AN INNOVATIVE APPROACH TO RENEWABLE ENERGY- SOLAR ASSISTED MOBILE CHARGER INTEGRATED EMERGENCY JACKET CUM BAG

PROJECT REPORT

Submitted by
EVANIA MARIA KADUTHUSE
(AB22PHY003)

Under the guidance of
Dr. FRINCY FRANCIS
Assistant Professor
Department of Physics,
St. Teresa's College (Autonomous), Ernakulam.

In the partial fulfillment of the requirements of award of Bachelor degree of Science of Physics

ST. TERESA'S COLLEGE (AUTONOMOUS)
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CERTIFICATE

This is to certify that the project report entitled "**AN INNOVATE APPROACH TO RENEWABLE ENERGY – SOLAR ASSISTED MOBILE CHARGER INTEGRATED EMERGENCY JACKET CUM BAG**" is an authentic work done by EVANIA MARIA KADUTHUSE, St. Teresa's College' Ernakulam, under my supervision at Department of Physics, St. Teresa's College, Ernakulam, for the partial requirements for the award of degree of Bachelor of Physics during the academic year 2024-25. The work presented in this dissertation has not been submitted for any other degree in this or any other university.

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PROJECT REPORT

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Year Work : 2024 – 25

This is to certify that this project work entitled, "AN INNOVATIVE APPROACH TO RENEWABLE ENERGY-SOLAR ASSISTED MOBILE CHARGER INTEGRATED EMERGENCY JACKET CUM BAG" is an authentic work done by EVANIA MARIA KADUTHUSE.

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Dr. Mary Vinaya

Submitted for the University examination held at St.Teresa's College, Ernakulam.

DATE: 02/05/2025

EXAMINER: 1.

2.

DECLARATION

I, **EVANIA MARIA KADUTHUSE**, final year B.Sc. Physics student, Department of Physics, St. Teresa's College (Autonomous), Ernakulam, do hereby declare that the project work entitled **"AN INNOVATE APPROACH TO RENEWABLE ENERGY - SOLAR ASSISTED MOBILE CHARGER INTEGRATED EMERGENCY JACKET CUM BAG "**, has been originally carried out under the guidance and supervision of **Smt. Dr. FRINCY FRANCIS**, Assistant Professor, Department Of Physics, St. Teresa's College (Autonomous), Ernakulam, in partial fulfilment for the award of the degree of Bachelor of Physics. I further declare that this project is not partially or wholly submitted for any other purpose and the data included in the project is collected from various sources and are true to be the best of my knowledge.

PLACE : Ernakulam EVANIA MARIA KADUTHUSE

DATE : 02/05/2025

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I would like to offer my heartfelt gratitude to everyone who assisted me in reaching this point of fulfilment. First and foremost, I thank the Lord Almighty for His abundant mercy throughout this project. I am grateful to Dr. Frincy Francis, St. Teresa's College (Autonomous), for her invaluable direction and regular monitoring, as well as for supplying vital project information and assistance in finishing the project. This project was a collaborative effort with Mithradam, Aluva, and I would like to extend my sincere gratitude to Sir Antony K.L. for his guidance, which greatly contributed to the progress of our project. I also appreciate the collaboration with our Fashion Department, which provided essential accessories and fabrication support, enriching our project. I want to thank all the teachers and non-teaching staff for their helpful advice and suggestions in completing the project. My gratitude and appreciation also go to everyone who has freely assisted us. Thank you all for your support and contributions.

ABSTRACT

This project aims to design and construct a solar mobile charging unit implemented in the bag that will charge from solar energy. This technology will help people to charge their mobile devices at places where electricity is unavailable. The solar bags are useful especially while traveling. One of the primary benefits of this project is the reduction of reliance on traditional energy sources such as fossil fuels generating electricity from solar panels and to charge electronic gadgets during natural calamities and other situations were grid electricity is unavailable. The renewable solar bag represents a ground breaking innovation in portable energy solutions by integrating solar assisted technology into jacket convertible into bag. We can also lower energy bills and reduce their impact on the environment. This abstract explores the design, functionality and environmental impact of renewable jacket cum bag, highlighting it ability to harness solar energy to charge mobile devices especially crucial in emergency situations and difficult environment. Additionally, solar power is a renewable energy source that is continuously replenishing, unlike finite fossil fuels.

