Green Tech Portable Power Supply

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Introduction

Green Tech Portable Power Supply is design to supply power electric for emergencies and for running electronics and appliance away from utility power. The rechargeable source from solar panel can track the position of sun make it suitable use for outdoor activities like camping.

Problem Statement

I. Electricity is the most important things we use every day. To get a continuous supply of electricity as the areas away from the power source of electricity, it requires a supply of energy-storage devices that you can carry wherever only.
II. A variety of mobile devices that store electricity that is sold in the market. Most of them use a energy supply that can pollute the environment. To ensure cleanliness, particularly when used, this device operates using environmentally friendly energy which is solar energy.
III. The Sun move from east to west. To collect maximum output power, the maximum intensity of light must be concentrated on solar panel. Solar panel is placed fixed and disables to move according to the sun movemement thus the power output is lesser.

Objectives

The objectives of the project are:

I. To track the sun so that the solar panel can produce maximum power output. The solar tracker will follow the sun movement to produce more output power to charging the batteries.
II. To design low cost solar tracker that compatible for user so that users are affordable in order to use domestic solar panel more efficiently.
III. To design portable power supply can generate DC and AC Power

Scope of Project

The scope of this project are:

I. The implementation of microcontroller in controlling the solar panel for track the position sun.
II. Choosing the suitable motor to control the angle of the solar panel so that it will always face to the sun.
III. Choosing suitable battery that can store energy to power up small gadget like smartphone, mp3 player, and laptop.
IV. To design DC for USB 5 Volt.

The limitation of this project is portable power supply AC only can support below than 300 Watt.

Literature Review

Human being are faced with the oil and coal depletion of fossil fuels such as a serious threat that these fossil fuels is a one-time non renewable resource, limited reserves and a large amount of combustion of carbon dioxide, causing the Earth's warming, deterioration of the ecological environment. With the development of society, energy saving and environmental protection has become a topical issue.

The green energy also called the regeneration energy, has gained much attention nowadays. Green energy can be recycled, much like solar energy, water power, wind power, biomass energy, terrestrial heat, temperature difference of sea, sea waves, morning and every tides, etc[1,2]. Among these, solar energy is most powerful resource that can be used to generated power. A good energy source prospect for industrial continuous processes needs to be:

- More or less constant energy throught the year
- Highly reliable and needs little maintanance
- Low cost to build and operate
- Virtually no environment impact
- Modular and thus flexible in term of size and applications
- Landscape friendly

Green Technology

"Green Technology is the development and application of product, equipment and systems used to conserve the natural environment and resources which minimizes and reduces the negative impact of human activities"[3].

Advantages & Disadvantages Solar Power Energy

There are many advantages worth considering when it comes to solar energy and everything that it offers. There are many advantages that solar energy has over oil energy. Not only does solar energy benefit your pocketbook, but it also benefits the environment as well. However, there are two sides to everything, and there is a list of solar power disadvantages to accompany the list of advantages[4].

Advantage	Disadvantage
Completely renewable resource.	Very expensive when first purchase them
Absolutely no noise at all	Cannot be harness during storm, on cloudy day or night.
No pollution	-
Very little maintanance is required to keep solar cell running.	-
Saving quite a great deal of money	-
Extremely easy to install	-
Quick responding	-
Infinite Free Energy	-

Solar Tracker

Previously, there are many projects related to solar tracking system that improve the solar tracking system that improve the solar tracking system. Following are the previous projects:

A. Microprocessor Based Control Solar Tracking System Using Stepper Motor

The microprocessor is being used to control the tracking system by interfaced with others components. The advantage using microprocessor is that many funtions can be added on to it by adding extra components[5]. However, it requires external components to implement program memory, RAM and ROM memory, input and output port, and DAC. This will cause high cost of the project, besides increasing the complexity of the project.

B. Miniature Solar Tracker

This solar tracker was microcontroller based and single axis tracking systems using DC motor. The single axis to track the sun, facing east in the morning and west in the evening. This project is cheap and simple in terms of controlling, since the solar tracking system is supported by a tripod[6]. This project does not have an intellingent feedback to control the position of the solar tracker if it is out of position, so it cannot track the maximum sunlight.

