Solar Energy Harvesting

Project Exhibition -2

Submitted in partial fulfillment for the award of the degree of

Bachelor of Technology
In
ELECTRICAL AND ELECTRONICS ENGINEERING

Submitted to

VIT BHOPAL UNIVERSITY (M.P.)

Submitted by:

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December - 2021

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SCHOOL OF ELECTRICAL & ELECTRONICS ENGG.

CANDIDATE'S DECLARATION

I hereby declare that the Dissertation entitled "Solar Energy Harvesting" is my own work conducted under the supervision of Dr. Anvesh kumar Nella, Assistant Professor, Electrical and electronics department at VIT University, Bhopal.

I further declare that to the best of my knowledge this report does not contain any part of work that has been submitted for the award of any degree either in this university or in another university / Deemed University without proper citation.

Sakshi pathak
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This is to certify that the above statement made by the candidate is correct to the best of my knowledge.

Date: 25 December 2021

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CERTIFICATE

This is to clarify that the work embodied in this Project Exhibition 2 report entitled **"Solar Energy Harvesting"** has been satisfactorily completed by Ms. Sakshi Pathak Registration no: 19BEE10004 in the School of Electrical & Electronics Engineering VIT University, Bhopal. This work is a bona fide piece of work, carried out under my/our guidance in the School of Electrical and Electronics Engineering for the partial fulfilment of the degree of Bachelor Technology.

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First and foremost, I would like to express my deep and sincere gratitude to my guide, Prof. Anvesh kumar Nella, Assistant professor, SEEE, VIT Bhopal University, and our programchair Dr. Pallabi Sarkar Asst. Professor, SEEE, VIT Bhopal University for offering me the opportunity to execute this project. Under their guidance and experience, I learned a lot about the various aspects in and around the project. They supported me whenever needed, even during their busy schedule. It was indeed a privilege to work under these qualified visionaries.

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EXECUTIVE SUMMARY

Solar energy can only be harnessed when it is daytime and sunny. To overcome this, solar panels can be coupled with a back-up battery which can store the excess power generated during the day and use it to provide energy to the system in the absence of sunlight. The large size of the solar panel makes the device bulky and non-portable. The solar panel should be fabricated to cover the entire device, which can effectively reduce the size of the entire device. For low power portable electronics, like calculators or small fans, a photovoltaic array may be a reasonable energy source rather than a battery. Solar chargers can charge lead acid or Ni-Cd battery banks up to 48 V and hundreds of ampere-hours (up to 400 Ah) capacity. Small portable models designed to charge a range of different mobile phones, cell phones, iPods or other portable audio equipment. Public solar chargers are permanently installed in public places, such as parks, squares and streets, which passers-by can use for free.

LIST OF SYMBOLS & ABBREVIATIONS:

A – Ampere

V – Voltage

LIST OF COMPONENT

Designing of charger

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CHAPTER –I

1. INTRODUCTION

Solar energy is the energy produced directly by the sun and collected elsewhere, normally the Earth. The sun creates its energy through a thermonuclear process. The process creates heat and electromagnetic radiation. Only a very small fraction of the total radiation produced reaches the Earth. The radiation that does reach the Earth is the indirect source of nearly every type of energy used today. The radiation that does reach the Earth is the indirect source of nearly every type of energy used today. The exceptions are geothermal energy, and nuclear fission and fusion. Even fossil fuels owe their origins to the sun; they were once living plants and animals whose life was dependent upon the sun. Much of the world's required energy can be supplied directly by solar power. More still can be provided indirectly. The practicality of doing so will be examined, as well as the benefits and drawbacks. In addition, the uses solar energy is currently applied to will be noted. Due to the nature of solar energy, two components are required to have a functional solar energy generator. These two components are a collector and a storage unit. The collector simply collects the radiation that falls on it and converts a fraction of it to other forms of energy (either electricity and heat or heat alone). The storage unit is required because of the non-constant nature of solar energy; at certain times only a very small amount of radiation will be received. At night or during heavy cloud cover, for example, the amount of energy produced by the collector will be quite small. The storage unit can hold the excess energy produced during the periods of maximum productivity, and release it when the productivity drops. In practice, a backup power supply is usually added, too, for the situations when the amount of energy required is greater than both what is being produced and what is stored in the container.

