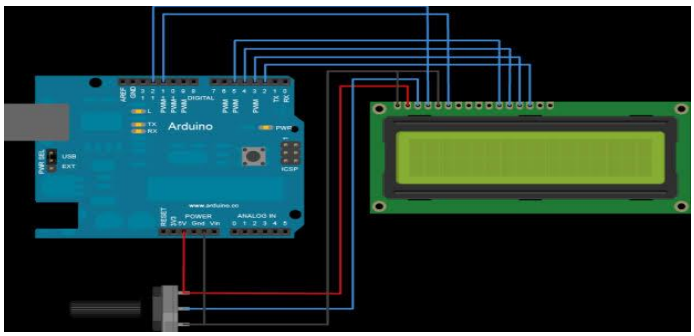
Light Dependent Resistor or Photoresistor, which is a passive electronic component, basically a resistor which has a resistance that varies depending of the light intensity. A photoresistor is made of a high resistance semiconductor that absorbs photons and based on the quantity and frequency of the absorbed photons the semiconductor material give bound electrons enough energy to jump into the conduction band.

2) **SG90 1.5 kg/ 0.3 sec 9 gm micro servo:**

Servo Motor Control with an Arduino. A small servo motor is connected directly to an Arduino to control the shaft position very precisely.Servo motors are small in size, and because they have built-in circuitry to control their movement, they canbe connected directly to an Arduino

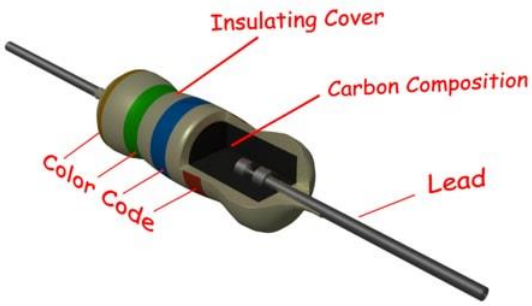
3) **LCD display:**

A liquid crystal display or LCD draws its definition from its name itself. It is combination of two states of matter, the solid and the liquid. LCD uses a liquid crystal to produce a visible image. Liquid crystal displays are super-thin technology display screen that are generally used in laptop computer screen, TVs, cell phones and portable video games. LCD's technologies allow displays to be much thinner when compared to cathode ray tube (CRT) technology.Here we used LCD for showing angle of rotation.



5) Carbon film resistor:

The carbon film resistor is a type of fixed resistor that uses carbon film to restrict the electric current to certain level. These types of resistors are widely used in the electronic circuits.

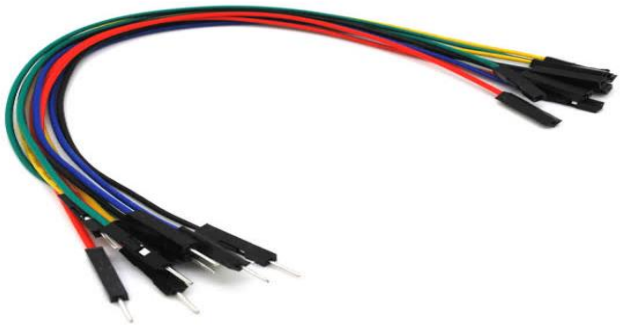


6) Solar panel :

Solar panels work by absorbing sunlight with photovoltaic cells, generating direct current (DC) energy and then converting it to usable alternating current (AC) energywith the help of inverter technology. AC energy then flows through the home's electrical panel and is distributed accordingly.

7) Line Junpers:

The term "jumper wire" simply refers to a conducting wire that establishes an electrical connection between two points in a circuit. You can use jumper wires to modify a circuit or to diagnose problems in a circuit. The following steps outline how you can safely use jumper wires in different electrical applications.



Working Principle:

In the modern solar tracking systes,the solar panels are fixed on a structure that moves according to the position of the sun. This project is an Arduino based solar tracker which will increase the effeciency of the solar panel while charging.Here,LDRs are used as the main light sensors.Servo motors will be used for holding and movement of the solar panel according to the light.Here LDRs sense the amount of sunlight falling on them. Four LDRs are divided into top, bottom, left and right.For east – west tracking, the analog values from two top LDRs and two bottom LDRs are compared and if the top set of LDRs receive more light, the vertical servo will move in that direction.If the bottom LDRs receive more light, the servo moves in that direction.For angular deflection of the solar panel, the analog values from two left LDRs and two right LDRs are compared. If the left set of LDRs receive more light than the right set, the horizontal servo will move in that direction.If the right set of LDRs receive more light, the servo moves in that direction. Here a code is used in arduino to display the angle in LCD.