MOTIVATION

The motivation behind the project of incorporating solar mobile charging unit into the bags arises from the growing concerns for sustainable energy solutions and the increasing reliance on electronic devices in today's world. Integrating these solar mobile charging unit into the bags helps individuals harness solar energy to charge their devices without the need for traditional electricity sources. India's new education policy aims to provide equitable and inclusive education, this project is a strategic and innovative initiative that addresses the growing need for sustainable energy. The primary objective of this project is to provide a reliable and eco-friendly solution for charging mobile devices, particularly in emergency situations such as power outages, natural disasters like floods and hurricanes, or in areas with limited access to electricity. Our solar mobile charging unit enables rapid charging, ensuring that individuals can stay connected and access critical information without delay. By applying renewable energy in everyday essentials, this project contributes to sustainable living practices and fosters a greener future. We envision a future where sustainable energy solutions become an integral part of our daily lives, and this project is a significant step towards achieving that vision.

AN INNOVATIVE APPROACH TO RENEWABLE ENERGY

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SOLAR ASSISTED MOBLE CHARGER INTEGRATED EMERGENCY JACKET CUM BAG

CONTENTS

CHAPTER 1
INTRODUCTION

1.1 RENEWABLE ENERGY

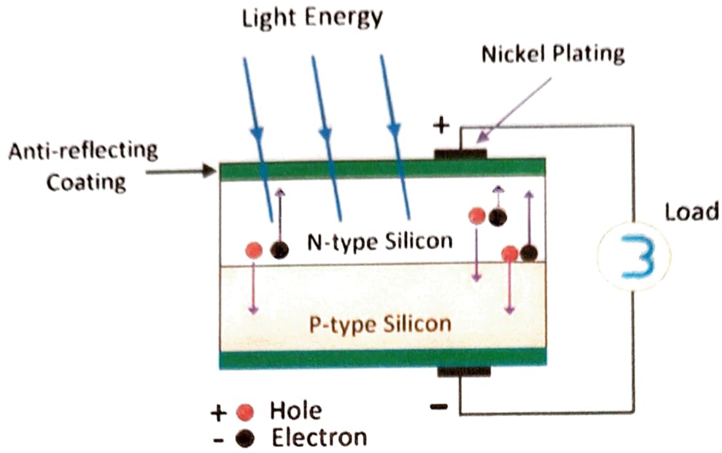
Renewable energy refers to the energy that comes from renewable resources that are replenished more quickly than they are consumed, such as sunlight, wind, rain, tides and geothermal heat. Unlike fossil fuels, they are sustainable and has lower environmental impact.

1.2 IMPORTANCE OF RENEWABLE ENERY

Renewable energy is becoming a key part of today's economy because it is eco-friendly and sustainable.as we are facing the challenges of climate, energy security and economic growth, the renewable energies such as solar energy, wind energy, hydroelectricity and geothermal are now essential for us, because renewable energy has such low environmental impact, it is one of the most beneficial technologies on the universe. as opposed to fossil fuels renewable energy sources release little or none at all, helping mitigate climate change, reduce air pollutants, and protect ecosystems. for example, solar panels and wind turbines generate clean electricity without destroying natural resources or damaging biodiversity.in addition to that beneficials of renewable energy include contributing significantly to economic growth and creating employment. the renewable energy sector has become an important contributor in manufacturing, installation, maintenance, and research, as well as encouraging innovation in clean energy technologies, restoring local economies, while at the same time reducing the dependency on imported fossil fuels.in addition, renewable energy also has a positive public health effects by reducing air pollution and also provides a healthier atmosphere for people to breathe in and prevent respiratory diseases and cardiovascular diseases. over time, technological development in renewable energy systems has made it more accessible and cheaper and has helped bring renewable energy to countries worldwide.