2. OBJECTIVE

- · To develop a solar powered battery charger.
- To develop a state of charge, (SOC) circuit to indicate the charging level of the batteries.

3. PROPOSED METHODOLOGY

3.1 PHOTOVOLTAIC CELL

The term "photovoltaic" comes from the Greek (photo) means "light", and "voltaic", means electric, from the name of the Italian physicist “VOLTA "after whom a unit of electro-motive force, the volt, is named. The sun is a star made up of hydrogen and helium gas and it radiates an enormous amount of energy every second. A photovoltaic cell is an electrical device that converts the energy of light directly into electricity by photovoltaic effect. Photovoltaic is the field of technology and research related to the practical application of photovoltaic cells in producing electricity from light, though it is often used specifically to refer to the generation of electricity from sunlight. Cells can be described as photovoltaic even when the light source is not necessarily sunlight (lamplight, artificial light, etc.). In such cases the cell is sometimes used as a photo detector (for example infrared detectors, detecting light or other electromagnetic radiation near the visible range, or measuring light intensity. The operation of a photovoltaic (PV) cell requires 3 basic attributes:

• The absorption of light, generating either electron-hole pairs or exactions. •

The separation of charge carriers of opposite types.

• The separate extraction of those carriers to an external circuit.

In contrast, a solar thermal collector collects heat by absorbing sunlight, for the purpose of either direct heating or indirect electrical power generation. "Photo electrolytic cell" (photo electrochemical cell), on the other hand, refers to either a type of photovoltaic cell (like that developed by A.E. Becquerel and modern dye-sensitized solar cells or a device that splits water directly into hydrogen and oxygen using only solar illumination.
Photovoltaic power generation employs solar panels composed of a number of solar cells containing a photovoltaic material. presently used for photovoltaic include monocrystalline silicon, polycrystalline silicon, amorphous silicon, cadmium telluride, and copper indium gallium selenite. Due to the increased demand for renewable energy sources, the manufacturing of solar cells and photovoltaic arrays has advanced considerably in recent years. 4 Solar photovoltaic is a sustainable energy source. Solar photovoltaic is now, after hydro and wind power, the third most important renewable energy source in terms of globally installed capacity. More than 100 countries use solar PV. Installations may be ground-mounted (and sometimes integrated with farming and grazing) or built into the roof or walls of a building (either building integrated photovoltaic or simply rooftop). Driven by advances in technology and increases in manufacturing scale and sophistication, the cost of photovoltaic has declined steadily since the first solar cells were manufactured, and the liveliest cost of electricity (LCOE) from PV is competitive with conventional electricity sources in an expanding list of geographic regions. Net metering and financial incentives, such as preferential feed-in tariffs for solar-generated electricity, have supported solar PV installations in many countries. With current technology, photovoltaic recoup the energy needed to manufacture them in 3 to 4 years.

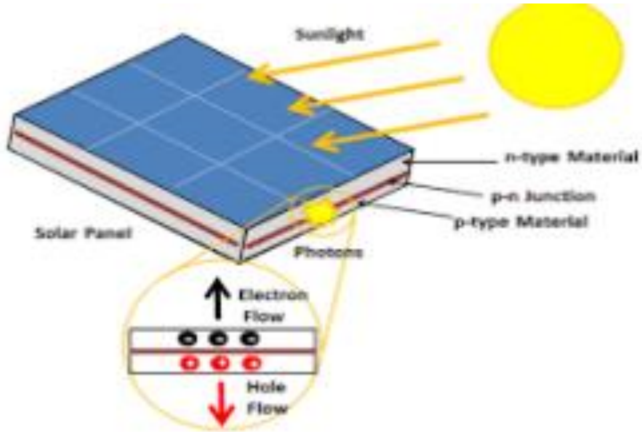

Figure :1 Solar cell

3.2 SOLAR PROCESS

Photovoltaic cells are made of special materials called semiconductors such as silicon. An atom of silicon has 14 electrons, arranged in three different shells. The outer shell has 4 electrons. Therefore a silicon atom will always look for ways to fill up its last shell, and to do this, it will share electrons with four nearby atoms. Now we use phosphorus (with 5 electrons in its outer shell). Therefore when it combines with silicon, one electron remains free.

