CHAPTER-1

INTRODUCTION

1.1 BACKGROUND

The world is facing major issues like huge reduction of fossil fuels on daily basis. Every country gives more focus on utilization of solar energy instead using fossil fuels. So, solar harvesting devices like solar cell and solar photovoltaic that are capable of producing electricity by utilization of solar energy should be used. The aim is particularly on summer days, the users will get more relaxed - they can feel cool and make them more efficient by cooling their head and face.

Each and every work will not be complete in the home or in the office, so in some cases even during summer workers have to do their work under any certainty of weather condition that cases caps will give them some respite. Manual labor work in hot temperature causes of water and salt imbalance in their body. Even in construction industry, there is a lack of protection, which can be fulfilled by this cap. This cap can will provide safety and will make them relax and thus making this research idea more beneficial. The degree of comfort also depends on metabolic rate of any person – under the influence of high temperature, a huge increase in sweating and evaporation can also be noticed to maintain adequate body temperature.

Basically agriculture, construction, traffic warden of each street, firefighting people can be more beneficial if they will use innovative solar cell applied cap; otherwise overall output of the worker will be reduced. Extended periods spent outside without cap may affect a lot to the workers because there is direct sun rays fall on the whole body. So solar panel with small fan based cap is required by each individual those who spend extended periods throughout the whole day. Definitely if anybody is exposed directly to the sunrays or sun’s greatest intensities, which in long run will affect their health. Now a days there are more number of applications are developed by using solar panel.

1.2 LITERATURE SURVEY

[1] Solar Powered Fan Cap For Outdoor Workers, Badri Narayan Mohapatra, Department of Instrumentation, AISSMS IOIT, Pune, INDIA,10, January 2020-IEEE

The use of solar energy is becoming increasingly important due to the depletion of fossil fuels. Solar harvesting devices like solar cells and photovoltaic panels are capable of producing electricity by utilizing solar energy, making them a viable alternative to traditional energy sources. The implementation of solar-powered accessories, such as a solar cap with a fan, can provide relief from the deleterious effects of overexposed heat radiation during the summer. This is particularly beneficial for outdoor workers who are exposed to severe summer conditions, as it can help prevent heat stress and related health issues. Additionally, the use of solar panels and solar energy can contribute to reducing greenhouse gas emissions, aligning with renewable energy policies. The solar cap with a fan can be a practical solution for outdoor workers, such as agricultural workers and construction laborers, who are often exposed to extreme temperatures. The cap's ability to provide safety and relaxation makes it a valuable innovation for individuals working in hot conditions. Furthermore, the cap's potential to improve the comfort and efficiency of outdoor workers aligns with the need for research priorities focused on the impacts of climate change on outdoor workers and their safety. In conclusion, the integration of solar technology into wearable accessories like the solar cap with a fan presents a promising solution for mitigating the adverse effects of heat exposure on outdoor workers, contributing to a more sustainable and safe working environment.

[2] UR-SolarCap: An Open-Source Intelligent Auto-Wakeup Solar Energy Harvesting System for Supercapacitor Based Energy Buffering Moeen Hassanalieragh, Tolga Soyata, Andrew Nadeau, Gaurav Sharma, Department of Electrical and Computer Engineering, University of Rochester, Rochester- 2017 IEEE

The UR-Solar Cap system is an open-source energy harvesting system designed for sustainable operation in harsh environmental conditions. It utilizes solar panels as the sole energy input and supercapacitors as the sole energy buffer, achieving a maximum solar power of 15 W and providing a regulated 5 V voltage to an external embedded device with a maximum power consumption of 10 W. The system is designed to resume functionality from a fully-depleted state when the supercapacitors have zero remaining energy, and it communicates vital energy-state information to the external computational device. Experimental results have demonstrated the system's robust and sustainable operation, its wakeup functionality, and high energy efficiency. The system's design methodology and rationale behind its design and configuration decisions have been summarized, and the results from the operation and testing of the system have been detailed. The system's ability to maintain sustained operation over a two-week period has been verified, and its auto-wakeup functionality has been highlighted in experiments. The system's high energy efficiency levels, reaching approximately 85%, are attributed to its sophisticated and modular circuit design, as well as the widespread availability of inexpensive solar panels and the ability to use supercapacitors in flexible topologies. The system is intended to be usable by a wide range of engineering and sciences research communities, with minimal expertise required for setup and deployment. The system's performance has been validated through experiments, and guidelines for sizing the solar panel and supercapacitors based on application requirements have been provided. Additionally, the system's open resources, including design schematics, PCB files, firmware code, and a component list, are available for download, with pre-assembled kits also available upon request.