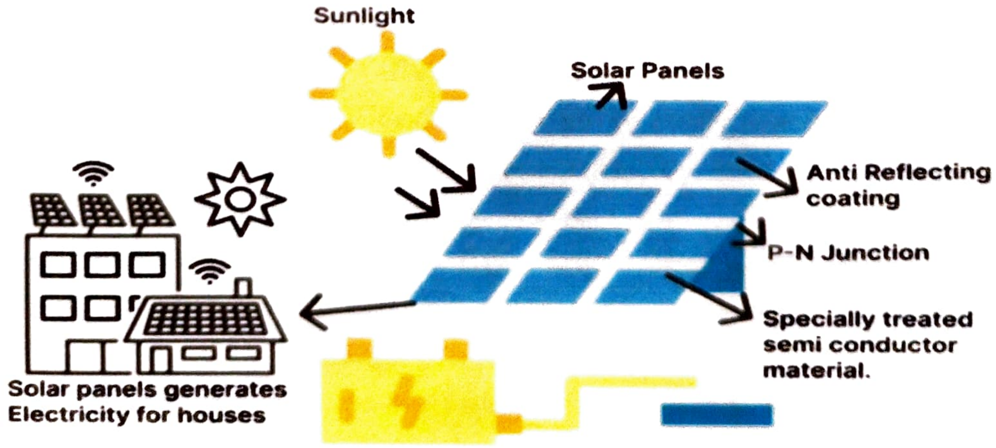
1.3 WORKING OF SOLAR CELL

The solar cell, also known as the photovoltaic (pv) cell, is a revolutionary device that converts sunlight directly into electricity. This innovative technology has transformed the way we generate energy, providing a clean, sustainable, and renewable source of power. The solar cell works by absorbing photons from sunlight, which excite electrons in the semiconductor material, causing them to flow through the material and create an electrical current. This current can then be collected and directed through a circuit, where it can power electrical devices or be stored in batteries. the simplicity and efficiency of this process make solar cells an attractive option for energy generation. One of the most significant benefits of solar cells is their potential to reduce our reliance on fossil fuels and mitigate climate change. Solar energy is a clean and renewable source of power, producing no emissions or pollution. This makes it an ideal alternative to traditional energy sources, which are finite and contribute to greenhouse gas emissions. Further, solar cells require minimal maintenance and can be easily integrated into existing energy infrastructure, making them a practical solution for energy generation. In addition to their environmental benefits, solar cells also offer economic advantages. The cost of solar energy has decreased dramatically in recent years, making it more competitive with traditional energy sources. Moreover, solar cells can be used to generate energy locally, reducing reliance on grid electricity and providing energy independence. This is particularly significant for remote communities, where access to energy can be limited. Despite the many benefits of solar cells, there are still challenges to their widespread adoption. one of the main limitations is the intermittent nature of solar energy, which can make it difficult to ensure a stable energy supply. However, advances in energy storage technology and grid management systems are helping to address this issue. Additionally, the development of more efficient and cost-effective solar cells is ongoing, which will further improve their viability as an energy source.



1.4 SOLAR PANEL

A solar panel, or solar module or photovoltaic (pv) panel, is a device that traps sunlight and turns it into electricity. It's a collection of solar cells, typically silicon cells, which are configured in a grid on the panel's surface. When sun light hits the solar cells, it excites the silicon material's electrons, making them move into the material to create an electric current. This current is tapped and fed into a circuit, where it can power electric appliances or be stored in batteries. Solar panels are a renewable energy source that produces no emissions or pollution



Solar panels absorbs sunlight and converts into electrical energy using photovoltaic cell and requires minimal maintenance, which makes them popular with individuals who would like to reduce their energy expenses and carbon footprint with individuals who would like to reduce their energy expenses and carbon footprint.

1.5 IMPORTANCE OF SOLAR CHARGING UNIT

The solar charging unit is a vital part in the utilization of solar energy's power, and its significance cannot be overemphasized. Below are some of the major reasons why:

- Renewable energy source: Solar charging units tap the use of sunlight as a renewable energy source, lowering the use of fossil fuels and climate change.
- Off-grid power: Solar charging units allow for off-grid power generation, offering access to energy in remote or underserved locations.
- Energy independence: With a solar charging unit, people and communities can produce their own energy, minimizing the use of grid electricity and maximizing energy independence.
- Cost-effective: Solar charging units can greatly lower energy costs, particularly for those with high energy usage or limited grid electricity access.
- Low maintenance: Solar charging units are low maintenance, as they contain few moving parts and are made to endure diverse environmental conditions.
- Increased efficiency: New solar charging units are made to maximize energy harvesting for maximum efficiency and minimizing energy waste.
- Environmental benefits: Solar charging units emit no pollution, noise, or emissions, making them a green choice for energy production.
- Backup power: Solar charging units can supply backup power during natural disasters or grid failures, providing uninterrupted energy access.