When energy is added to pure silicon it can cause a few electrons to break free of their bonds and leave their atoms. These are called free carriers, which move randomly around the crystalline lattice looking for holes to fall into and carrying an electrical current. However, there are so few that they aren't very useful. But our impure silicon with phosphorus atoms takes a lot less energy to knock loose one of our extra electrons because they aren't tied up in a bond with any neighbouring atoms. As a result, we have a lot more free carriers than we would have in pure silicon to become N-type silicon. The other part of a solar cell is doped with the element boron (with 3 electrons in its outer shell) to become P-type silicon. Now, when this two types of silicon interact, an electric field forms at the junction which prevents more electrons from moving to the P-side.

When a photon hits a solar cell, its energy breaks apart electron-hole pairs. Each photon with enough energy will normally free exactly one electron, resulting in a free hole as well. If this happens close enough to the electric field, this causes disruption of electrical neutrality, and if we provide an external current path, electrons will flow through the P side to unite with holes that the electric field sent there, doing work for us along the way. The electron flow provides the current, and the cell's electric field causes a voltage.

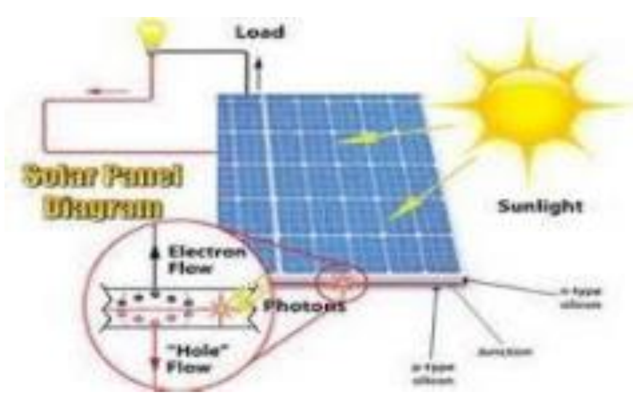

Figure 2. Solar process

In this project we have used a solar panel that converts solar energy into electrical energy (DC) through photovoltaic effect. After that we use a buck converter, which is used to convert high voltage into low voltage, so it produces variable DC voltage. Then we make connection between buck

CHAPTER -II

4. LITERATURE REVIEW

This chapter focuses on existing literature related to key concepts of this report's research and addresses the following research objectives:

Paper1:

A Review Paper on Electricity Generation from Solar Energy Mohd Rizwan Sirajuddin Shaikh 1, Santosh B. Waghmare 2, Suvarna Shankar Labade 3, Pooja Vittal Fuke4, Anil Tekale5 1, 2,3,4,5 Students, Department of Electrical Engineering, Savitribai Phule Pune University.

- In this article, they have reviewed about the Solar Energy from Sunlight and discussed about their future trends and aspects. The article also tries to discussed working, solar panel types; emphasize the various applications and methods to promote the benefits of solar energy.

- PV cells Convert Sunlight to Direct Current (DC) electricity with the help of inverter into Alternating Current (AC).

• For website
https://www.researchgate.net/publication/320226399_A_Review_Paper_on_Electricity_Gene r ation_from_Solar_Energy

• Book
Shruti Sharma, Kamlesh Kumar Jain, Ashutosh Sharma a review on "Solar Cells: In Research and Applications", Materials Sciences and Applications, 2015, 6, 1145-1155 Published December 2015 http://dx.doi.org/10.4236/msa.2015.612113

Paper2:

Solar Cells: In Research and Applications—A Review Shruti Sharma1, Kamlesh Kumar Jain1, Ashutosh Sharma2, 1CMD College, Bilaspur, India 2Materials Science and Engineering, University of Seoul, Seoul, South Korea.