[3] Autonomous Solar Smart Cap (ASSC) for Pedestrian Safety Sidhu, Assistant Professor (IEEE member), Department of Electronics and Communication Engineering Punjabi University Patiala-2017 IEEE

The main topics covered in the 2017 International Conference on Big Data Analytics and Computational Intelligence (ICBDACI) include big data analytics, computational intelligence, and machine learning. Additionally, the conference also addressed the challenges and opportunities in data mining, artificial intelligence, and deep learning. Furthermore, the conference delved into the applications of big data in various fields such as healthcare, finance, and social media. The ethical considerations and privacy issues related to big data and computational intelligence were also discussed.

[4] SOLAR-CAP: Super Capacitor Buffering of Solar Energy for Self-Sustainable Field Systems Amal Fahad, Tolga Soyata, Tai Wang, Gaurav Sharma, Wendi Heinzelman, Kai Shen

Research papers and conference presentations cover defense systems, face recognition technology, energy harvesting circuits, solar energy harvesting, power management systems, and energy-aware computing. Topics include real-time face recognition using mobile-cloudlet-cloud acceleration architecture, low-cost photovoltaic energy harvesting circuits, efficient solar energy harvesters for wireless sensor nodes, ultra-low power management systems for solar energy harvesting applications, and power-aware run-time systems for high-performance computing. Use of super capacitors for buffering solar energy in self-sustainable field systems is discussed, highlighting advantages over conventional battery-based energy storage. Prototype implementation of energy management and harvesting circuitry is presented, ensuring safe device operation within permitted voltage range. Feasibility of using supercapacitors for solar energy buffering in self-sustainable field systems is discussed, along with the development of control software for managing energy flow and powering a computing board. Authors suggest that software-level adaptive resource management techniques can mitigate the relatively small energy storage capacity of supercapacitors, with support from NSF grants.

[5] Solar cycle dependence of polar cap patch activity Received 19 September 2000; revised 16 March 2001; accepted 25 October 2001; published 21 February 2002. B. S. Dandekar

The paper discusses the formation and behavior of polar cap patches in the polar cap region, their relationship to solar activity and interplanetary magnetic field transitions, and their impact on communication systems. The study finds that polar cap patch activity changes significantly over a solar cycle and is dependent on solar activity levels. The study also explores the seasonal and diurnal variations in patch activity and its dependence on planetary magnetic activity and the interplanetary magnetic field.

1.3 OBJECTIVE OF PROJECT

- It is used for cooling purpose during day-time.
- It provides instant power supply to various appliances.
- The primary objective of solar caps is to capture sunlight and convert it into usable electrical energy through integrated solar panels, reducing reliance on traditional energy sources.
- Solar caps aim to provide users with a convenient and portable power generation solution, allowing them to charge their electronic devices such as smartphones, tablets, or wearable tech while on the move.
- By utilizing renewable solar energy, solar caps contribute to sustainability efforts by reducing carbon emissions and environmental impact associated with fossil fuel-based energy generation.
- Solar caps serve as a practical tool for emergency preparedness, providing a reliable power source for essential communication devices during emergencies or power outages.
- Solar caps can also serve as educational tools to raise awareness about renewable energy and encourage sustainable lifestyle choices among users and communities.
- The development and adoption of solar caps contribute to advancements in solar panel technology, wearable tech integration, and energy harvesting techniques, driving innovation in these fields.

1.4 OVERVIEW OF PROJECT

Chapter-1: It contains background, literature survey and objective of the project.

Chapter-2: It consists of block diagram of solar cap with mobile charging**.**

Chapter-3: It comprises of circuit diagram, schematic diagram and working principle of solar cap with mobile charging.

Chapter-4: It has description of specification of all components used in solar cap with mobile charging.

