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SOLAR POWER OPERATED TABLE FOR CHARGING ELECTRONIC GADGETS

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***Abstract*--**The objective of the work is to apply solar power for charging electronic appliances namely iphones. The circuit is designed for low ampere and high ampere charging by using PROTEUS software and fabricated and tested for its performance. Time required for full charging of iphone 5 with 1A charging is 90 minutes whereas it is only 50 minutes with 2A charging port. Solar power operated table can be developed by the companies for charging electronic gadgets such as mobile phones that can be employed in public places such as parks, bus stations and airports. Another feature of this product is that three consumers can charge at a time. Charging of electronic gadgets can be done by the common public by drawing power from the battery charged by solar power thereby reducing consumption of electricity from the main grid. The system with 1A and 2A charging of i-phones using solar power operated battery is unique and new to the locality of Caledonian college of engineering and the work can be extended to other parts of Sultanate of Oman.

Keywords--solar powered table, solar panel, electronic gadgets, solar charger

INTRODUCTION

Solar table collects all the energy from the sunlight and helps to charge the electronic gadgets. The design of the table still looks very elegant and stylish. The present project will be an eco-friendly solar panel table. The solar table features also recharging connectivity for many electronic gadgets such as laptops and smartphones. It contains electronic gadgets of 50 watts of 3 hours with continuous operation are powered with 1.0(PV) Photo-Voltaic module of 10W,3 regulators, 6 capacitor,3 battery (3.7v) and 4 diode. The solar panel needs to consume power from the battery at night and for that a diode will be used. There are USB ports to charge. The first port is for low charge and the other for high charge. The output from the table will be 1A and 2A.

The problem of this project is a difference in seasons. The average sunlight per day is less in winter season compared to that of summer. Also, the power of sunlight less in winter and the cell cannot stock up the sunlight. Hence the solar table will be more Figure 1 Insolation world wide (http://solarinsolation.org/) effective in summer than winter. The solutions to this problem are to search and calculate the Insulation sunlight intensity for various seasons. The first thing is to identify the location that gives more insolation throughout the year. The second step is to evaluate the solar insolation based on the literature for that particular location. The sunlight intensity (insolation) is not the same with respect to the time of daylight. Figure 1.1 shows the insolation worldwide. From the overview, the average of sunlight intensity in the sultanate of Oman is 5-6 hours per day. So this result is enough to get good results in the project. During winter, the sunlight intensity will be less. We need more time in order to get full charge. **Figure 1** provides monthly average insolation (kWh per square meter per day) for Muscat as per the data provided by Jha [1].

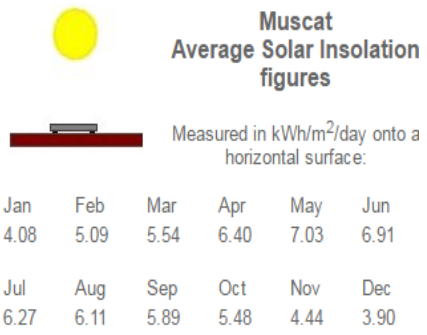

Figure 1 Monthly average insolation

The main problem encountered nowadays is the huge consumption of electricity for various human needs. Mostly electricity is produced from burning petroleum derived products which is finishing day by day.The solution to this problem is using the solar energy to reduce usage of the electricity. This will make everything eco-friendly and less risk involved with electricity.

The aim of project is to use a solar energy to charge the table which in turn charge the electronic gadgets

to reduce usage of electricity. The objectives of the project are design the table that consumes solar energy, fabricate the solar powered table to charge the electronic devices, test and evaluate the solar powered table as well as analyse reduction of consumption electricity by using the solar powered table. The scope of the project is that the solar powered table is so useful because it is portable and small. Also, this table is eco-friendly and it is comfortable to use.

This project involved the design of solar- powered table which is collecting all the energy from the sunlight to store the energy in the battery to use it for another time. That means the stored energy can help the people to recharge the electronic gadgets in need. The main idea or innovation of this project is the usage of solar energy to reduce usage of electricity. Initially, individual components of the table will be designed separately to obtain specification of the components in order to meet the requirements. The problem faced in the project is the difference in seasons that gives different insolation. The locality is very important from this point of view.

LITERATURE REVIEW

Solar-powered battery is presented by Vira *etal*.[2] that uses photo-voltaic (PV) panel for converting solar energy into electrical energy. It uses a converter circuit to control the output power from the PV panel and thereby charging current for battery. A solar charger is used to charge battery during the day with good sunlight and the efficiency is up to 17%. This gives output in order to charge the various electronic devices. In conclusion, the portable device charge system is proposed by solar energy with DC-DC boost converter circuit. The universal USB becomes the most prominent and feasible solution for connection.

