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Mobile Charger Based on Solar Energy with Solar Tracking System

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Abstract

Solar energy is one of nature's most abundant sources of electricity and one of the most efficient kind of renewable energy. The Solar Tracking System keeps track of the sun's movement through the sky. It

tries to keep the solar panel perpendicular to the sun's beams all day long, ensuring that the panel receives the maximum amount of sunlight. The Solar Tracking System comprises two LDRs, a solar panel, a stepper motor, and an ATMEGA8 microprocessor. In this study, a microcontroller 8051-based circuit is employed with a small number of components, and stepper motors are used to follow the sun accurately. A solar mobile charger with a solar tracking system has been designed and developed in this study. The quantity of energy generated by a solar cell is stored in a battery. The photovoltaic cell will be positioned according to the intensity of sunshine. Because the sun will be higher on the west side in the morning, the solar tracker will be on the west side. Similarly, at midday, the intensity of sunlight is the same in both directions. Therefore, the photovoltaic cell does not move and remains stationary. The motor can control the solar cell's movement. And, depending on the intensity of light falling on the LDRs employed in the solar cell, it will be positioned west or east. As a result, by implementing this scheme, we want to utilize solar energy better to provide a consistent supply to loads and alleviate the energy crisis to a large extent. Consequently, the electricity bill will be lower, and the cost of electricity generation per unit will be lower.

1.Introduction

A solar panel is a bundled, connected photovoltaic cell assembly, also known as a solar module, photovoltaic module, or photovoltaic panel. Photovoltaic (PV) is a method of converting solar energy into direct current electricity using semiconducting materials that exhibit the photovoltaic effect. A photovoltaic system employs solar panels composed of several solar cells to supply usable solar power. Power generation from solar PV has long been seen as a clean, sustainable energy technology that draws upon the planet's most plentiful and widely distributed renewable energy source – the sun. The direct conversion of sunlight to electricity occurs without any moving parts or environmental emissions during operation. The photoelectric effect was first noted by a French physicist, Edmund Becquerel, in 1839, who found that certain materials would produce small amounts of electric current when exposed to light [1]. In 1905, Albert Einstein described the nature of light and the

photoelectric effect on which photovoltaic technology is based, for which he later won a Nobel prize in physics. Bell Laboratories built the first photovoltaic module in 1954. It was billed as a solar battery and was mostly just a curiosity as it was too expensive to gain widespread use [2]. In the 1960s, the space industry began to make the first serious use of the technology to provide power aboard spacecraft. The technology advanced through the space programs, and its reliability was established, and the cost began to decline. During the energy crisis in the 1970s, photovoltaic technology gained recognition as a source of power for non-space applications [3]. In commercial and domestic applications, the solar panel can be utilized as a part of a larger photovoltaic system to generate and supply electricity, effectively creating renewable energy. The DC output power of each panel is rated under conventional test settings and normally ranges from 5 to 10 watts. Solar panels, in general, are immobile and do not follow the sun's movement. Thus, they do not receive the maximum amount of sunshine throughout the day. Another key issue is determining whether a solar power unit's storage battery is being charged or not. Solar energy is one of the numerous energy sources provided by nature and one of the most efficient types of renewable energy, so this study proposes a solution to the aforementioned concerns. We will utilize a Solar Tracker System to follow the sun's movement across the sky and try to keep the solar panel perpendicular to the sun's beams throughout the day, ensuring that the maximum amount of sunlight is incident on the panel. From dawn to dusk, the solar tracker follows the sun throughout the day until evening, then repeats the process the next day. Along with the Solar Tracker, we'll utilize a simple Charging Monitor to show whether or not a solar power unit's storage battery is being charged.