Chapter-5: It presents result, conclusion and future scope of solar cap with mobile charging.

Chapter-6: It comprises of advantages and disadvantages of solar cap with mobile charging.

CHAPTER-2

BLOCK DIAGRAM OF SOLAR CAP WITH MOBILE CHARGING

2.1 BLOCK DIAGRAM

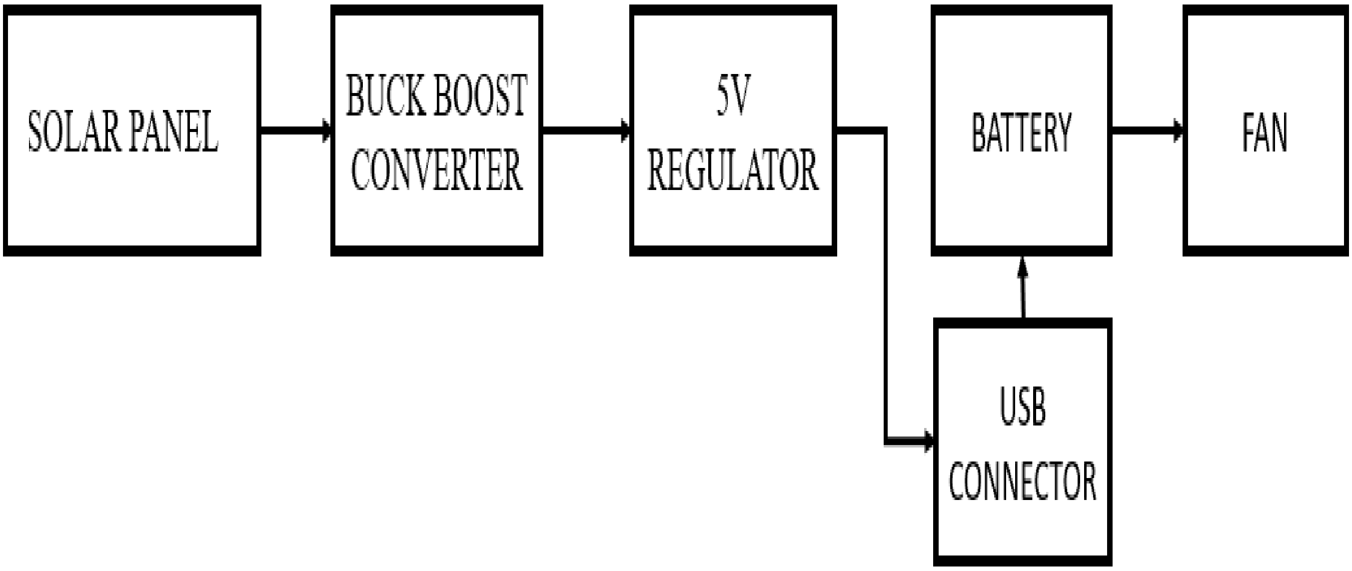

Fig 2.1: Block diagram of solar cap with mobile charging

The block diagram consists of a solar panel, regulator, battery, booster, charging module and a fan. The solar panel is connected to the battery and booster. One end of the booster is connected to the solar panel and the other end is connected to 5V regulator. It can boost voltage upto 35V. The 5V regulator is connected to the USB module or USB port. This regulates the voltage to 5V. Voltage regulator is also connected to the battery. The fan runs with the help of power supply given from the battery. Devices under the range of 5V can be charged through the charging module. The battery is connected to the fan. Fan consists of three speed levels, that is, low speed, medium speed and high speed. This can be set according to one’s requirement.