C. Different Tracking Strategies for Optimizing the Energetic Efficiency of A Photovoltaic System

This project was a fuzzy logic neural controller and dual-axis tracking systems. The two-axis tracking systems are able to follow very precisely the sun path along the period of one year[7]. Therefore it is more efficient than the single axis systems, yet more expensive. This is because they are using more electrical and mechanical parts. Another disadvantage is the difficulty and complexity of the control part increases.

D. Automatic Solar Tracker (AST)

This project design and built a system to automatically orient a solar panel for maximum efficiency and safely charge batteries. The AST allows the user to place the system anywhere in the world without any calibration. The sun travels through 360 degrees east – west a day, but from perspective of any fixed location the visible portion is 180 degrees during a ½ day period. The AST will control the solar panel angle by using two servo motor which one servo motor control 360 degrees azimuth and one more servo motor will control 180 degrees zenith[8]. This project have an intelligent feedback to control the position of the solar tracker if it is out of position, so it can track the maximum sunlight.

Methodology

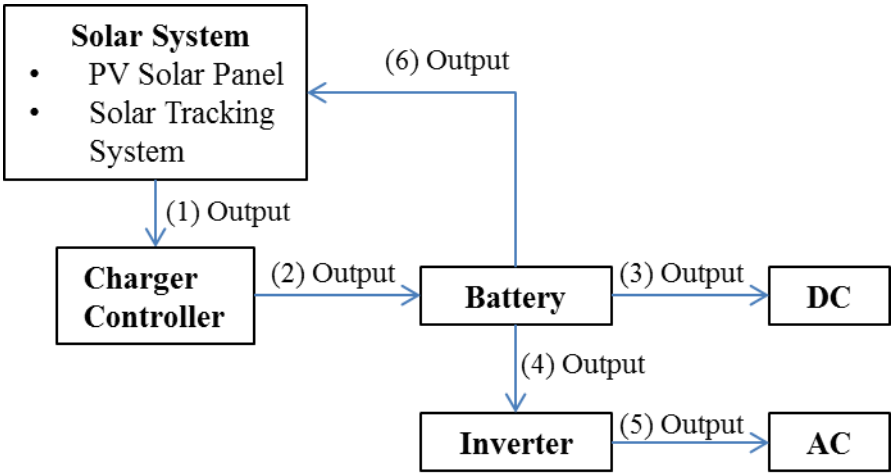


Figure 1: Block diagram

Figure 1 is the simple block diagram of portable power supply. It consist of four main part in this project. Basically the main part of our project is at Solar Tracking System.

Solar Tracking System

Solar energy is rapidly advancing as an important means of renewable energy resource. More energy is produced by tracking the solar panel to remain aligned to the sun at a right angle to the rays of light. Here will describes in detail the design and construction of a prototype for solar tracking system with two degrees of freedom, which detect the sunlight using 4 LDR. The control circuit for the solar tracker is based on a PIC16F84A microcontroller. This is programmed to detect the sunlight through the LDR and the actuate the motor to position the solar panel where it can receive maximum sunlight.

In order to ensure maximum power output from solar panel, the sunlight's angle of incident needs to be constantly perpendicular to the solar panel. This requires constant tracking of the sun's apparent daytime motion, and hence developes an automated sun tracking system which carries the solar panel and positions it in such a way the direct sunlight is always focused on the solar panel.

This is about moving a solar panel along with the direction of sunlight, it uses a gear motor to control the position of solar panel, which obtains its data from PIC16F84A microcontroller. The objective here is to design and implement an automated, double-axis solar-tracking mechanism using embedded system design in order to optimize the efficiency of overall solar energy output. Four light dependent resistor (LDR) is used for each degree of freedom. LDR are basically photocells that are sensitive to light. Software will be developed which would allow the PIC to detect and obtain its data from the four LDRs will be positioned in such a way, so that if one of the four comes under a shadow, the PIC microcontroller will detect the different in resistance and thus actuate the motor to move the solar panel at a position where the light upon four LDRs is equal.