Solar energy is a valuable renewable energy source that produces no pollution or hydrocarbons, making it highly beneficial to our environment. Because fossil fuels are fast decreasing, they can provide energy for a very long time. As a result, the solar charger application can help minimize reliance on fossil fuels and is also considered a possible solution to future energy shortages. It can also diminish the greenhouse effect and global warming, which causes temperature rises and sea level rises on Earth. In conclusion, the solar charger application has numerous advantages, not only for consumers but also for the environment in the long run. A solar panel is connected to the motor. A solar panel consists of photovoltaic cells arranged in an order. Photo resembles light, and voltaic is electricity. A solar cell is made up of semiconductor material silicon. When a light ray from Sun is incident on the solar cell, some amount of energy is absorbed by this material. The absorbed energy is enough for the electrons to jump from one orbit to another inside the atom as shown in Figure 1. Cells have one or more electric field that directs the electrons which creates current. By placing metal contact, energy can be obtained from these cells. Light Dependent Resistors are resistors whose resistance values depend on the intensity of the light. As the intensity of light falling on the LDR increases, the resistance value decreases. In the dark, LDR will have maximum resistance. LDR will output an analog value which should be converted to digital.

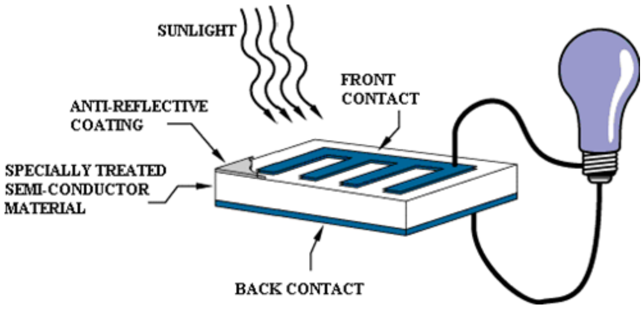

Figure 1. Schematic diagram exhibits the photo voltaic effect.

How Sun Tracking Solar Panel Works?

- Initially power the circuit.
- Place the set up in the dark
- When the two LDRs are in the dark, there is no movement in the panel.
- Now place a torch in front of the left LDR. Panels slowly move towards its left.
- Now move the light from left to right. You can observe the panel moving slowly with the torch towards the right.
- In the middle, when intensity on both LDRs is equal, the panel will not move until there is a difference between the light intensity falling on the LDRs.
- Advantages of Sun Tracking Solar Panel:
- solar energy can be reused as it is a non- renewable resource.
- This also saves money as there is no need to pay for energy used.
- Sun Tracking Solar Panel Applications:
- These panels can be used to power the traffic lights and streetlights
- These can be used in the home to power the appliances using solar power.
- These can be used in industries as more energy can be saved by rotating the panel.

Limitations of Sun Tracking Solar Panel Circuit:

a) Though solar energy can be utilized to the maximum extent, this may create problems in the rainy season.
b) Although solar energy can be saved to batteries, they are heavy and occupy more space, and are required to change from time to time.
c) They are expensive.

A few other aspects of extracting maximum power from solar PV cells using blend of MPPT with Artificial Intelligence-based approach. With advancements in Artificial Intelligence Techniques, the machine learning algorithms can be exploited in several applications. Various ML approach for different applications have been extensively used in [4-12].

2. Methodology

Two LDRs, a solar panel, a stepper motor, and an ATMEGA8 Microcontroller make up the solar tracking system. On the solar panel's edges, two light- dependent resistors are positioned as shown in Figure 2. When light falls on light-dependent resistors, they produce low resistance. The panel is rotated in the direction of the Sun by a stepper motor connected to it. The panel is set up so that the light from two LDRs is compared, and the panel is rotated toward the LDR with the highest intensity, i.e., lowest resistance. The panel is rotated at a specific angle by the Stepper motor. The panel progressively slides to the right when the intensity of the light falling on the right LDR is higher and to the left when the intensity of the light falling on the left LDR is higher. Sun is ahead at midday, and the intensity of light on both panels is the same. In such circumstances, the panel remains stationary and does not rotate [13,14].

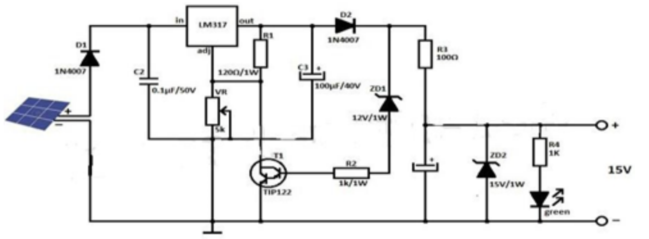

Figure 2. Solar mobile charger circuit.

