A Project Report

On

Solar Power Bank

Submitted for partial fulfilment of the requirements for the subject

Project Based Learning (FE, II Semester)

of

BACHELOR OF ENGINEERING

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(DIT), PIMPRI, PUNE. 2021-2022

CERTIFICATE

This is to certify that the project work entitled "Solar Power Bank" is a bonafide work carried out by

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Abstract

The objective of this research is to design a Solar Powered Portable Power Bank for electrical devices using sunlight as its ultimate power, which can be used effectively during disaster events or any other emergencies or while caming/treks.

It has in-built solar panel which converts the solar energy to electrical energy. The charge is then transferred to a battery for storage of charge for further use.The battery is connected to a charging circuit having an USB port as output to the respective Electrical Device.

The major factor that drove us to this project is that it is one the method of charging that utilizes the renewable sources of energy where we can overcome the exhaustible usage of power and charge. It reduces the environmental pollution and is much user friendly. During disasters and power outrages, it can be used with ease and with a long and forever durability of device and power. Even in the remote areas having scarcity of electricity, such models can be used. It can be a bit rusty during the rainy and foggy days and needs delicate care.

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CHAPTER I

INTRODUCTION

1.1 Objectives:-

The major liability or drawbacks of communication lines comes because of the distortion of electrical lines or lack of generation of electricity as like in remote areas or during disaster or natural calamities. To set back such drawbacks, we need a renewable source of energy which can function round the clock without any disruption. Solar power bank is one of its kind. It works on the power of the sun, converting solar to electrical and helps in charging the cell phones which can be used in communication, and thus, turns to be vital during disasters and power outage.

1.2 Problem Specifications:

The major factor that drove us to this project is that it is one the method of charging that utilizes the renewable sources of energy where we can overcome the exhaustible usage of power and charge. It reduces the environmental pollution and is much user friendly. During disasters and power outrages, it can be used with ease and with a long and forever durability of device and power. Even in the remote areas having scarcity of electricity, such models can be used. It can be a bit rusty during the rainy and foggy days and needs delicate care.

1.3 Methodology:-

There are 2 main things to consider choosing a Solar panel or creating a Solar system. Battery capacity is measured in Amp Hours. The AH figure must be multiplied by the battery voltage to convert this to Watt Hours which is given by the simple calculation below.

$$X \times Y = Z \qquad \ldots(1)$$

where, Y = Battery Voltage

Z = Power available in watt hours

X =Battery size in AH.

However, as we know that we will not be able to power the battery once the voltage drops below our equipment’s requirements, that is why, we are never really able to take all the power from a battery. Lead acid batteries will give around 50% of their rated power and Li-ion batteries will give around 80% of their rated power. Solar panels are the most critical and final part in designing solar panels. The generation of power in a solar panel is measured in Watts. Theoretically, the energy that can be supplied to a battery can be calculated by multiplying the power generation rating of the solar panel (measured in Watts) to the number of hours the panel is exposed to sunshine. A photovoltaic module can be defined as an assembly of 6x10 solar cells connected and packaged together. The solar array of a photovoltaic system which is generally comprised of these photovoltaic cells generate solar electricity and is used in domestic applications. Only a few solar panels exceed an efficiency of over 19%. Most installations contain multiple modules as a single solar module generates only a limited amount of power. Some of the typical examples of photovoltaic systems are an array of solar modules, a solar inverter, a battery, a solar tracker and interconnection wiring. The photovoltaic panels present in solar-charged power banks can trickle-charge the internal battery of the system when placed in direct sunlight. Depending on the capacity of the Power Bank and its current level of charge, it can take quite a while to fill up. For example, the time taken by a smartphone to charge completely is same as the time taken to charge a 1500mAh power bank completely. For larger banks, this charging time can be doubled, tripled or quadrupled. Most Power Banks use LED indicators to show whether these power banks are at capacity and a safety cut-off valve to avoid overheating and overcharging.

1.4 Contributions :-

In this paper, the product proposed meets the following requirements.