Light Dependent Resistor

A light sensor is the most common electronic component which can be easily found. The simplest optical sensor is a photo resistor or photocell which is a light sensitive resistor these are made of two types, cadmium sulfide (CdS) and gallium arsenide (GaAs), the sun tracker system designed here uses the cadmium sulfide (CdS) photocell for sensing the light. This photocell is a passive component whose resistance is inversely proportional to the amount of light intensity directed towards it. It is connected in series with capacitor. The photocell to be used for the tracker is based on its dark resistance and light saturation resistance. The term light saturation means that further increasing the light intensity to the CdS cells will not decrease its resistance any further. Figure 1 shows the dimensions of the light dependent resistor[9,10].

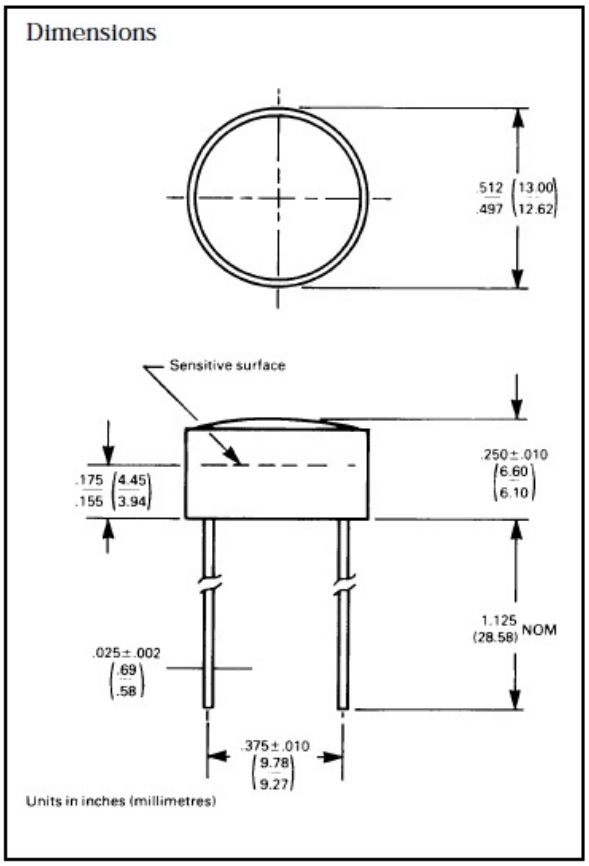


Figure 2: Dimension LDR

PIC16F84A Architecture Detail

There are three types of PIC16F84A packaging designs available in the market: PDIP (18-Lead Plastic Dual In-Line), SOIP (18-Lead Plastic Small Outline), and SSOP (20-Lead Plastic Shrink Small Outline). PDIP type packaging will be used for the solar tracker embeded design. Figure 3 illustrates the PIC16F84A PDIP and shows the name and pin positions[11].