3.Software Implementation

To create a new project in µVision2, you must:

a) Select Project - New Project.
b) Select a directory and enter the name of the project file.
c) Select Project - Select Device and select an 8051, 251, or C16x/ST10 device from the Device Database™.
d) Create source files to add to the project.
e) Select Project - Targets, Groups, Files. Add/Files, select Source Group1, and add the source files to the project.
f) Select Project - Options and set the tool options. Note when you select the target device from the Device Database™, all special options are set automatically. You typically only need to configure the memory map of your target hardware. Default memory model settings are optimal for most applications.
g) Select Project - Rebuild all target files or Build target as shown in Figure 3.

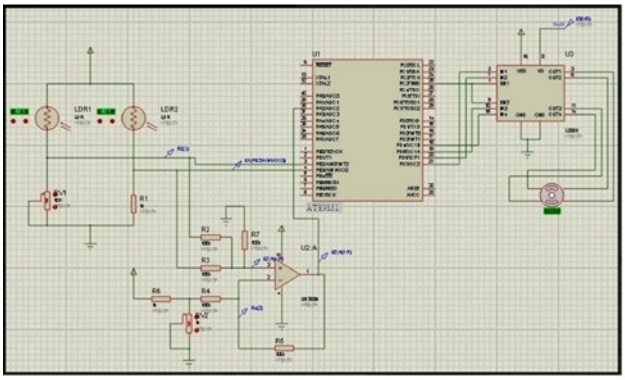

Figure 3. Solar tracking system schematic diagram

Building Projects and Creating HEX Files:

Typical, the tool settings under Options – Target is all you need to start a new application. You may translate all source files and line the application with a click on the Build Target toolbar icon. When you build an application with syntax errors, µVision2 will display errors and warning messages in the Output Window – Build page. A double click on a message line opens the source file on the correct location in a µVision2 editor window. Once you have successfully generated your application, you can start debugging. After you have tested your application, it is required to create an Intel HEX file to download the software into an EPROM programmer or simulator. µVision2 creates HEX files with each build process when Create HEX files under Options for Target – Output is enabled. You may start your PROM programming utility after the making process when you specify the program under the option Run User Program Ref. Appendix.

The LDR with different sunlight intensity and hardware implementation are shown in Figure 4 and Figure 5 respectively.

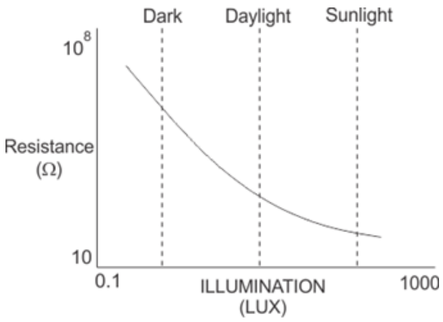

Figure 4. LDR with different sunlight intensity.

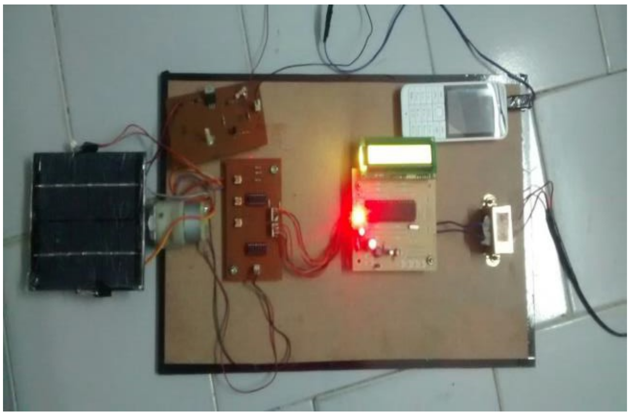

Figure 5. Hardware implementation.