CHAPTER-3

CIRCUIT DIAGRAM OF SOLAR CAP WITH MOBILE CHARGING

3.1 CIRCUIT DIAGRAM

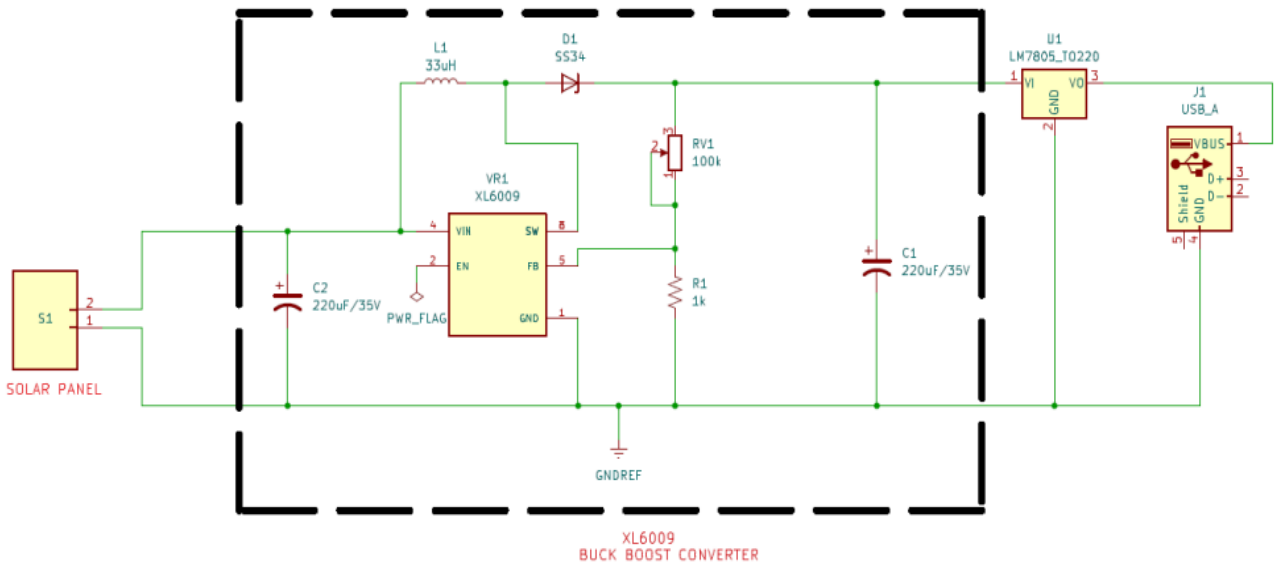

Fig 3.1: Circuit diagram of solar cap with mobile charging

The positive terminal of the solar panel is connected to the input positive terminal of the booster. The negative terminal of the solar panel is connected to the input negative terminal of the booster. The capacitors in the booster charge and discharge electrons and the zener diode boosts the voltage. The positive output terminal of the booster is connected to the input of the 5V regulator. The output negative terminal of the booster is connected to the ground of the voltage regulator. The output of the voltage regulator is connected to the positive terminal of the charging module or USB port. The ground of the voltage regulator is connected to the negative terminal of the charging module.

3.2 METHODOLOGY

The methodology for integrating solar cap with mobile charging involves a systematic approach tailored to harness solar energy for portable device charging. Initially, a thorough assessment of solar potential is conducted, considering factors such as sunlight exposure, available space, and device charging requirements. Designing an optimized solar cap configuration follows, incorporating solar panels, storage batteries, and charging outlets in a compact and efficient layout. This design is customized to accommodate the specific needs of mobile device users, ensuring convenient access to charging stations while maximizing solar energy utilization. Permitting and regulatory compliance processes are navigated to secure approvals for installation and operation.

The solar cap system is then installed and commissioned, with rigorous testing to verify functionality and safety. Continuous monitoring ensures optimal performance, with regular maintenance routines established to uphold efficiency. Educational initiatives may be implemented to raise awareness and promote the use of solar-powered mobile charging among the community. By following this methodology, solar cap projects with mobile charging capabilities can provide sustainable, accessible, and environmentally friendly solutions for powering portable devices.

In addition to the fundamental steps of solar cap implementation, integrating mobile charging requires additional considerations. These include selecting appropriate charging technologies compatible with various mobile devices, optimizing charging station placement for accessibility and user convenience, and implementing secure payment systems if applicable. Furthermore, the design phase must account for the dynamic nature of mobile device usage, ensuring scalability to accommodate fluctuations in charging demand. This may involve incorporating features such as modular charging stations or adjustable panel configurations to adapt to changing user needs. Permitting and regulatory processes may also vary when integrating mobile charging, particularly if the solar cap system is deployed in public spaces or commercial settings. Collaboration with local authorities and stakeholders is crucial to navigate these requirements and ensure compliance with relevant regulations.