- Improved energy security: By producing their own energy, people and communities can improve their energy security, less dependent on grid electricity.
- Future-proofing: Spending money on a solar charging unit is a future-proof investment, as it offers a clean energy solution for generations to come.

1.6 SIGNIGICANE OF SOLAR MOBILE CHARGES

Solar mobile charges have transformed daily life by enabling the use of renewable energy in various applications. The power devices like solar chargers, lights, and mobile accessories, providing energy access in remote or off-grid areas. By harnessing solar energy, individuals can reduce energy costs, increase energy independence, and contribute to environmental sustainability. Solar mobile charges also support the growth of sustainable technologies, such as solar-powered homes, businesses, and electric vehicles, promoting a cleaner and more sustainable future.

1.7 COMPARISON BETWEEN NORMAL AND SOLAR MOBILE CHARGER

Solar chargers have several advantages over normal chargers. They harness renewable energy from sunlight, reducing dependence on traditional electricity sources and lowering carbon footprints. Solar chargers provide energy independence, allowing users to charge devices anywhere, anytime, without relying on grid electricity. They're ideal for outdoor activities, emergency situations, or off-grid locations. Additionally, solar chargers are environmentally friendly, sustainable, and can save users money on electricity bills in the long run. Overall, solar chargers offer a clean, reliable, and cost-effective alternative to traditional charging methods.

CHAPTER 2
PROJECT ANALYSIS

2.1 AIM

Our project aims to design and develop a sustainable solar mobile charger using renewable energy. Building upon a previous project, using multiple components and a buck-boost setup without a Battery Management System (BMS) can lead to several issues. The increased complexity can result in errors, higher costs, and potential performance problems like overheating or electrical noise. Without a BMS, the battery is vulnerable to overcharging or over-discharging, which can reduce its lifespan or cause damage. The system also lacks protection against overcurrent, short circuits, or other safety hazards, making it less reliable. Furthermore, inefficient energy management can lead to wasted energy and reduced system performance, highlighting the importance of incorporating a BMS for safe and efficient operation. we simplified the setup to reduce components, focusing on efficient energy harvesting and storage. The system consists of a solar panel for energy generation and a battery management system for energy storage, enabling mobile device charging. By harnessing clean energy from the sun and storing excess energy for later use, our project provides a sustainable and eco-friendly mobile charging solution. The battery management system ensures efficient energy storage and supply, demonstrating the feasibility of using solar energy to charge mobile devices sustainably. This innovative approach reduces reliance on traditional energy sources, promoting a cleaner and more environmentally friendly way to power our devices. Overall, our project showcases the potential of solar energy in everyday applications, contributing to a more sustainable future.

2.2 MODULE ANALYSIS

IC model	Type	Input Voltage	Charge/ Output Current	Features
HT4928S	Lithium Battery Charger	4.5V to 6.5V	Up to 1A	Integrated power MOSFET, automatic recharge, charge status indication
TP4056	Lithium Battery Charger with Protection	4V to 8V	Up to 1A	Integrated power MOSFET, automatic recharge, charge status indication, battery temperature monitoring, over-voltage protection, over-discharge protection
MHCD42	Lithium Battery Charger	4.5V to 6.5V	Up to 1A	Integrated power MOSFET, automatic recharge, charge status indication
CN3065	Lithium Battery Charger	4.35V to 6.5V	Up to 1A	Integrated power MOSFET, automatic recharge, charge status indication
CN3791	MPPT Solar Charger	4.5V to 28V	Up to 2A	Integrated power MOSFET, automatic recharge, charge status indication, optimized for solar charging, MPPT tracking
HT4936S	Lithium Battery Charger	4.5V to 6.5V	Up to 1A	Integrated power MOSFET, automatic recharge, charge status indication

MT3608	Step-Up (Boost) Converter	2V to 24V	Up to 2A	Adjustable output voltage up to 28V, high efficiency, internal 4A switch current, low ripple, over-temperature protection