- is compact and lightweight to conserve resources;
- achieves the top levels of energy conservation performance;
- manages hazardous chemical substances
- is easily recycled at the end of life;
- Parts reuse/recyclability, disassembly/dismantling
- Sustainably uses the renewable resources
- Minimises the use of number of inter-connecting wires or cables

1.5 Layout of Project:-

The proposed system is solar based and solar panel plays a vital role in the experiment. Here, we have one solar panel of 6v, for receiving the sunlight, which is connected to the battery of the system where the charge from the sun is stored for future use. The battery is a rechargeable Li-ion battery of 3.7V. Then, the battery is connected to the mobile charging circuit which is further connected to a USB Port from where a mobile can be connected for charging. There are also LEDs attached at the solar panel side, at the charging point for detection of flow of charge. When the solar panels are open, then sunlight direct falls on the photovoltaic cell of the panel and it converts the solar energy to electrical energy. The panel gives a voltage of 3.7V and the charge flows to the battery. There is also a LED which displays the transfer of charge from the panel to the battery. When the battery is charged perfectly up to its full capacity, and then we can connect a mobile phone at the end of the circuit. With the appropriate charge, we can charge the mobile phone at the end of the circuit where we can get an USB port and the phone will be charged by connecting to the port.

After conducting the experiments, we concluded that in order to operate with high efficiency, we need to go through these selections:

- We need bright and sunny weather for a better charging.

• The panel wing should be placed under direct sunlight for better efficiency.

• We need a solar panel of 6v to power the battery.

• Assuming that the battery is not charged then, simultaneously connecting the phone for charging and the battery being charged from the solar panels might take a longer time for the battery to charge.

A basic layout of the whole product can be given as below:

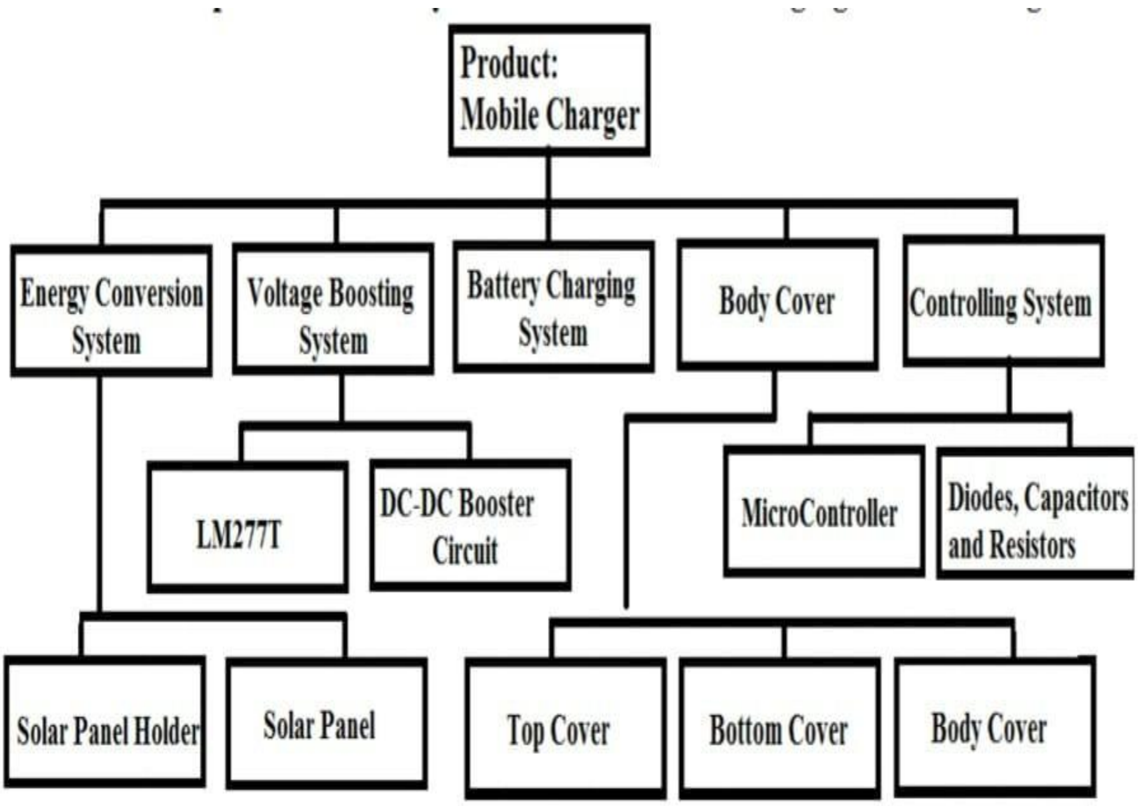

Figure 1. Component Hierarchy of a portable solar charger

Following is the basic layout of the principle system:

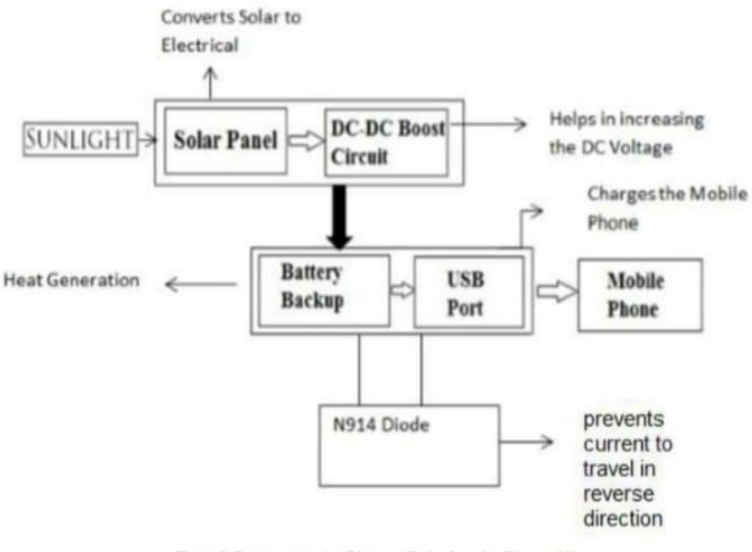

Figure 2. Basic Layout of Principle

CHAPTER II

Literature survey

[1] Chih-HaoHou Chun-Ti Yen Tsung- Hsi Wu Chin-Sien Moo, "A Battery Power Bank of Serial Battery Power Modules with Buck-Boost Converters", The 2014 International Power Electronics Conference, pp. 211-216, 2014.

The operation of a battery power bank with buck-boost battery power modules (BPMs) connected in series is studied. With serial configuration, the output currents of all BPMs are the same as the load current. However, the currents from batteries can be scheduled in accordance with the state-of-charges (SOCs) by adjusting the duty-ratios of the associated power converters for balanced discharging. With such a configuration, in addition to discharge equalization capability, those BPMs with completely exhausted or damaged batteries can be isolated from the battery power bank without interrupting the system operation.

[2] Ke Liu, John Makaran, "Design of a solar powered battery charger", Electrical Power & Energy Conference (EPEC), 2009 IEEE, 2009.

A solar powered battery charger is presented, where a photovoltaic (PV) panel is used to convert solar power into electricity and a DC/DC converter is used to control the output power of the PV panel and the charging current for the battery. In the software, an optimal control algorithm is applied to obtain the maximum available power from the sunshine. The simulation and experimental results are presented and compared. The applications of this technique can be light electrical vehicles such as golf carts, scooters, airport utility vehicles, as well as other renewable power stations where batteries are used for energy storage.

[3] Sangyoung Park, Bumkyu Koh, Yanzhi Wang; Jaemin Kim, Younghyun Kim, Massoud Pedram, Naehyuck Chang,"Maximum power transfer tracking in a solar USB charger for smartphones", Low Power Electronics and Design (ISLPED), 2013 IEEE International Symposium.

Battery life of high-end smartphones and tablet PCs is becoming more and more important due to the gap between the rapid increase in power requirements of the electronic components and the slow increase in energy storage capacity of Li-ion batteries. Energy harvesting, on the other hand, is a promising technique that can prolong the battery life without compromising the users' experience with the devices and potentially without the necessity to have access to a wall AC outlet. Such energy harvesting products are available on the market today, but most of them are equipped with only a large battery pack, which exhibits poor capacity utilization during solar energy harvesting.

[4] K.Jaiganesh, K.Duraiswamy, "Dump Power Control Techniques for standalone Hybrid Wind / Solar Power Generation Control", 2012 - International Conference on Emerging Trends in Science, Engineering and Technology.