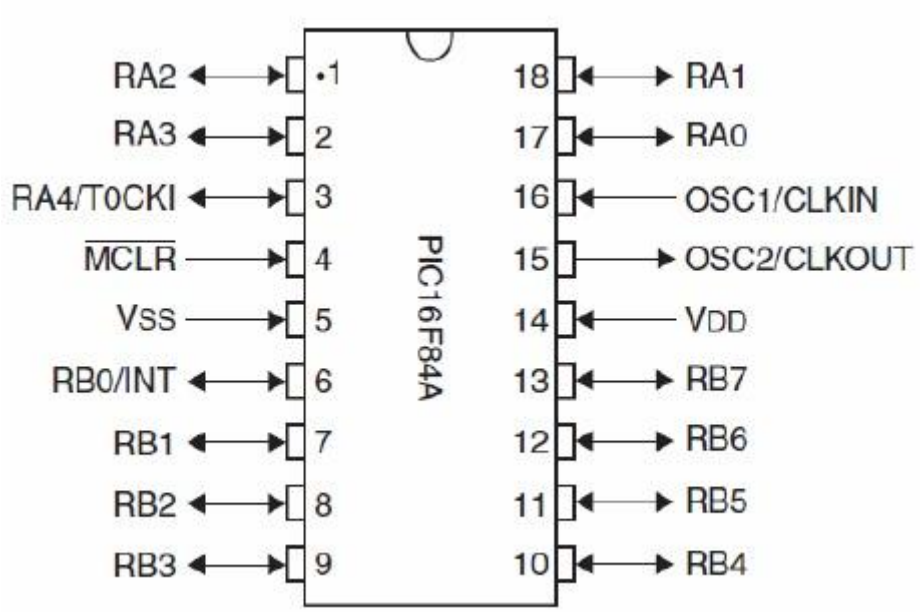


Figure 3: PIC16F84A Pin Position

The PDIP has three key features that satisfy the objective. These are:

- 8 bit multi-channel analog-to-digital converter
- 13 input/output pins
- 64 bytes of data EEPROM memory

Motor Driver

The PIC16F84A controls the H-bridge which consists of four transistor 2N2222, Four diodes 1N4148 and two 10KΩ resistos. Althought any NPN transistor can be used, it was decide to use CS9013 NPN transistor for tracker circuit. This was chosen because it is capable of handling high current as compared with 2N2222. The CS9013 can handle up to 500mA, which is sufficient enough to power up the motor. It was known that the speed of motor was not controlled and was moving very fast, to solve this problem a variable resistor bank was connected and resistance of about 6 Ohm was set. This enabled the motor to move slowly producing the same amount of torque.