2.3 PANEL ANALYSIS

ROUND PANEL	SQUARE PANEL	RECTANGULAR PANEL
6V80mAh Polycrystalline Peak power: 0.48 Watt Working current: 0-330mA(2W), 0-56mA(0.28W) Working voltage: 6V(2W), 5V(0.28W)	6V 100mAh Polycrystalline Max output power: 0.72W Max working voltage: 6.6V Max charging current: 110mA Min output power: 0.6W Min working voltage: 6V Min charging current: 100mA Weights 33g	6V 600mAh Polycrystalline Power at STC, (Pmax): 3.6 Watt Open Circuit Voltage, (Voc): 7.20Volts DC Short Circuit Current, (Isc): 0.60Amps Maximum Voltage at Pmax, (Vmpp): 6.00Volts DC Maximum Current at Pmax, (Impp): 0.58Amps.

2.4 BATTERY ANALYSIS

- Capacity: The most obvious difference is the capacity, with the 10000mAh pouch cell offering more power storage than the 6000mAh Lithium battery.
- Type: The 6000mAh battery is a LiFePO4 (Lithium Iron Phosphate) battery, known for its reliability, long service life, and low maintenance.

The 10000mAh battery is a Lithium Polymer battery, which is thin, light, and powerful .

• Voltage: The 6000mAh LiFePO4 battery has a nominal voltage of 3.2V, while the 10000mAh Lithium Polymer battery has a voltage of 3.7V.

. 6000mAh LiFePO4 Battery: Suitable for applications requiring reliable, long-lasting power, such as solar lights and power tools.

• 10000mAh Lithium Polymer Battery: Ideal for portable power solutions, like power banks, Bluetooth speakers, and medical equipment .

• Weight and Size: Lithium Polymer batteries are generally thinner and lighter than LiFePO4 batteries.

• Discharge Rate: LiFePO4 batteries are known for their stable discharge rate, while Lithium Polymer batteries can have varying discharge rates depending on the application.

2.5 COMPONENT SELECTION

After conducting a thorough comparison of various modules, we have finalized our selection for the solar-powered project. Our chosen components include:

- Solar Panel: A 3.7V solar panel with a capacity of 600mA, which will efficiently harness solar energy to power our project.
- Battery: A Lithium Pouch Cell battery with a capacity of 1000mAh, providing a reliable and efficient power storage solution..
- Charging and Power Management Module: TP4056 has simple and efficient charging, programmable charge current, overcharge protection, low cost and wide applicability from other modules. HT4928s has reliable power management capabilities, power management, output stability, and protection features from other modules.

This combination of components will enable effectively harness and utilize solar energy, providing a reliable and sustainable power solution. The 3.7V solar panel will provide sufficient power, while the 1000mAh Lithium Pouch Cell battery will store excess energy for later use. The TP4056 charging module will ensure safe and efficient charging, and the HT4928S power management module will optimize power distribution.

CHAPTER 3

DESIGN AND DEVOLEPMENT

The Solar Assisted mobile charging jacket cum bag is an innovative product that integrates a solar panel, battery management system, and USB connectivity to charge mobile devices on-the-go.

3.1 OBJECTIVES

. • To design and develop a dual-purpose jacket and bag equipped with integrated solar panels.

• To efficiently convert solar energy into electrical energy through photovoltaic technology.

• To store the converted energy in a rechargeable battery system for later use.

• To incorporate a user-friendly USB charging interface for powering mobile electronic devices.

3.2 MATERIALS AND COMPONENTS

- Flexible solar panels with output specifications around 5V, 1–2A.
- Lithium-ion rechargeable battery with a capacity of 10000mAh.
- TP4056 lithium battery charge controller module with protection.
- HT4928S DC-DC boost converter module for stable 5V USB output.
- USB type-A output ports for device charging.