With ever increasing concern on energy issues, the development of renewable energy sources is becoming more and more attractive. In the past few year the photovoltaic and wind power generation have been increased significantly. Both energy flow and operation characteristics of stand-alone wind / PV hybrid power systems are analyzed to achieve its optimal and reliable operation. Here the proposed unique standalone hybrid power generation system, applying advanced power control techniques feed to power sources; Wind power, solar power, storage battery. The objectives of the advanced power control techniques are to satisfy the load power demand and, to maintain the state of charge of the battery bank to prevent blackout and to extend the life of the batteries.

CHAPTER III

Problem Definition

The major factor that drove us to this project is that:-

- It is one the method of charging that utilizes the renewable sources of energy where we can overcome the exhaustible usage of power and charge.

- During disasters and power outrages, it can be used with ease and with a long and forever durability of device and power.

- In the remote areas having scarcity of electricity, such models can be used. It can be a bit rusty during the rainy and foggy days and needs delicate care.

- It reduces the environmental pollution and is much user friendly.

CHAPTER IV

System Design

The system consists of following:

(1) Power bank module: It is a charging board circuit which works on batteries of 3.7 – 4.2 V and gives an i=output current of 1 Amp

(2) Battery: A rechargeable Li-ion battery of 3.7 V and battery capacity of 6000 mAH.

(3) Solar panel: A solar panel which converts solar energy to electrical energy at 1.5 W. It has 6V and 250 milli Amp output.

(4) LED: An LED is used to indicate the working of solar panel (in use or not).

(5) Diode: A diode is used to restrict the current in one direction , i.e. , from solar panel to battery and module but not in reverse.