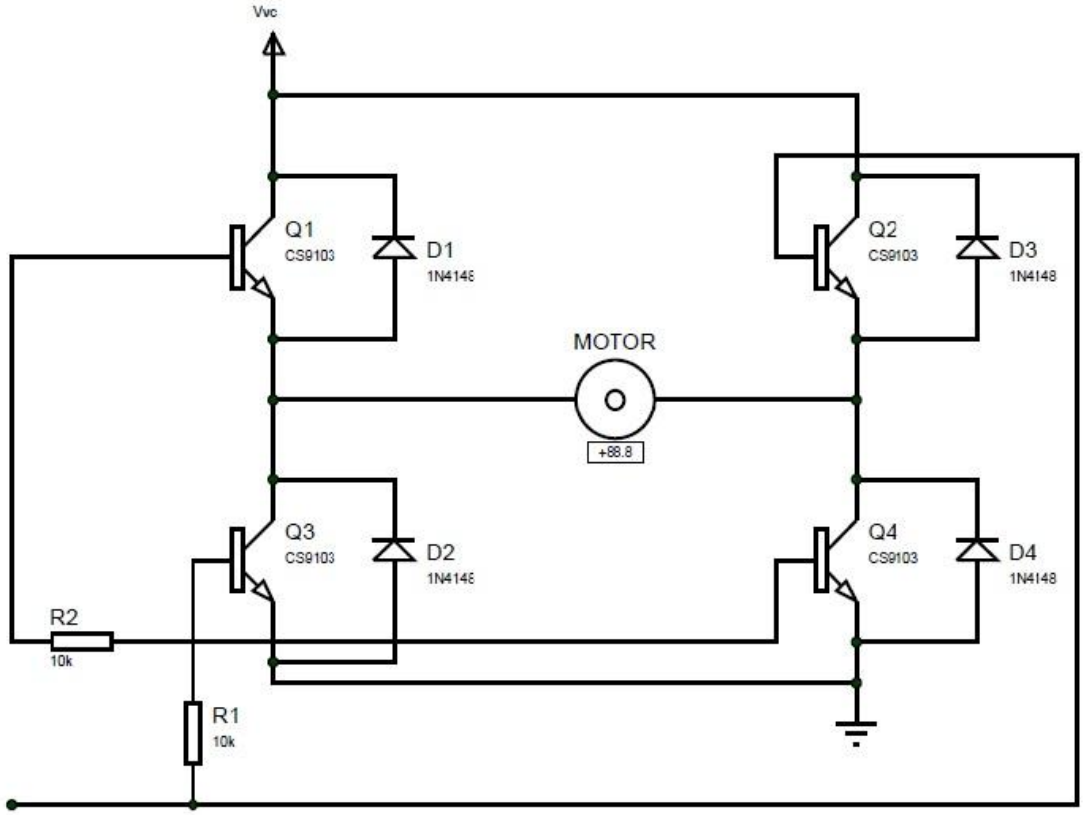


Figure 4: H-Bridge Motor Control

The 1N4148 diodes were chosen to be mounted on all four transistors because the PIC microcontroller is very sensitive to electrical spikes (which may cause a reset or lockup), the diodes are connected across the collector-emitter junction of each transistor. Their function is to stop any electrical spikes caused by switching the motor's winding on and off.

Voltage Regulation

The PIC16F84A needs a regulated supply D.C voltage of 5 Volts, the 7805 voltage regulator is used to provide the voltage required by microcontroller.

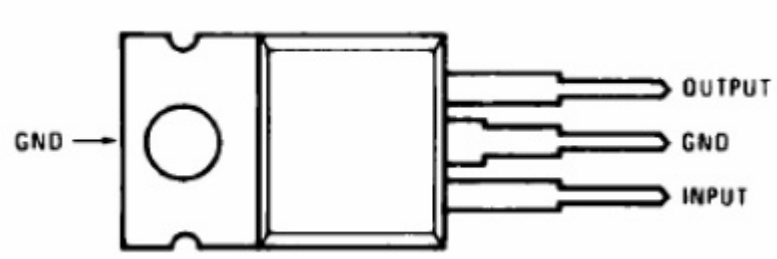


Figure 5: Voltage Regulator

The top view of the regulator itself is shown in Figure 5. The circuit of Figure 6 shows how to convert the unregulated of 12V to 5V, the capacitor of 0.1 microfarad is placed between the input and output to smoothen and maintain the voltage.