3.3 PROTOTYPE DEVELOPED

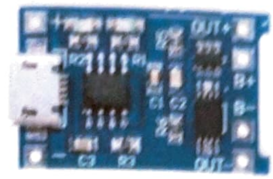
The system begins with solar panels generating a 6V output, which is then connected to a TP4056 module. This module plays a crucial role in regulating the charging process for a 10000mAh pouch cell battery. The TP4056 ensures that the battery is charged efficiently and safely, preventing overcharging and potential damage. Once the battery is charged, the stored energy is utilized to power a mobile phone through an HT4928S module. This module acts as a boost converter, stepping up the voltage to the required 5V output that is standard for USB charging. The HT4928S module ensures a stable and efficient energy transfer, allowing users to charge their phones reliably. The final stage of the system involves connecting the HT4928S module to a USB cable, which is then linked to the mobile phone. The phone can now receive a steady 5V supply, meeting its charging requirements. This project showcases the feasibility of using solar energy to charge mobile devices, providing a sustainable and environmentally friendly solution. The implications of this project are significant, particularly for outdoor enthusiasts, travelers, or individuals in areas with limited access to traditional power sources. By harnessing solar energy, users can charge their mobile devices on the go, reducing reliance on conventional energy sources and minimizing their carbon footprint.

3.4 WORKING PRINCIPLE

The core principle behind the Solar Assisted Mobile Charging Jacket cum Bag is the photovoltaic effect. When sunlight strikes the solar panels, the photovoltaic cells generate direct current (DC) electricity. This electricity flows through the TP4056 charge controller, which regulates the voltage and current to safely charge the lithium-ion battery. The HT4928S module then boosts the stored battery voltage to a constant 5V output, enabling USB-based mobile device charging.

3.5 TECHNICAL SPECIFICATIONS

TP4056 Module:



A lithium-ion battery charging module that regulates the charging process, providing overcharge protection and ensuring safe battery operation.

Specifications:

- Input voltage: 4.5V – 6V
- Charge current: Adjustable (typically 1A)
- Output voltage: 4.2V (for single-cell Li-ion batteries)
- Charging type: Constant current/constant voltage (CC/CV)

Features:

- Overcharge protection
- Over-discharge protection (in some versions)
- Short-circuit protection
- Adjustable charge current
- High charging efficiency
- Compact size (typically 25mm x 19mm)
- Low power consumption

HT4928S Module:

A boost converter module that steps up the battery voltage to a stable output, suitable for charging mobile devices via USB.

Key Features:

- Highly Integrated: Built-in charge management module, LED indicator block, and boost discharge management module

- Output Current: 0.8A (at 3.6V)

- ESD Protection : 4KV ESD protection for enhanced reliability

- Package: SOP8 package for compact design

- Functionality: Lithium battery charging, boost converter, and LED display

- USB Compatibility: Suitable for USB-based applications

Specifications:

- Input/Output : Designed for lithium-ion battery charging and power management

- Efficiency: High efficiency due to built-in management modules

- Protection: Includes protection features for safe operation

POUCH CELL

Rechargable Lithium Polymer cells uses solid polymer electrolyte with nominal voltage of 3.7V. Li-Po batteries are known for their

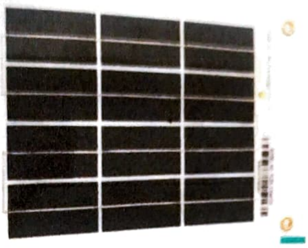
1. Lightweight and Sleek design
2. High Specific energy and energy density,
3. Excellent capacity to weight ratio,
4. Flexible form factor,

Specifications:

Capacity 10000mAh

Voltage- 3.70V
Charge Voltage- 4.20
Standard/Fast Charge 0.2C/ 0.5C
Standard/Fast Discharge 0.2C/ 0.5C
Minimum Cut off voltage- 3.0V