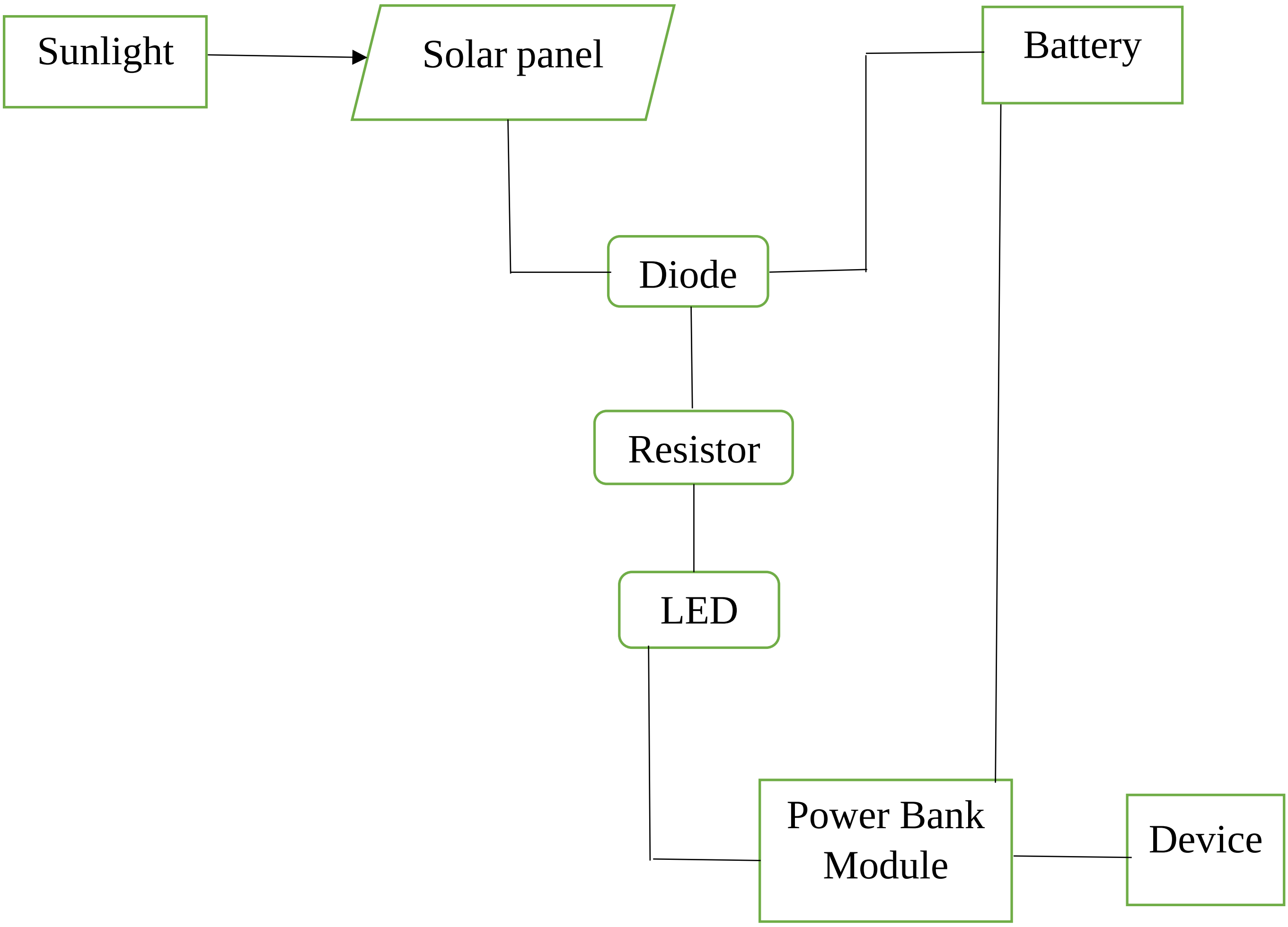

Figure 3. Block diagram

The positive terminal of solar panel is connected to diode as well as a resistor and LED . The diode then allows the current two paths – towards the battery and secondly, towards the power bank module.

A switch is connected between the diode and battery connection.

This allows us to charge our device directly from the solar panel without including the battery.

The negative terminal of the battery, solar panel and LED are connected to the negative terminal of the power bank module.