The terminal voltage variation of a supercapacitor causes degradation in associated power converter efficiency by offsetting the operating voltage and current from the optimal point as per Kim et al. [3]. Thus, careful charge management such as the MPTT should be performed to maximize the chargers efficiency. A Solar USB charger for smartphone shows the maximum power transfer. A USB-compatible solar charger for smartphones using supercapacitor as the energy buffer supports the maximum power transfer tracking (MPTT).The conversion efficiency is expressed as a function of input voltage, output voltage and output current.

$$\eta(V_{in}, V_{out}, I_{out}) = \frac{P_{out}}{P_{in}} = \frac{P_{in} - P_{loss}}{P_{out}}$$

This paper introduces the solar USB charger for smartphone that shows the maximum power transfer tracking (MPTT). The most commercial solar chargers rely on a large capacity built-in battery. Such as solar sharer with a built-in battery have drawbacks in many aspects including cycle life, weight, volume, and cost as well as low solar charging efficiency.

While designers of battery charger systems often maximize the energy efficiency of their devices to ensure long operation times between charging, they often ignore how much energy is consumed in the process of converting ac electricity from the utility grid into dc electricity stored in the battery as per Al-Mashhadany and Attia [4]. Significant energy savings are possible by reducing the conversion losses associated with charging batteries in battery-powered products. Methodology of this paper is designing a PV-based 3W -18V energy system for mobile applications. It contains a PV Photo-Voltaic, circuit design, an oscilloscope and a 9V direct current battery for charging. When the battery charges fully, the battery will start to convert the energy through the 9V direct current which is used when the solar source dries up or at night. Control of the battery charging involves maintaining the current level at the high speed charging limit equaling 34mA. There is a different level of charging current possible, "the normal charging is 100mA". The results about the simulation data (graphs) for the charging circuit, the charging current and the controlling voltage.

The design in this paper is so simple and cheap yet has a high performance. The simulation and result of experiment shown as:

- Charging efficiency above 95% (the ability of solar energy to supply energy to mobile phone).
- The current limiter circuit extends battery life and can save even the charge fully.
- In future work can increase the solar panel efficacy and reducing the size of system.

The amount of additional energy required to improve the desired energy services depends on the efficiency with which the energy is produced, delivered, and used as per Maroma [5]. Energy efficiency improvement would help reduce financial investment in new energy supply system. The methodology of this paper focuses on the development of a cell phone charging station that is run only through solar energy

by solar cells, which are fitted to the charging station through Battery backup storage. The device is designed primarily for commercial use because some fees can be collected for a specified period from mobile phone chargers. Since the device is a standalone system, it can charge a mobile phone as long as there is sunlight. Even during the night, the device can still charge the phone as long as the battery has power. The result of this paper is to evaluate the acceptability of the station in terms of the following:

1- Physical features
2- Cost
3- Durability
4- Operation

On previous results and the results of the assessment basis, the following conclusions can be drawn:

- Solar panel should be directed manually towards the direction of the sun.
- The time programmed for charging (15 minutes) to be too short to charge cell phones.

The electronic circuits often use solar panels consisting of few or several solar cells, standard voltage regulator integrated circuits (IC) chips, transistors, Zener diodes, diodes and resistors that are used to regulate the output voltage and charging currents. Attia et al. [6] made special attention to the design specifications for the circuits designed previously. Methodology of this paper is to design as well as the testing and analysis of electronic circuits that can be used as a solar charger for mobile devices using solar energy as a source of electric power. Small size of the portable panel of solar cells is chosen so that it is easy to carry to any location from electric grids. Alternative use of solar energy as a power source is useful in emergencies at outdoors. This paper proposes a special electronic design with a significant advantage to control the battery charging currents. The parameters calculated are:

1- Maximum current (I_{max}) =(V_{max}-V_Z)/R_2=48mA
2- Value of zener diode (P_Z) =V_Z*I_Z=0.269W
1- Power in R_2 P(R_2)=(I_{max}^2)* R_2=(0.048*2)*300=0.691W

To improve the stability and transistor behavior of the voltage produced by the solar energy capacitance (C1) = 10 µF/25V

Then will connect the Darlington (Q).it leads to an increase current gain β = β1*β2

Calculate the actual power from maximum Vce and maximum Ic

Max V_{ce} = Max Solar panel Voltage – Mobile Battery voltage = 16.3V

Max Ic= Max charging current = 200 mA.So the Max power = Vce_{Max} * Ic_{Max}

Then calculate the I charging in Max,Mid and Min,

I_{char} = voltage across the (R4+R5) / value of resistance (R4+R5)

$I_{MaxChar}$ = 0.7 / Min of (R4+R5) = 0.7 / 3 = 233 mA

$I_{Mid\ Char}$ = 0.7 / Mid of (R4+R5) = 0.7 / 4.5 = 155 mA

$I_{Min.\ Char}$ = 0.7 / Max of R4+R5 = 0.7 / 6 = 116 mA

The purpose of this paper is an electronic design that can be used for mobile device charging purposes. Summary of this paper is as follows: Solar energy can be used effectively as an alternative energy source to charge portable devices at any locations, especially in places where sunlight or the light source readily available. To absorb maximum solar energy, it should be on direction of plate direct or vertical line of sight with the light of the sun.

