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Intelligent Microcontroller Solar 12V Battery Charger

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ABSTRACT

Our aim is to design a single axis solar tracker as well dual axis Intelligent microcontroller solar 12V Battery. The sun is tracked by the tracker and its position is changed in such a way that it maximizes the power output. The solar panel is moved by two geared DC motors so that sun's light can remain aligned with the solar panel. The operation of experimental model of the device is based on a DC motor which is intelligently controlled by a dedicated drive until that moves a mini photovoltaic panel, the presence of the two simple but efficient light sensors receive signals by a microcontroller. The performance and characteristics of the solar tracker device are experimentally analyzed. Then from the dc current which is provided it will be transferred to step up convertor and from that it will provide electricity to charge 12v battery.

Keywords: *Open loop concept, Intelligent, Decentralized, Battery charger, Solar.*

1. INTRODUCTION

A typical solar panel converts only 30 to 40 percent of the incident solar irradiation into electrical energy. Thus, to get a constant output, an automated system is required which should be capable of constantly rotating the solar panel. The Sun Tracking System (STS) was made as a prototype to solve the problem, mentioned above. It is completely automatic and keeps the panel in front of the sun until that is visible. The unique feature of this system is that instead of taking the earth as its reference, it takes the sun as a guiding source. Its active sensors constantly monitor the sunlight and rotate the panel towards the direction where the intensity of sunlight is maximum.

1.1. Scope of the Research

(1) It can be used for small and medium scale power generator.

(2) It can used as domestic and as industrial generator as backup system.

(3) Solar radiation Tracker has played a vital role in increasing the efficiency of solar panels in recent years, thus proving to be a better technological achievement. The vital importance of a dual axis intelligent microcontroller solar 12V Battery lies in its better efficiency and sustainability to give a better output compared to a fived solar panel or a single axis solar tracker. The tracking system is designed such that it can trap the solar energy in all possible direction.

1.2. Single and Dual Axis

An Intelligent microcontroller solar 12V Battery is an automated solar panel which follows the sun to get maximum power. The primary benefit of a tracking system is to collect solar energy for the longest period of the day, and with the most accurate alignment as the Sun's position shifts with the seasons. Dual Axis Tracker has two different degrees through which they use as axis of rotation. The dual axis is usually at a normal of each rotate both east to west (zenithal) and north to south. Solar tracking is the most appropriate technology to enhance the

electricity production of a PV system. To achieve a high degree of tracking accuracy, several approaches have been widely investigated. Generally, they can be classified as either open-loop tracking types based on solar movement mathematical models or closed-loop tracking types using sensor-based feedback controllers. In the open loop tracking approach, a tracking formula or control algorithm is used.

2. MATERIALS USED

Intelligent microcontroller solar 12v battery charger is used to gather the maximum solar energy and charge the battery. Here are the main components that are used in the paper.

A. Solar Panel

Solar panel refers to a panel designed to absorb the sun's rays as a source of energy for generating electricity or heating.

Figure 2.1

B. Arduino UNO Microcontroller

Arduino is an open source, computer hardware and software company, paper, and user community that designs and manufactures microcontroller kits for building digital devices and interactive objects that can sense and control objects in the physical world.

Figure 2.2

C. LDRs

A Light Dependent Resistor (LDR) or a photo resistor is a device whose resistivity is a function of the incident electromagnetic radiation.

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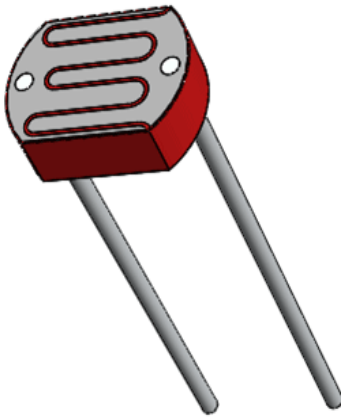


Figure 2.3

D. Servo Motors

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration.

Figure 2.4

3. WORKING PRINCIPLE

An Intelligent microcontroller solar 12V Battery works with the help of lDRs in the four opposite direction to sense the light and where more light appears it will face that direction automatically below algorithm shows how the LDRs detect

Algorithm-

Step 1: Start.

Step 2: Initialize all necessary inputs and outputs to zero.

Step 3: Assign analog LDR outputs and PWM servomotor inputs to Arduino Uno.

Step 4: If center LDR = 0, then delay (longer).

Step 5: Check alignment (Simultaneously for north south and east-west)

Step 6: If up (LDR) greater than center and down (LDR) lesser than center, then increase position of

servomotor1 by 1 unit. Give delay.

Step 7: Else if up (LDR) lesser than center and down (LDR) greater than center, then decrease position of servomotor1 by 1 unit. Give delay.

Step 8: (Simultaneously along with step6) If right (LDR) greater than center and left (LDR) lesser than center then increase the position of servomotor2 by 1 unit. Give delay.