- In this article, they have reviewed a progressive development in the solar cell research from one generation to other, and discussed about their future trends and aspects. The

  the article also tries to emphasize the various practices and methods to promote the benefits of solar energy.
- The working mechanism of solar cells is based on the three factors: (1) Adsorption of light

in order to generate the charge careers, holes (p-type) and electrons (n-type) (2) Separation of charge careers, and (3) the collection of charge careers at the respective electrodes establishing the potential difference across the p-n junction.

• For website
https://www.researchgate.net/publication/288056432_Solar_Cells_In_Research_and_Applications-A_Review

• Book
Choubey, P.C., Oudhia, A. and Dewangan, R. (2012) A Review: Solar Cell Current Scenario and Future Trends. Recent Research in Science and Technology, 4, 99-101.

Paper3:

Design and Analysis of a DC -DC Buck converter and Boost Converter to Achieve High Efficiency by altering duty cycle and input voltage R. Abhishek *, Pallavi Zoting*, Purva Ragit * Department of electronics and communication (ECE), VNIT-NAGPUR

- This paper explains DC to DC buck convertor and boost converter which cites the dependency of duty cycle and input voltage on output voltage.

- It consists of elements like switch/MOSFET, transistor, inductor, resistors. A simulation has been conducted to analyze the efficiency of the DC-DC buck converter and boost converter. The result shows the efficiency of the DC-DC buck and boost converter increases as we increase the duty cycle and the input voltage.

• For website
https://www.researchgate.net/publication/342837349_Design_and_Analysis_of_a_DC_-DC_Buck_converter_and_Boost_Converter_to_Achieve_High_Efficiency_by_altering_duty_cycle_and_input_voltage

• Book
Sairatun Nesa Soheli et al, Design and Analysis of a DC -DC Buck Boost Converter to Achieve High Efficiency and Low Voltage Gain by using Buck Boost Topology into Buck Topology, "IEEE Transactions on Power Electronics Year.

CHAPTER -III

5. LIST OF COMPONENTS FOR SIMULATION

- IC Mc34063
- Diode IN5819
- Inductor 330uh
- Capacitor 1nf
- Capacitor 100uf
- Capacitor 1000uf
- Variable 10k
- Resistor 1ohm
- Variable resistor 10k
- Jumper wire
- USB connector
- Breadboard
- Solar panel
- Smartphone

CHAPTER - IV

6. PRACTICAL IMPLEMENTATION

6.1 BUCK CONVERTER

It is a DC to DC step-down converter. The simplest way to reduce the voltage of a DC supply is to use a linear regulator (such as a 7805), but linear regulators waste energy as they operate by dissipating excess power as heat. Buck converters, on the other hand, can be remarkably efficient (95% or higher for integrated circuits). It utilizes a MOSFET switch (IRFP250N), a diode, inductor and a capacitor. Few resistors also are used in the circuit for the protection of the main components. When the MOSFET switch is ‘ON’ current rises through the inductor, capacitor and load. Inductor stores energy. When the switch is ‘OFF’ the energy in the inductor circulates current through the inductor, capacitor freewheeling diode and load. The output voltage will be less than or equal to the input voltage.

Here we use an Mc34063DC-DC buck converter step-down power module with a high precision potentiometer for adjusting output voltage, capable of driving a load up to 3A with high efficiency.