3.3 WORKING PRINCIPLE

The solar panel converts sunlight into electrical energy. This energy is stored in the battery. The same electrical energy is step-down with the help of a 5V regulator and supplied to the charging module. In this charging module devices upto 5V can be charged. Battery power is used to run the fan. The fan basically has three speed levels, that is, low speed, medium speed and high speed. This can be set as per the individual’s requirement.

The solar cap contains photovoltaic (PV) cells, usually made from silicon or other semiconductor materials. These cells are designed to capture sunlight and convert it into electricity through the photovoltaic effect. When sunlight hits the surface of the PV cells, it excites electrons within the material, creating an electric current. The cells are strategically placed on the cap's surface to maximize sunlight absorption. The excited electrons create a flow of electricity within the PV cells. This direct current (DC) electricity is then transferred to a control unit or battery within the cap for storage and distribution.

In some solar caps, the generated electricity is stored in a rechargeable battery integrated into the cap. This battery acts as a power reservoir, storing excess energy generated during periods of high sunlight for use during low-light conditions. The stored electricity can be used to power various electronic devices integrated into the cap, such as small fans for ventilation or USB ports for charging mobile devices. Solar caps are designed to be energy-efficient, with efficient PV cells and power management systems to optimize energy capture and usage. This allows them to operate effectively even in partially cloudy conditions or lower light environments.

During daylight hours, the PV panels absorb sunlight and convert it into direct current (DC) electricity. This electricity is then either stored in batteries for later use or directly supplied to the charging ports to power or charge mobile devices. The stored energy in batteries can be utilized when sunlight is not available, such as during night-time or cloudy weather conditions. The integration of charging circuitry and control systems within the cap ensures efficient and safe charging of mobile devices. These systems regulate voltage and current to match the requirements of the connected devices, preventing overcharging or damage to the batteries.

CHAPTER-4

COMPONENTS SPECIFICATION

4.1 COMPONENTS REQUIRED

4.1.1 SOLAR PANEL

- The solar panel is integrated into the cap.
- These panels capture sunlight and convert it into electrical energy.
- It converts sunlight using PV (Photovoltaic) cells.

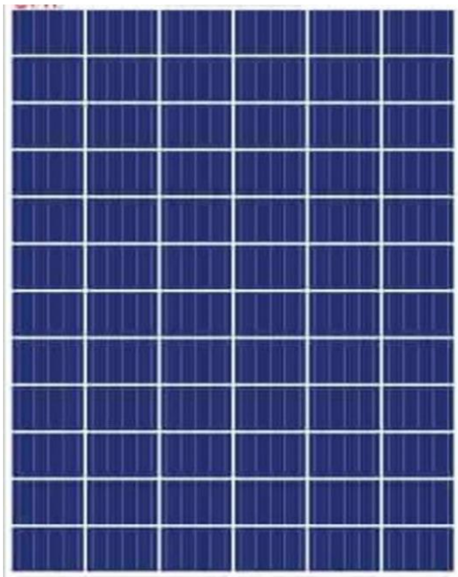

Fig 4.1: Solar panel

4.1.2 5V REGULATOR

- The 5V regulator (7805) is used to regulate the produced voltage into 5V DC to supply energy to the mobile charger & fan.
- This component maintains a stable output voltage to power the devices connected to the solar cap.
- It ensures that the voltage supplied to the devices remains within safe operating limits.

Fig 4.2: 5V Regulator

4.1.3 RECHARGABLE BATTERIES

- The Battery is used to energize the fan which is connected to the cap (i.e. Solar Cap).
- The battery stores the electrical energy generated by the solar panels.
- It acts as a power reservoir for charging electronic devices even when there's no sunlight available.

Fig 4.3: Rechargeable batteries

4.1.4 BUCK-BOOST CONVERTER

- A booster is a device that increases the voltage or current of an electrical signal.
- Boosters are often used to amplify signals in various applications such as audio amplifiers, power supplies, and telecommunications equipment.
- They can be implemented using different techniques and components, such as transistors, operational amplifiers, or specialized integrated circuits.