Step By Step Construction:

1. First we attached four LDR to the rotating structure (which will hold the solar panel) . Then we connected the LDR to four 100k resistor . All the positive sides of the LDR are connected together And one side of all the resistors are connected to be ground. Now we soldered six wires to the common positive,common negative and between four LDRs and resistors.
2. We made the construction in such a way that two SG90 Servos we connected to the bending angles. One for the horizontal rotation and one for the verticle rotation.
3. The common positive wire has been connected to the positive in the breadboard and the common negative is connected to the negative in the breadboard. The top right,top left,bottom right and bottom left LDR is connected to the A0,A1,A2,A3 pins of the ARDUINO UNO respectively.
4. The signal pin of the horizontal servo is connected to the pin#9 of the ARDUINO and the vertical servo's signal pin is connected to the pin#10 of the ARDUINO PWM pins.
5. Now,we added a LCD to the circuit. The LCD connection to the Arduino is , 1=Ground,2=5V,3=Potentiometer signal pin, 4= 12^{th} PWM Pin, 5=11^{th} PWM pin, D4,D5,D6,D7 is connected to 5,4,3,2 respectively. The 15^{th} pin of the LCD is connected through a 150ohm to 5V and 16^{th} pin of LCD is grounded.
6. The we uploaded the code which contained the Servo and the LCD library .
7. The servo will move according to the light and the angle of the horizontal servo will be shown in the LCD.

Necessary Code:

```
#include <LiquidCrystal.h>
#include <Servo.h>
// initialize the library by associating any needed LCD interface pin
// with the arduino pin number it is connected to
const int rs = 12, en = 11, d4 = 5, d5 = 4, d6 = 3, d7 = 2;
LiquidCrystal lcd(rs, en, d4, d5, d6, d7);



Servo servohori;
int servoh = 0;
int servohLimitHigh = 90;
int servohLimitLow = 0;

Servo servoverti;
int servov = 0;
int servovLimitHigh = 90;
int servovLimitLow = 0;
//Assigning LDRs
int ldrtopl = 1; //top left LDR green
int ldrtopr = 0; //top right LDR yellow
int ldrbotl = 3; // bottom left LDR blue
int ldrbotr = 2; // bottom right LDR orange



void write_angle_lcd(int pos){
  lcd.setCursor(0,1);
  lcd.print(pos);
  lcd.print(" ");

}
```

```
 void setup ()
 {

  servohori.attach(9);
  servohori.write(0);
  servoverti.attach(10);
  servoverti.write(0);
  lcd.begin(16,2);
  lcd.print("SERVO ANGLE");
  lcd.setCursor(0,1);



 }

void loop()
{

  servoh = servohori.read();
  servov = servoverti.read();
  //capturing analog values of each LDR
  int topl = analogRead(ldrtopl);
  int topr = analogRead(ldrtopr);
  int botl = analogRead(ldrbotl);
  int botr = analogRead(ldrbotr);
  // calculating average
  int avgtop = (topl + topr) / 2; //average of top LDRs
  int avgbot = (botl + botr) / 2; //average of bottom LDRs
  int avgleft = (topl + botl) / 2; //average of left LDRs
  int avgright = (topr + botr) / 2; //average of right LDRs

  if (avgtop < avgbot)
```

```
{
  servoverti.write(servov +1);
  if (servov > servovLimitHigh)
   {
    servov = servovLimitHigh;
   }
  delay(10);
}
else if (avgbot < avgtop)
{
  servoverti.write(servov -1);
  if (servov < servovLimitLow)
{
  servov = servovLimitLow;
}
  delay(10);
  }
else
{
  servoverti.write(servov);
}

if (avgleft > avgright)
{
  servohori.write(servoh +1);
  if (servoh > servohLimitHigh)
  {
  servoh = servohLimitHigh;
  }
  delay(10);
}
```

```
  else if (avgright > avgleft)
  {
    servohori.write(servoh -1);
    if (servoh < servohLimitLow)
     {
     servoh = servohLimitLow;
     }
    delay(10);
  }
  else if (avgleft ==avgright)
  {

}
int pos;
for (pos = 0; pos <=0; pos -= 1)
{
  servohori.write(pos);
  write_angle_lcd(pos);
  delay(50);
}
}
```

Total Cost

Component Name	Quantity	Cost
Breadboard	2	160 Tk
Line Jumper	3 dozen	100 Tk
LDR	4	40 Tk
SG90 1.5 kg/ 0.3 sec 9 gm micro servo	2	240 Tk
6V 1W mini solar panel	1	180Tk
16*2 LCD display	1	150Tk
Total		870Tk

CONCLUSION :

This article was proposed by the system of dual-axis sun tracking based on type of microcontroller LM324N. This article has shown, the development and implementation of dual-axis sun tracking system with minimal effort. The mechanical structure was very simple and reliable, it has been designed in such a way that the entire controller card should fit into the platform tracking system. The scheme was designed with a minimal number of components to minimize cost and to simplify the assembly have been integrated onto a single board. The article shows the optimality of the dual-axis sun tracking system compared to a stationary photovoltaic cell.