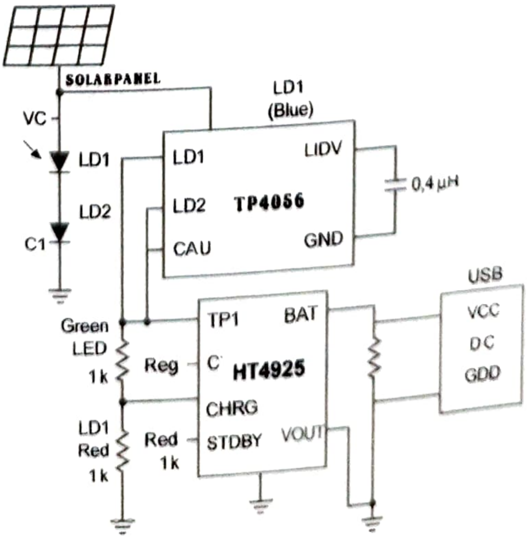
SOLAR PANEL



Specifications

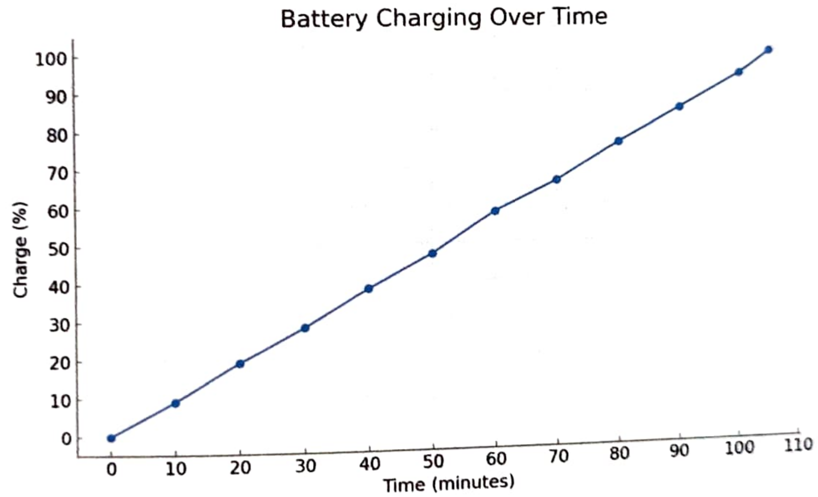
Polycrystalline panel
Power at STC, (Pmax): 3.6 Watt
Open Circuit Voltage, (Voc): 7.20Volts DC
Short Circuit Current, (Isc): 0.60Amps
Maximum Voltage at Pmax, (Vmpp): 6.00Volts DC
Maximum Current at Pmax, (Impp): 0.58Amps
Output port: Type A Female USB
Standard Test Condition(STC): Irradiance 1000W/m

3.6 CIRCUIT DIAGRAM



3.7 RESULT AND OBSERVATION

Experiment to measure the charging time of a phone using a solar panel. We recorded the time taken to reach specific percentages of charge and plotted the results on a graph. Initially, we observed that it took approximately 1.5 minutes to charge the battery by 1%. As we continued the experiment, we noticed some deviations in the charging time as the mobile charge approached higher percentages. The below graph represents the time taken by mobile phone to get fully charged.



Time taken for 100 % charge is 1 hour 45 minutes.

CHAPTER 4

CONCLUSION

4.1 FINDINGS AND INSIGHTS

The Solar Assisted Mobile Charging Jacket cum Bag project effectively demonstrates the integration of renewable energy technology into wearable and portable products. It showcases a practical solution to one of the common modern-day challenges—keeping mobile devices charged while on the move. The inclusion of HT4928S and TP4056 modules enhanced the system's performance, stability, and safety. This project not only contributes to the development of sustainable technology but also serves as a stepping stone for future innovations in wearable electronics and green energy applications.

4.2 INFERENCE

During testing, minimal electromagnetic interference (EMI) was observed, as the components used operate at low frequencies. Time taken for 100% charging is 1 hour 45 minutes. The presence of electronic devices inside the bag did not affect solar charging system's performance. Care was taken to shield the wiring and components to prevent damage.

4.3 DISCUSSION

This project highlights the viability of integrating renewable energy systems into wearable and portable products. It demonstrates a practical application of solar technology in a form that enhances daily convenience. The materials selected were chosen based on their durability, efficiency, and cost-effectiveness. The HT4928S and TP4056 modules were critical in achieving regulated power conversion and efficient battery management. Though the system has limitations to reliance on sunlight, the concept is scalable and can be improved with more advanced materials and technology.

4.4 FUTURE SCOPE

• Advanced Solar Cells: Use of transparent, lightweight, and more efficient solar cells to improve aesthetics and efficiency.

• Energy Harvesting Integration: Incorporate piezoelectric materials to generate power from motion.

• Wireless Charging: Add wireless Qi-charging pads for device compatibility.

• Smart Features: Embed sensors and microcontrollers for real-time energy monitoring and smart power management.

• Improved Design: Use of modular components for easy repair and upgrades.

• Scalability: Expand design for other wearables such as hats, shoes, or tents.

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