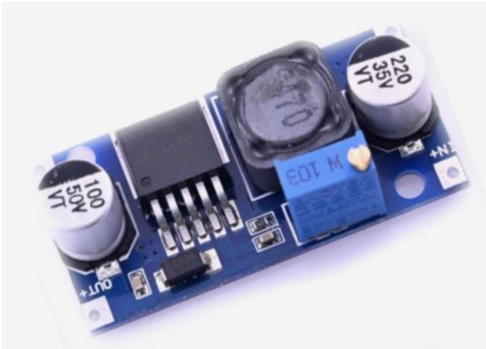

Fig 4.4: Buck-boost converter

4.1.5 USB MODULE

- These are the output ports on the solar cap where one can connect their electronic devices for charging.
- They provide a convenient way to access the stored solar energy for powering various devices.

Fig 4.5: USB module

CHAPTER-5

RESULT AND DISCUSSION

5.1 RESULT

Thus, solar cap with mobile charging project is a versatile project that runs with help of solar energy or solar power. We get 5.2V from the solar panel. It is then boosted using buck boost converter to around 12V. The output of the buck boost is given to LM7805 Voltage Regulator to regulate the voltage to 5V. The output of the regulator is given to the USB header to charge various devices under the range of 5V. This method is efficient and is used for multiple purposes. It uses renewable source of energy. Therefore, it causes no harm to the nature or environment and reduces the dependence on fossil fuels or non-renewable resources.