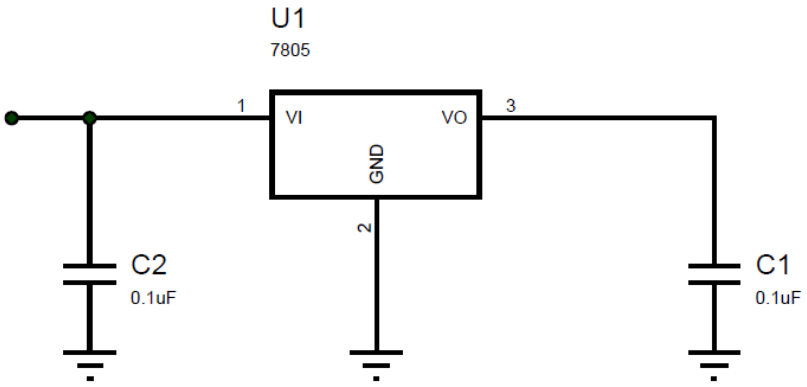


Figure 6: Voltage Regulator Circuit

Operation of the Solar Tracker Circuit

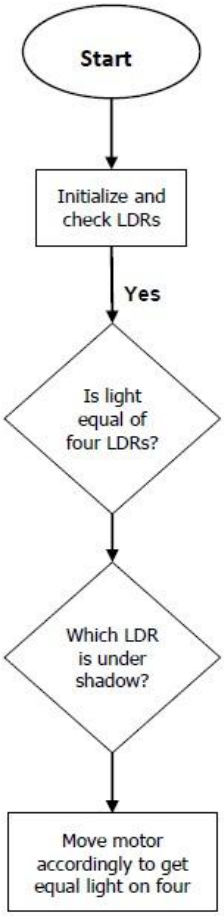
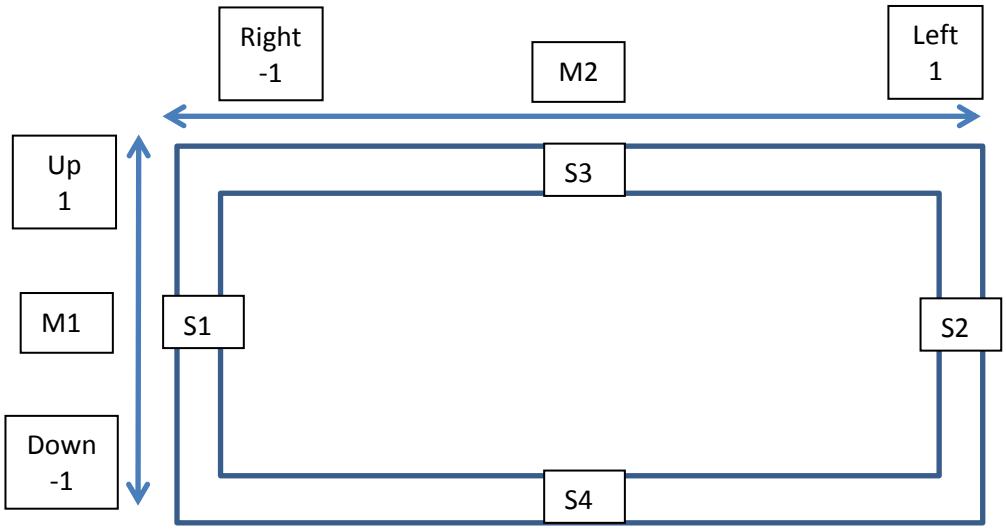


Figure 7: Basic Operation Flowchart

Truth Table of Operation Solar Tracker



Truth Table				Output		Description
S1	S2	S3	S4	M1	M2	
0	0	0	0	0	0	Off
0	0	0	1	-1	0	Down
0	0	1	0	1	0	Up
0	0	1	1	0	1/-1	Right&Left
0	1	0	0	0	1	Left
0	1	0	1	-1	1	Left&Down
0	1	1	0	1	1	Left&Up
0	1	1	1	0	1	Left
1	0	0	0	0	-1	Right
1	0	0	1	-1	-1	Right&Down
1	0	1	0	1	-1	Right&Up
1	0	1	1	0	-1	Right
1	1	0	0	1/-1	0	
1	1	0	1	-1	0	Down
1	1	1	0	-1	0	Down
1	1	1	1	0	0	Off

Motor M1 for control Zenith Angle and Motor M2 for control Azimuth angle.

Photovoltaic Solar Systems

Solar electric systems also known as photovolataic (PV) systems is an electrical device that convert the energy of lights directly into electricity by the photovoltaic effect[5]. PV is the technology that generates direct current (DC) electrical power measured in watts (W) or kilowatts (kW) from semiconductor when they are illuminated by photons. As long as light is shining on the solar cell (the name for the individual PV element), it generates electric power. When the light stops, the electricity stops. Brighter sunlight causes more electrons to be freed resulting in more power generated[12,13].

Charger Controller

A charge controller is used to maintain the proper charging voltage on the batteries. As the input voltage from the solar array rises, the charge controller regulates the charge to the batteries preventing any over charging. It prevents overcharging and may prevent against overvoltage, which can reduce battery performance or lifespan, and may pose a safety risk.

Inverter

Power Inverter is an electrical device that changes direct current (DC) to alternating current (AC).

Gantt Chart

NO	ACTIVITY	NO OF WEEK										
		1	2	3	4	5	6	7	8	9	10	11
1	Project Briefing											
2	Findout Title and submit project suggestion											
3	Submission the Title Project Proposals											
4	Determine of: Problem Statement, Objective Project, Scope of Project, Literature Review, Methodology and Biblography.											
5	Submit First Draf Initial Proposal											

Table 1:Schedule for Completed Initial Proposal

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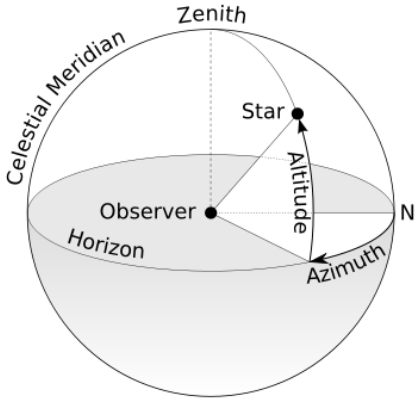

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Appendices