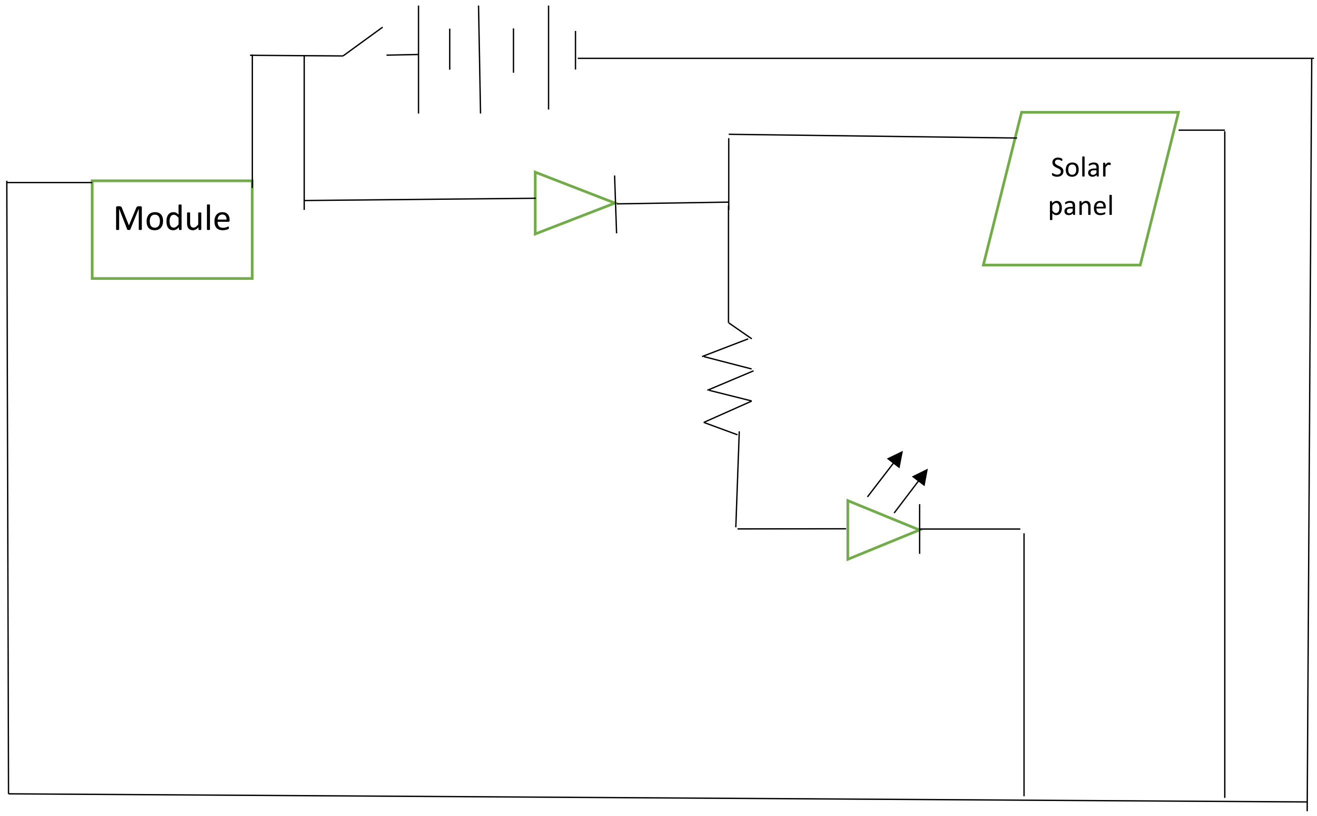

Figure 4. Circuit Diagram

CHAPTER V

Implementation

The following are the calculations done to test the project work:

- Battery efficiency assumed to be 80%. Thus, the power needed to fully charge the battery of 3.7V and 6000mAH battery capacity :

  P = (3.7 x 6)/0.8

  P = 27.75 Watt Hours

- Power generated by solar panel of 6V and 250mA :

  P = 6 x 0.25

  P = 1.5 Watts

- Thus, the time needed to charge the battery by solar panel is :

  Time = 27.75/1.5

  Time = 18.5 Hours

Thus, the time needed to charge the battery is around 18.5 – 20 hours in optimal sunshine.

Our circuit connection allows us to use the product in the following three ways:-

(1) When device is kept to charge directly from the battery in absence of sunlight. Here the device to be charged has battery capacity of 4000 mAH and 3.7 V. The current supplied to the device is of 1 Ampere at 3.7 V.
The time required to charge the device will be :

Time = (4 x 3.7)/(1 x 3.7)

Time = 4 hours

It takes 4 hours of charging to completely charge the mobile device.

Our circuit connection allows us to use the product in the following three ways:-

(1) When device is kept to charge directly from the battery in absence of sunlight. Here the device to be charged has battery capacity of 4000 mAH and 3.7 V. The current supplied to the device is of 1 Ampere at 3.7 V.
The time required to charge the device will be :

Time = (4 x 3.7)/(1 x 3.7)

Time = 4 hours

It takes 4 hours of charging to completely charge the mobile device.

Figure 5. Case (1)

(2)When device is charged directly by solar panel of 1.5 W :

Time = (4 x 3.7)/1.5
Time = 9.87 hours

Thus, it takes approximately 10 hours of charging directly from the solar panel. As you can see this kind of charging is too slow and the condition is that it is needed to be kept under optimal sunshine for 10 hours. This can cause the device to heat up quite a bit.

(3)When device is charged from both the battery as well as solar panel , the times required to charge it is :

Time = (4 x 3.7)/(1 x 3.7 + 1.5)
Time = 2.85 hours

Thus, it takes around 3 hours of charging. However, this is only when the battery is fully charged. If not, then some current flows from the solar panel to the battery to charge it as well. Therefore, the time it takes varies anywhere from 3 hours to under 4 hours.

When no device is connected and product is kept under sunlight, the current flows from the solar panel to the battery and charges it. From the above calculations we can see it takes around 18.5 to 20 hours of optimal sunshine to charge it completely.