The specification of the DC-DC buck converter is

1. Module properties: non-isolated constant voltage module
2. Rectification: non-synchronous rectification
3. Input Voltage: 0V-35V
4. Output Current: 3A maximum
5. Output Voltage: 1.3V-30V
6. Conversion efficiency: 92% (maximum)
7. Switching frequency: 150KHz
8. Output ripple: 50mV (maximum) 20M-bandwidth
9. Load regulation: ± 0.5 %
10. Voltage regulation: ± 2.5%
11. Operating temperature: -40 °C to +85 °C
12. Size: 48x23x14 mm

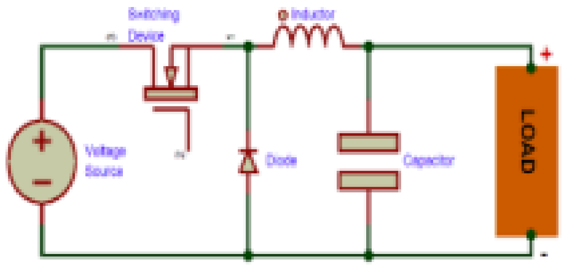

Figure 3: Buck Converter

6.3 SOLAR PANEL

A solar panel is a set of solar photovoltaic modules electrically connected and mounted on a supporting structure. A photovoltaic module is a packaged, connected assembly of solar cells. The solar panel can be used as a component of a larger photovoltaic system to generate and supply electricity in commercial and residential applications. A photovoltaic system typically includes a panel or an array of solar modules, an inverter, and sometimes a battery and/or solar tracker and interconnection wiring. Photovoltaic cells or panels are only one way of generating electricity from solar energy. They are not the most efficient, but they are the most convents to use on a small to medium scale. PV cells are made of silicon, similar to that used in computer "chips". While silicon itself is a very abundant mineral, the manufacture of solar cells (as with computer chips) has to be in a very clean environment. This causes production costs to be high. A PV cell is constructed from two types of silicon, which when hit by solar energy, produce a voltage difference across them, and, if connected to an electrical circuit, a current will flow. A number of photovoltaic cells will be connected together in a "Module", and usually encapsulated in glass held a frame which can then be mounted as required. The cells in a module will be wired in series or parallel to produce a specified voltage. What may be referred to as a 12 volt panel may produce around 16 volts in full sun to charge a 12 volt battery.

The mechanical characteristics are made from high efficiency crystalline silicon solar cells. Cells encapsulated in low iron, high transmission, toughened glass using UV stable ethylene vinyl acetate (EVA) sheets. Premium quality back sheet protects the module from environmental conditions. Laminate framed with strong anodized aluminum profile with fitted junction box

.

Specification of the solar panel:

1. Material: Silicon
2. Wattage: 2W
3. Type: Polycrystalline
4. No of Cells: 12
5. Output Voltage: 6V
6. Dimensions: 30x20cm