Chafle et al. [7] presented a coin base mobile charger using solar tracking system is provided. In this research, the system is designed for public in rural as well as semi urban areas. This is designed base on microcontroller that does the countdown time for a period for a 3 min. with LCD display showing the actual time left. The mobile coin charger consists of solar panel, battery, coin detected sensor and microcontroller. The output parts are LCD Display and multiple charger connectors. The charger driver will be between the microcontroller and multiple charger connectors. This circuit is for charging the mobile phone. Specifications are: AC voltage 230V and DC voltage 6V, current up to 4.5 AH. Schematic representation of the system is provided in this paper. The controller reads the program. Then the controller will give a signal to multi pin charger for use to charge more than one.

Smartphones should automatically get recharged so that users do not need to worry about recharging their smartphones as per Liu et al. [8]. However, existing solutions cannot achieve this desirable goal. Automatic charge smartphones is a system to charge phones from the light beam. The circuit of the project consists of solar panel, MSP430, charging circuit, LED light and smartphone. Specifications are charging voltage 4.2V, power output 2.5W to 5W (1A). In this paper auto charge is introduced, a new

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approach that enables automatic smartphone charging.

METHODOLOGY

The **Proteus** Design Suite is an Electronic Design Automation (EDA) tool including schematic capture, simulation and PCB Layout modules. It is developed in Yorkshire, England by Lab center Electronics Ltd with offices in North America and several overseas sales channels. Proteus means PROcessor for TExt Easy to Use. The project needs to use the PROTEUS to do the circuit because the program has all the components related to the project. The circuit is shown in Figure 2 below. The symbol 'U' represents regulator, 'D' represents diode, 'C' represents the capacitor, 'BAT' represents battery and 'J' represents the Port for charging the electronic gadgets. Total cost involved with the components amounts to 45 Omani Riyal. The components are assembled one after to another to complete the final assembly.

RESULTS AND DISCUSSION

This project called solar powered table, is to use sunlight of energy to charge the solar table .In addition, this project uses the solar energy as a source to charge the table then the table help the people to charge their electronic devices. The solar energy will use to reduce the losses of the electricity. Moreover, the PV panels collect the energy from the sunlight when the sunlight intensity equals 6 hours or more. However, the sunlight intensity different in each country around the world so should know before start doing any projects of solar energy. In OMAN the sunlight intensity is 6 hours. The circuit ade up of linear voltage regulator (2) L8705 & (1) L8712 with (6) capacitors, (4) diode and (3) batteries. Then can put the devices in USB to starting charge.

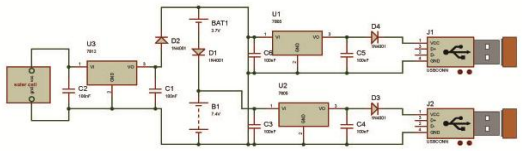

Figure 2 Circuit

Test for the solar panel

Solar panel is tested to confirm whether it is functioning as per the requirement. The test result is presented in the form of table below.

Table1 Solar panel data

Voltage (V)	Current (I)
20.8	0.55

Result from the table indicates that the solar panel satisfy the requirement of 8.3 W.

Test for battery voltage

The voltage built up by the battery with respect to the day of time is tested and the results are shown in the table below.

Table 2 Battery voltages (18-11-2016)

Time of the day	Voltage (V)
8.30 AM	0
9.30 AM	0.30
10.30 AM	0.65
12.00 NOON	1.00
2.00 PM	1.60
3.00 PM	1.89
4.25 PM	2.27

It is evident from the table that the voltage of battery increases with respect to time of the day so that it can be charged completely within a full sunshine day.

Test for charge

Time required for full charging is a critical parameter towards fulfilling the requirements of the system. Test for full charging time required is performed with 1A and 2A ports separately and the results are presented in tables below

Table 3 Full Charging time with 1 A port

No. of users	Time taken for full charge (minutes)
1	90
2	90
3	90

It is evident from the above table that the iPhone gets fully charged by 90 minutes upto 3 users.

Table 4 Full Charging time with 2 A port

No. of users	Time taken for full charge (minutes)
1	50
2	50
3	50

It is evident from the above table that the iPhone gets fully charged by 50 minutes upto 3 users.

CONCLUSIONS

In conclusion, the solar table is taking advantage from the sunlight. Solar table will collect all the energy from the sunlight to help the people to charge the electronic gadgets. This will be an eco-friendly solar panel table. The solar table also features

recharging connectivity for many electronic gadgets such as laptops and smartphones. The solar panel needs to pull power from the battery which works like source power backup at night. There is USB port to charge the phone. The result of the project are takes from the testing the circuit. The output come like can charge phone 3 times but the different is the periods of time. Also, the time to charge the battery full from the solar panel is take 12 hours if the sunlight high. The table is ready for charge and use in this time. It is so comfortable for users and easy to use it.

Further, the design of solar table is done and ready to use. In the future, the table will make it bigger for normal people in office to reduce using electricity. The table will come with small design and small components to make it like a normal table. The circuit of the table also can take it and do any another project is not just for a table. It is so good and easy when use in many type of furniture to reduce use electricity. The solar energy is a daily energy for that good when use it in many projects. The small projects of solar power help many people and easy to pick up.

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