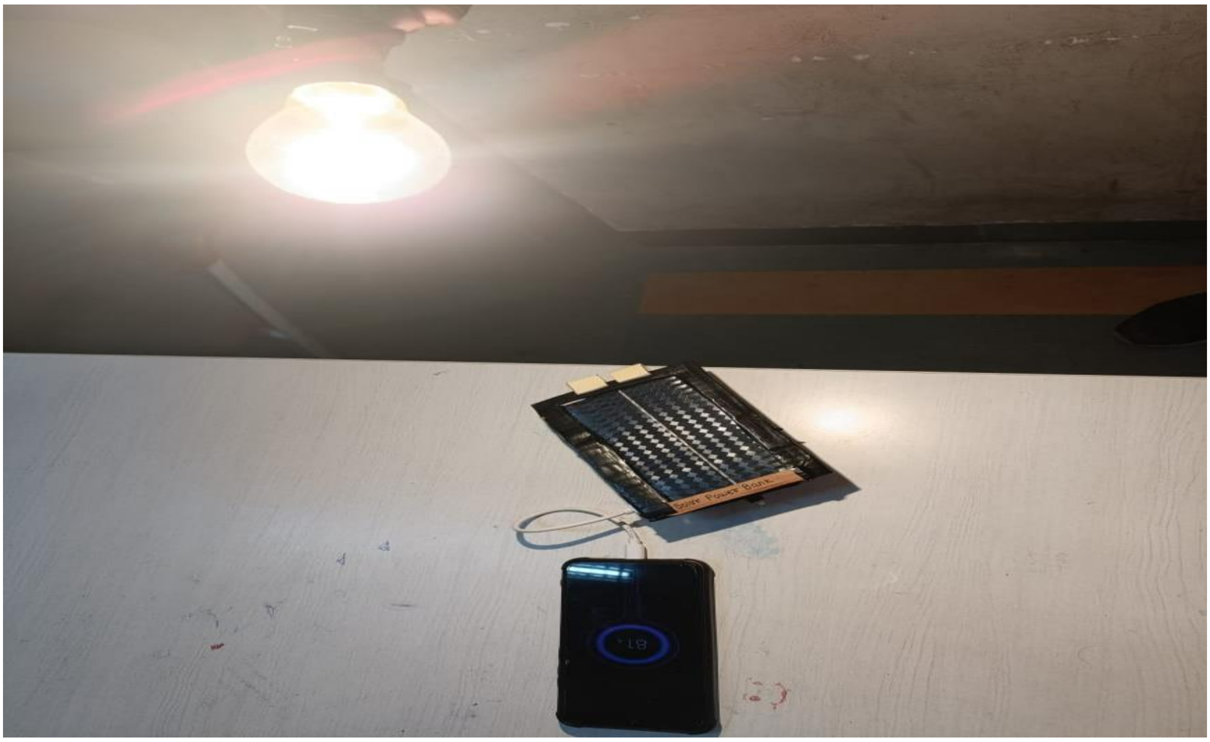

Figure 6. Case (2)

CHAPTER VI

Conclusion

olar power banks are affordable, environment friendly, cost – saving and reliable source of power supply for gadgets. The earth is already battling so many environmental hazards and global warming is the most glaring issue today. By using solar power, you will be conserving energy, thereby reducing the strain. This is because solar energy is pollution-free, it is clean, renewable energy. Its use doesn't promote the emission of greenhouse gases, unlike regular electricity, instead, you are only tapping sunlight on mother earth. If you have a lot of electronic gadgets, the chances are that you normally pay high electricity bills. Well, that can changes when you go for a solar power bank. Since you will not be using the regular electricity as much, your utility bill will reduce. After all, you are not paying for sunlight. Most importantly, it helps stay connected anytime, anywhere and on the go!

CHAPTER VII

Future Scope

- We can use more solar panels instead of one to charge faster.
- We can add relay circuit to improve the safety of the circuit, battery and the mobile phone.
- If the phone is undercharged or overcharged, the relay will cut the supply saving the battery and mobile from getting damaged.
- Better modules can be used to increase charging rate of devices.
- An emergency light can be added to it as an extra function.
- Can use better battery indicators to display accurate battery information.

CHAPTER VIII

Biblography

[1] Chih-HaoHou Chun-Ti Yen Tsung- Hsi Wu Chin-Sien Moo, "A Battery Power Bank of Serial Battery Power Modules with Buck-Boost Converters", The 2014 International Power Electronics Conference, pp. 211-216, 2014.

[2] Ke Liu, John Makaran, "Design of a solar powered battery charger", Electrical Power & Energy Conference (EPEC), 2009 IEEE, 2009, pp. 1-5.

[3] Sangyoung Park, Bumkyu Koh, Yanzhi Wang; Jaemin Kim, Younghyun Kim, Massoud Pedram, Naehyuck Chang,"Maximum power transfer tracking in a solar USB charger for smartphones", Low Power Electronics and Design (ISLPED), 2013 IEEE International Symposium, pp. 88-93.

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