Figure 4: solar panel

BLOCK DIAGRAM

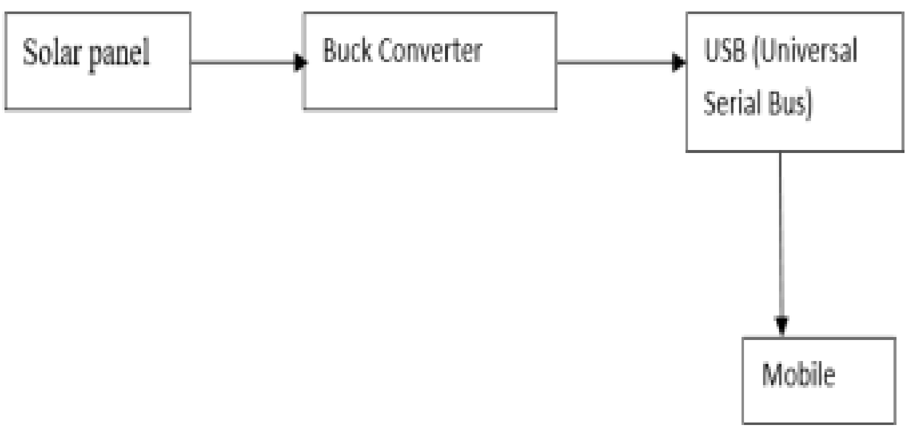

Figure 5: block diagram

SIMULATION DIAGRAMS

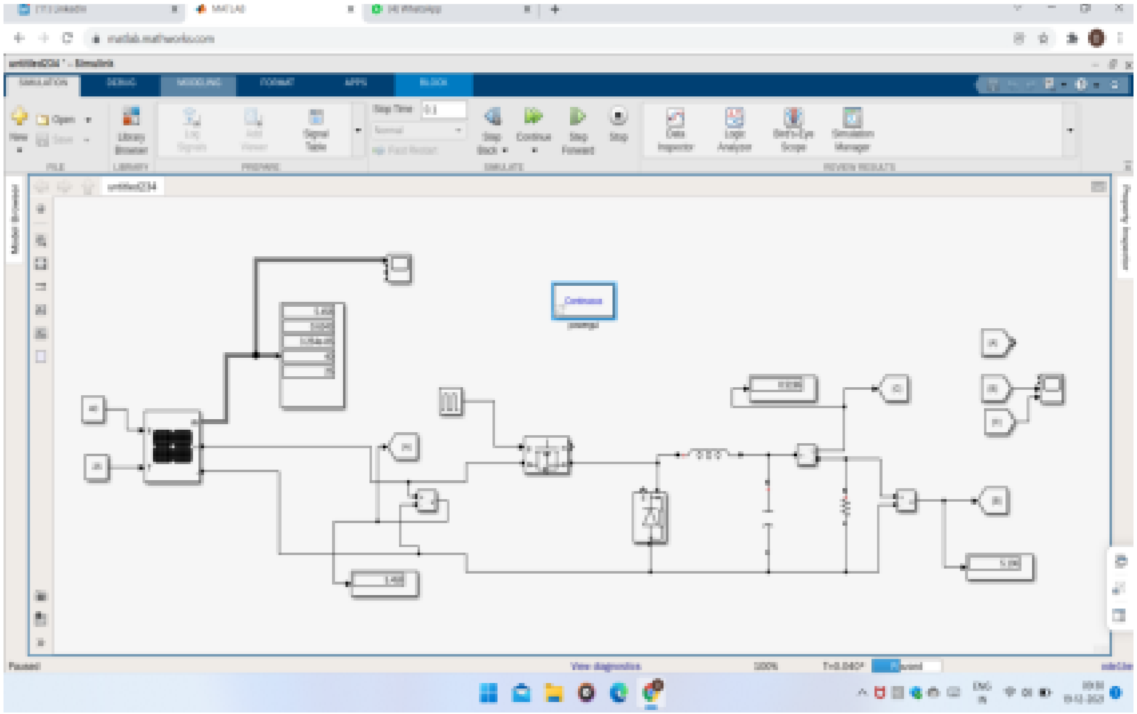

Figure 6: simulation of solar buck converter