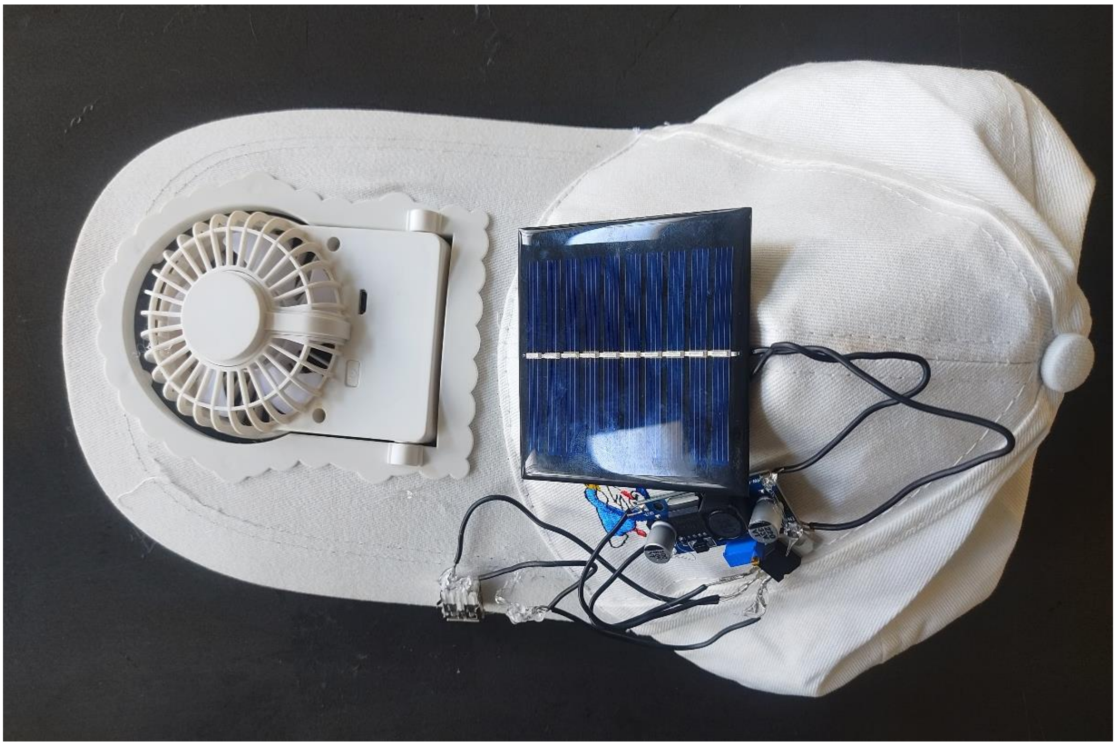

Fig 5.1: Solar cap with mobile charging

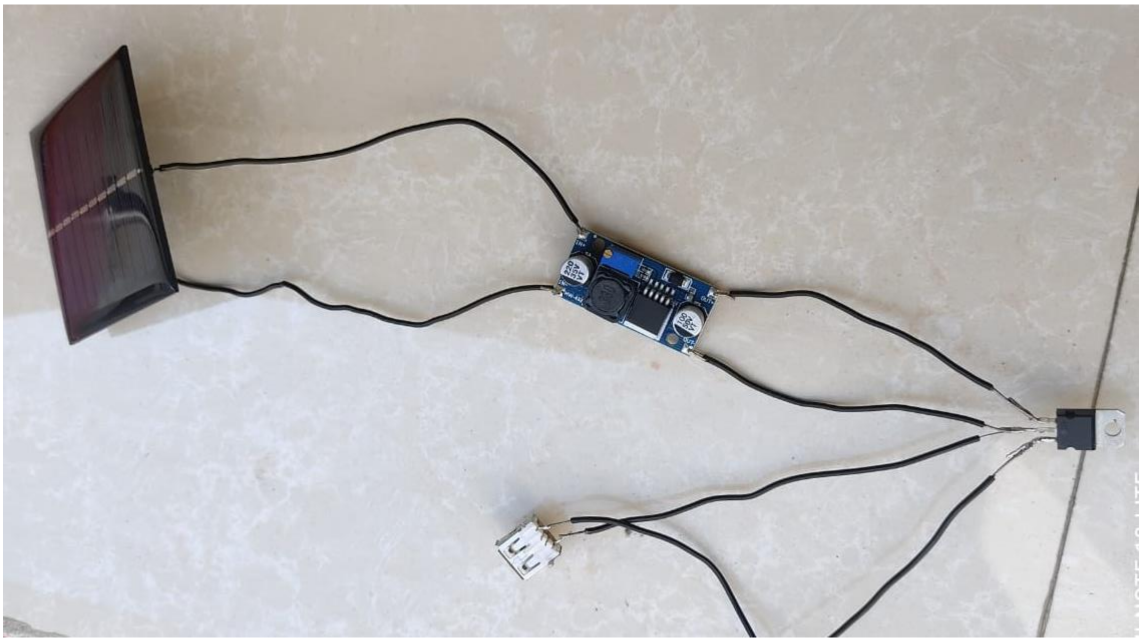

Fig 5.2: Circuit connection of solar cap with mobile charging

Fig 5.3: Mobile phone charging using solar cap

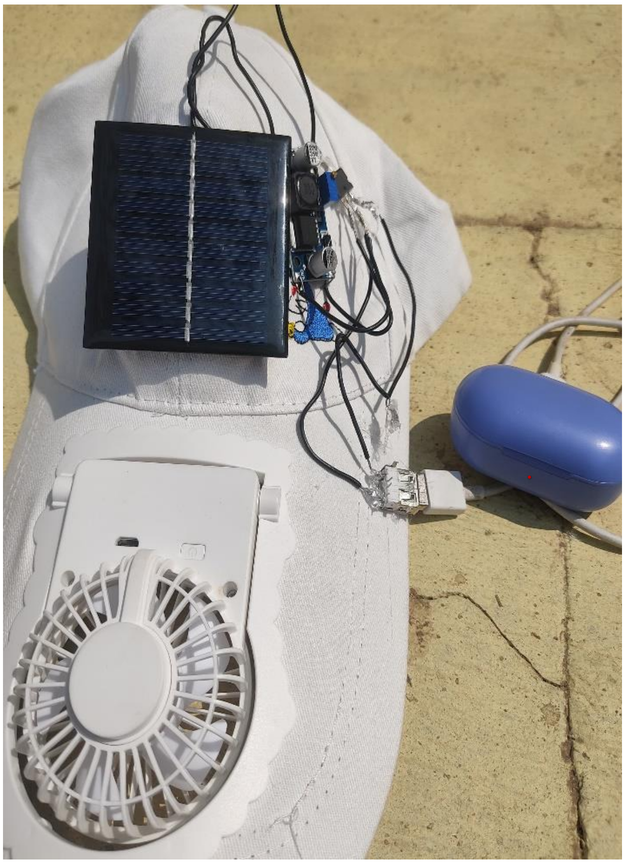

Fig 5.4: Airpods charging using solar cap

5.2 CONCLUSION

In this project, the solar cap is used as a power source to charge devices upto 5V especially in remote areas. It is also used as a source of breeze necessary to beat the heat. It is done by providing a fan which also runs with the help of solar energy. This project makes use of renewable energy source, that is, solar power or sunlight for multiple applications with causing any kind of pollution making it environmental friendly. Overall, solar caps offer a versatile and environmentally friendly solution for various outdoor activities and applications, providing both shade from the sun and a renewable source of power. Solar caps provide a convenient and eco-friendly way to harness solar energy.

5.3 FUTURE SCOPE

- Solar caps could be integrated with other wearable technologies, such as smartwatches or fitness trackers, to enhance their functionality and provide a sustainable power source for these devices.
- Continued advancements in solar panel technology could lead to more efficient and lightweight solar caps, increasing their appeal and usability.
- Solar caps could become popular among outdoor enthusiasts and travelers who rely on portable electronic devices like GPS devices, cameras, or smartphones.
- In regions where access to reliable electricity is limited, solar caps could serve as a valuable energy source for charging essential devices like mobile phones, providing connectivity and communication capabilities to underserved communities.
- Future solar cap systems may feature modular designs that can be easily scaled up or down to meet varying energy needs, allowing for flexible deployment in different environments and applications.
- Integration with smart grid technology could enable better coordination of energy generation and distribution, optimizing the use of solar power and enhancing grid stability and resilience.
- With increasing awareness of climate change and the growing demand for clean energy solutions worldwide, the market for solar cap systems is expected to expand significantly in the coming years, driving further innovation and cost reductions.
- Emerging economies with abundant sunlight and growing energy demand represent a particularly promising market for solar CAP technology, offering opportunities for deployment at scale and economic development.
- Collaboration between governments, industry stakeholders, academia, and civil society can facilitate knowledge sharing, technology transfer, and capacity building, driving innovation and accelerating the deployment of solar cap technology on a global scale.