Step 9: Else if right (LDR) is lesser than center and left (LDR) greater than center then decrease position of servomotor2 by 1 unit. Give delay

Step 10: Go to Step 5

Step 11 : End

4. RESULTS AND DISCUSSIONS

To check the result of the Intelligent microcontroller solar 12V Battery multimeter have been used and in the tables below shows the result.

Table 1(a). Solar panel without tracking

Time (Hrs)	Voltage (V)	Current (A)	Power (W)
9am	5.5	0.11	0.605
10am	9	0.19	1.71
11am	10.5	0.2	2.1
12 pm	12.5	0.28	3.5
1 pm	14	0.32	4.49
2 pm	13.5	0.3	4.05
3 pm	11	0.26	2.86
4 pm	8	0.16	1.28
5 pm	6	0.12	0.72

The table given below shows the efficiency and performance of the solar panel with tracking.

Table 1(b). Solar Panel with tracking

Time (Hrs)	Voltage (V)	Current (A)	Power (W)
9am	12.2	0.23	2.8
10am	13.5	0.25	3.4
11am	14	0.28	3.92
12 pm	14	0.3	4.2

1 pm	15	0.3	4.5
2 pm	14	0.3	4.2
3 pm	13	0.26	3.38
4 pm	10	0.25	2.5
5 pm	7	0.2	1.4

2.134 watts is the average power obtained from solar panel without tracking and 3.18 watts power is obtained from solar panel with tracking. 41.64% is the improved efficiency neglecting the power consumption of motor.

5. CONCLUSION

The current paper is based on Intelligent microcontroller solar 12v battery charger. These panels change their orientation in relation to solar radiation to increase the efficiency and results in maximum production of energy and helps in getting full benefit of optimal angle between solar panels and solar radiations. The execution of solar tracking system was made clear because of our sufficient research and preplanning of our goals and objectives. The main agenda of this paper was to make simple machinery on low-cost basis. Trial and error method help us in achieving our goal. Thus, the output increases indicating that the efficiency more than a fixed solar panel (about 30 -40% more) or a single axis solar tracker (about 6-7% more).

Appendix – A

```
*/
#include <Servo.h>              //  Library for servo motors.
Servo servo_horizontal;         //  Define horizontal servo.
int servoh = 90;                //  Horizontal servo first position.
int servohLimitHigh = 150;      //  Servo move position maximum limit.
int servohLimitLow = 30;        //  Servo move position minimum limit.
Servo servo_vertical;           //  Define vertical servo.
int servov = 90;                //  Vertical servo first position.
int servovLimitHigh = 150;      //  Servo move position maximum limit.
int servovLimitLow = 30;        //  Servo move position minimum limit.
#define SERVO_H_LIMIT_H   160   //  Servo horizontal high limit value.
#define SERVO_H_LIMIT_L   30    //  Servo horizontal low limit value.
#define SERVO_V_LIMIT_H   140   //  Servo vertical high limit value.
#define SERVO_V_LIMIT_L   60    //  Servo vertical low limit value.
#define LTL_PIN       A0        //  LDR top left defined input.
#define LTR_PIN       A4        //  LDR top right defined input.
#define LBL_PIN       A1        //  LDR bottom left defined input.
#define LBR_PIN       A3        //  LDR bottom right defined input.
void setup() {
  Serial.begin(9600);
  pinMode(LTL_PIN, INPUT);
  pinMode(LTR_PIN, INPUT);
```

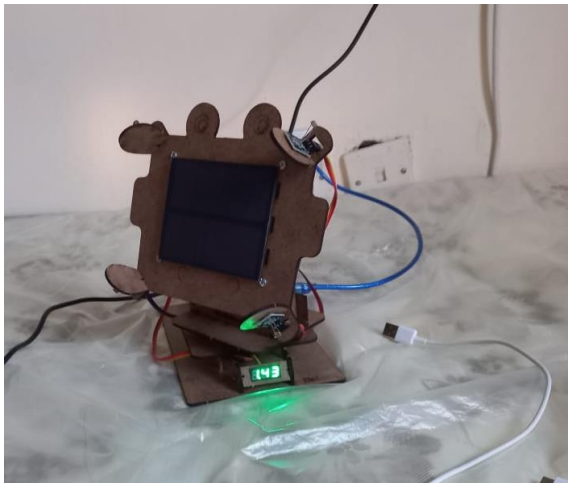
```
  pinMode(LBL_PIN, INPUT);
  pinMode(LBR_PIN, INPUT);
  servo_vertical.attach(9);
  servo_vertical.write(90);
  servo_horizontal.attach(11);
  servo_horizontal.write(90);
  Serial.println("TL\tTR\tBL\tBR\tT\tL\tB\tR\tservov\tservoh");  //    Shows the values that described on the Serial Port.
}

void loop() {
  int TL_value = analogRead(LTL_PIN);             //    Reading value of top left LDR.
  int TR_value = analogRead(LTR_PIN);             //    Reading value of top right LDR.
  int BL_value = analogRead(LBL_PIN);             //    Reading value of bottom left LDR.
  int BR_value = analogRead(LBR_PIN);             //    Reading value of bottom right LDR.
  int T_value = (TR_value + TL_value) / 2;        //    Average of top LDRs.
  int L_value = (BL_value + TL_value) / 2;        //    Average of left LDRs.
  int B_value = (BR_value + BL_value) / 2;        //    Average of bottom LDRs.
  int R_value = (TR_value + BR_value) / 2;        //    Average of right LDRs.


  //Serial.println("TL\tTR\tBL\tBR\tT\tL\tB\tR\tservov\tservoh");    //    Shows the values that described on the Serial Port.
  Serial.print(TL_value);                                 //    Printing Values to Serial port.
  Serial.print("\t");
  Serial.print(TR_value);
  Serial.print("\t");
  Serial.print(BL_value);
  Serial.print("\t");
  Serial.print(BR_value);
  Serial.print("\t");
  Serial.print(T_value);
  Serial.print("\t");
  Serial.print(L_value);
  Serial.print("\t");
  Serial.print(B_value);
  Serial.print("\t");
  Serial.print(R_value);
  Serial.print("\t");
  Serial.print(servov);
  Serial.print("\t");
  Serial.print(servoh);
  Serial.println("\t");
  if (T_value - B_value < 0) {            //    if difference of top value and bottom value are smaller than 0, decrease servo vertical angle value.
    servov--;
```