CHAPTER - V

7. RESULT AND DISCUSSION:

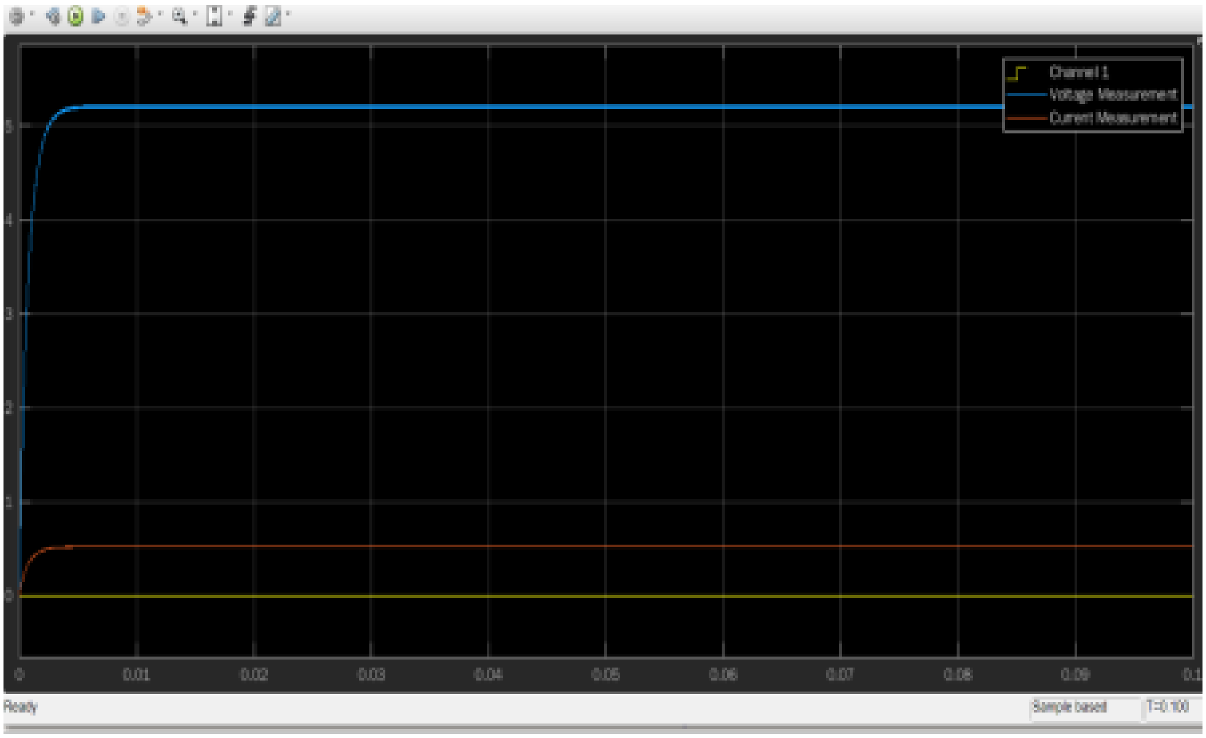

Figure 7: Voltage and current waveform of buck converter

CIRCUIT DIAGRAM AND OUTPUT:

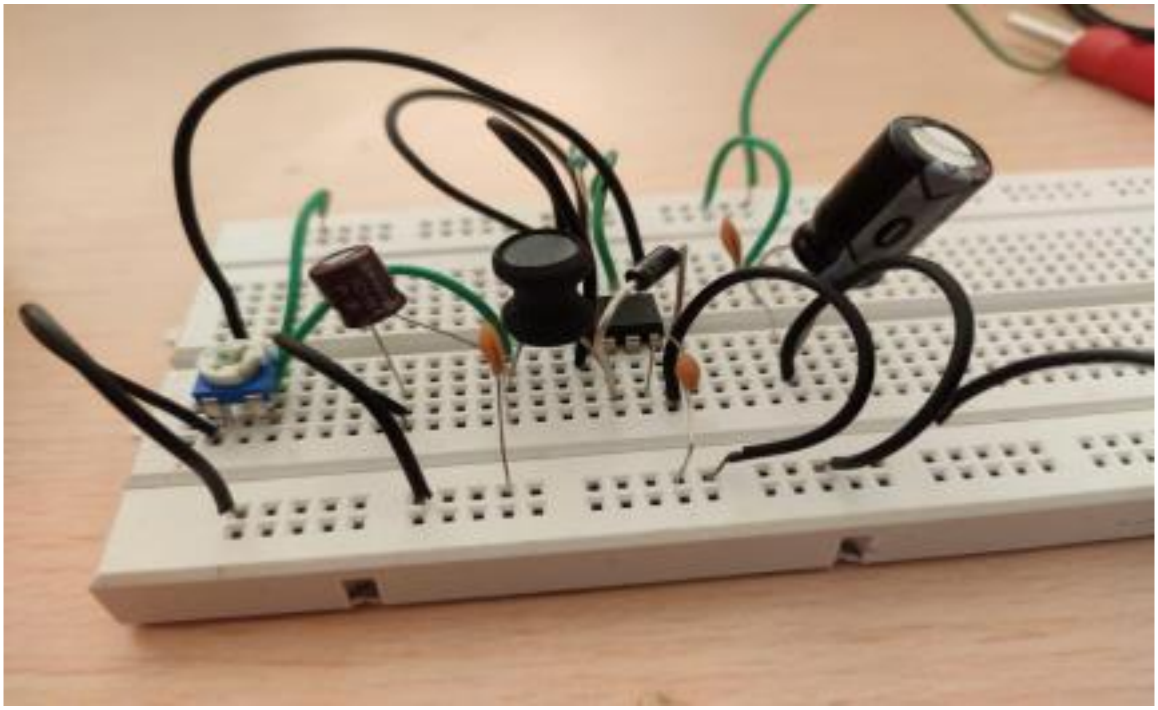

Figure 8: DC to DC buck converter in brad board

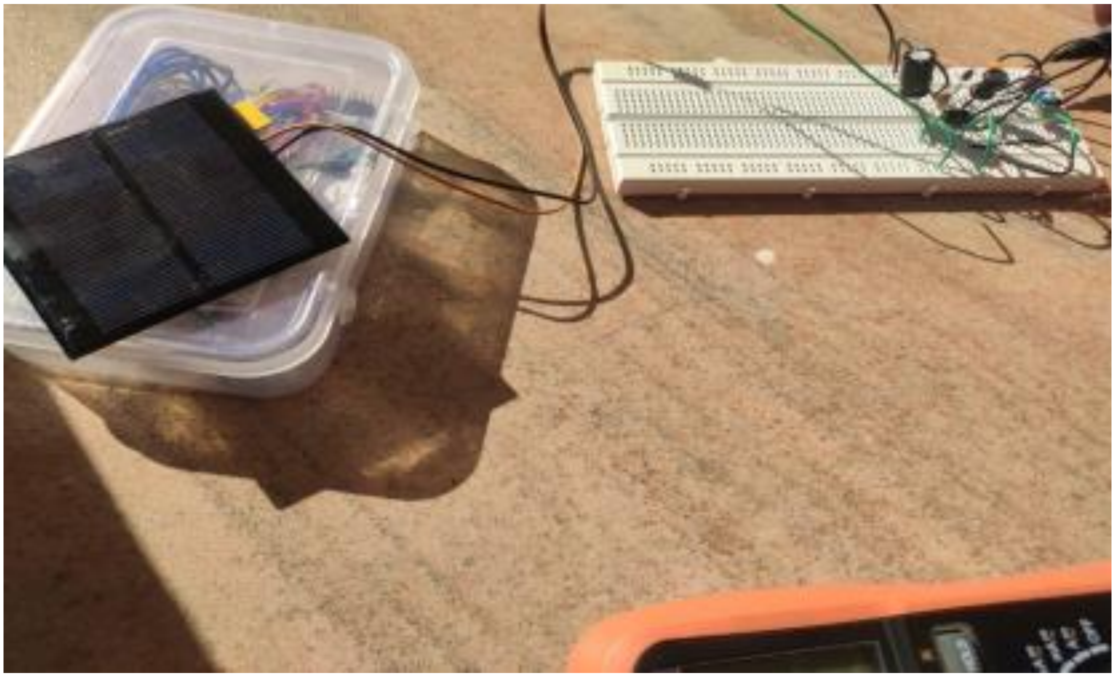

Figure 8: DC to DC buck converter connected with solar panel

Figure 8: Output voltage of DC to DC buck converter (solar mobile charger)

PRESENT AND FUTURE SCOPE OF PROJECT:

Design a charger which can take 12V of solar energy and store it into a battery and after that convert it into 5/7 V DC voltage so that we can charge our mobile or other devices at any time and anywhere.

CONCLUSION:

As solar powered energy becomes increasingly popular, these phone chargers will rise in popularity as well. Because people are searching for new and improved forms of energy, solar energy is becoming a very appreciated idea. Fossil fuels and non-renewable energy sources are ways of the past. This is the way of the future. Solar powered phone chargers will soon be everywhere.

- Solar powered cell phone chargers can be a better alternative to electrical cell phone chargers.
- Solar acts as a good power supply in bright sunlight. The only problem is the unregulated voltage due to the variation in intensity of light. Voltage regulator is used to solve this problem by regulating the output voltage.

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9. REFERENCES

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