4. Conclusions

In this study, the sun tracking system is developed based on an 8051 microcontroller. The microcontroller 8051 based circuit is used in this system with a minimum number of components, and the use of stepper motors enables accurate tracking of the sun. After examining the information obtained in the data table section and the plotted graph, it has been shown that the sun tracking systems can collect maximum energy than a fixed panel system collects. High efficiency is achieved through this tracker, and it can be said that the proposed sun tracking system is a feasible method of maximizing the light energy received from the sun. This is an efficient tracking system for solar energy collection. We considered the study to be a successful attempt at supplementing their energy requirements while maintaining economic viability. Our initial goal was to develop the economically viable circuitry required to step up the 1.5V to 5V. On developing the circuitry, we decided to prototype the entire system and performed it favorably.

Declaration of Conflict of Interests

The author(s) declare(s) that there is no conflict of interest. They have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix

Program for Solar Tracking System #include<reg52.h>

```
#define lcd_data P2 sbit lcd_rs=P2^0; sbit lcd_en=P2^1; sbit ldr1=P1^0; sbit ldr2=P1^1; sbit ldr3=P1^2; sbit m1=P1^3;

sbit m2=P1^4;

void delay(unsigned int value)

{

unsigned int x,y; for(x=0;x<300;x++) for(y=0;y<value;y++);

}

void lcdcmd(unsigned char value)        // LCD COMMAND

{

lcd_data=value&(0xf0); //send msb 4 bits lcd_rs=0;        //select command register

lcd_en=1; //enable the lcd to execute command delay (3);

lcd_en=0;

 lcd_data=((value<<4)&(0xf0)); //send lsb 4 bits lcd_rs=0;      //select command register

lcd_en=1; //enable the lcd to execute command delay(3);

lcd_en=0; }

void lcd_init(void){ lcdcmd(0x02); lcdcmd(0x02);

lcdcmd(0x28); //intialise the lcd in 4 bit mode*/ lcdcmd(0x28); //intialise the lcd in 4 bit mode*/ lcdcmd(0x0c); //cursor blinking

lcdcmd(0x06);       //move the cursor to right side lcdcmd(0x01);       //clear the lcd

}

void lcddata(unsigned char value)

{

lcd_data=value&(0xf0); //send msb 4 bits lcd_rs=1;        //select data register

lcd_en=1; //enable the lcd to execute data delay(3);

lcd_en=0;

lcd_data=((value<<4)&(0xf0));  //send lsb 4 bits lcd_rs=1;      //select data register

lcd_en=1; //enable the lcd to execute data delay(3);

lcd_en=0; delay(3);

}

void lcd(unsigned char b[]) // send string to lcd{ unsigned char s,count=0;

for(s=0;b[s]!='\0';s++)

{

count++; if(s==16) lcdcmd(0xc0); if(s==32)

{

lcdcmd(1); count=0;

}

lcddata(b[s]);

}

}

void main()

{

//m1=m2=0;

//ldr1=ldr2=ldr3=1; lcd_init();

lcd(" SOLAR TRACKING ");

lcdcmd(0xc4); lcd("SYSTEM");

while(1)

{

if(ldr1==0 && ldr2==1 && ldr3==1)

{

lcdcmd(1);

lcd("solar moving to position 1"); m1=1;

m2=0;

delay(100); m1=m2=0;

while(ldr1==0 && ldr2==1 && ldr3==1);

}

if(ldr1==1 && ldr2==0 && ldr3==1)

{

lcdcmd(1);

lcd("solar moving to position 2"); m1=1;

m2=0;

delay(100); m1=m2=0;

while(ldr1==1 && ldr2==0 && ldr3==1);

}

if (ldr1==1 && ldr2==1 && ldr3==0)

{

lcdcmd(1);

lcd("solar moving to position 3"); m1=1;

m2=0;

delay(100); m2=1;

m1=0;

delay(300); m1=0;

m2=0;

lcdcmd(0x01);

lcd(" SOLAR TRACKING ");
```

```
lcdcmd(0xc4); lcd("SYSTEM");
while(ldr1==1 && ldr2==1 && ldr3==0);
}
}
}
```