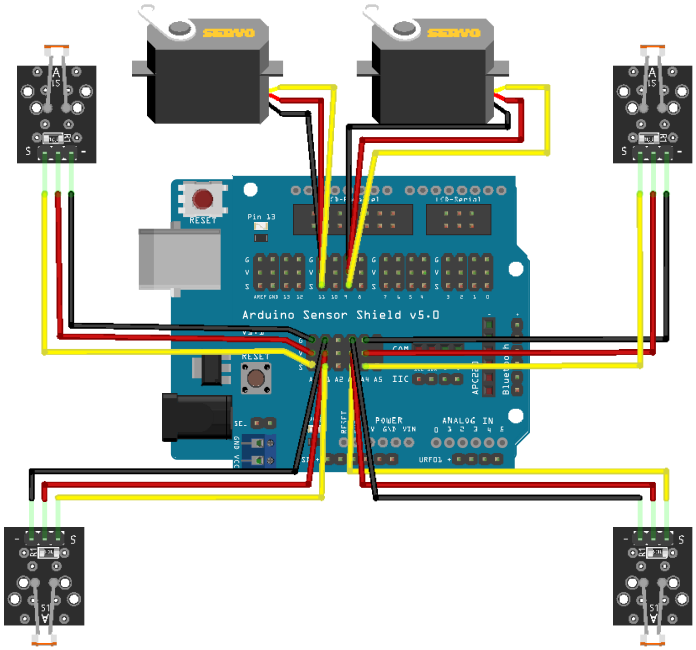
```
  }
  else if (T_value - B_value > 0){       //    else if difference of top value and bottom value are bigger than 0, increase servo vertical angle value.
      servov++;
  }
  if (L_value - R_value < 0) {           //    if difference of left value and right value are smaller than 0, decrease servo horizontal angle value.
    servoh--;
  }
  else if (L_value - R_value > 0){       //    else if difference of left value and right value are bigger than 0, increase servo horizontal angle value.
    servoh++;
  }
  if (servoh <  SERVO_H_LIMIT_L)         //    if servo horizontal angle value smaller than servo horizontal limit low value, equalize servo horizontal angle value and servo horizontal limit low value.
  {
    servoh = SERVO_H_LIMIT_L;
  }
  else if (servoh >  SERVO_H_LIMIT_H)    //    if servo horizontal angle value smaller than servo horizontal limit low value, equalize servo horizontal angle value and servo horizontal limit low value.
  {
    servoh = SERVO_H_LIMIT_H;
  }
  if (servov >  SERVO_V_LIMIT_H)         //    if servo vertical angle value bigger than servo vertical limit high value, equalize servo horizontal angle value and servo vertical limit high value.
  {
    servov = SERVO_V_LIMIT_H;
  }
  else if (servov <  SERVO_V_LIMIT_L)    //    else if servo vertical angle value smaller than servo vertical limit low value, equalize servo horizontal angle value and servo vertical limit low value.
  {
    servov = SERVO_V_LIMIT_L;
  }
  servo_horizontal.write(servoh);        // Available this delays if you have shut down when you run your paper.
  delay(50);
  servo_vertical.write(servov);
  delay(50);
}
```

Appendix – B



LDR	Connection Table
A0	Top Left
A1	Bottom Left
A3	Bottom Right
A4	Top Right

Servo Motor Connection on the Table	
9	X Axis Servo Motor
11	Y Axis Servo Motor



Declarations

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Competing Interests Statement

The authors declare no competing financial, professional, or personal interests.

Consent for publication

The authors declare that they consented to the publication of this research work.

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