CHAPTER-6

ADVANTAGES AND DISADVANTAGES

6.1 ADVANTAGES

- Solar caps reduces reliance on fossil fuels and contributes to a cleaner environment.
- Solar caps are portable and can be worn outdoors, allowing users to charge their devices on the go without needing access to traditional power outlets.
- Users can charge their devices directly from the solar cap without the need for additional cables or power banks, making it a convenient and hassle-free charging solution.
- In emergency situations or during outdoor activities, solar caps can provide a reliable source of power for essential devices like phones or GPS units, ensuring connectivity and safety.
- Solar caps provide a source of power independent of traditional electricity grids, making them ideal for outdoor activities, remote areas, or off-grid living situations where access to electricity may be limited or unavailable.
- By utilizing solar energy to charge devices, users can potentially reduce their reliance on grid electricity, leading to lower electricity bills over time and providing long-term cost savings.
- Solar caps help reduce carbon emissions and air pollution associated with conventional energy generation methods, contributing to environmental conservation and combating climate change.
- With proper care and maintenance, solar caps can have a long lifespan, providing sustainable power generation for years to come, and reducing the need for frequent replacements compared to traditional batteries or power sources.

6.2 DISADVANTAGES

- The size and surface area of solar caps limit the amount of energy they can generate, which may not be sufficient for charging larger devices or multiple devices simultaneously.
- Solar caps rely on sunlight to generate power, so they may be less effective in cloudy or overcast conditions, reducing their usability during inclement weather.
- The durability of solar caps may be a concern, as they are exposed to outdoor elements like sunlight, moisture, and physical wear and tear, potentially affecting their longevity and performance.
- Battery storage is also limited.
- Solar caps may have a higher upfront cost compared to traditional hats or caps due to the integration of solar panels and associated technology, which could limit their accessibility to some consumers.
- Some users may find the appearance of solar caps less appealing or stylish compared to traditional hats or caps, impacting their adoption and acceptance in mainstream fashion.
- Solar caps rely on sunlight for power generation, meaning they may not be effective during night-time or in areas with limited sunlight, leading to intermittent charging capability.
- Solar caps often lack built-in energy storage capacity, requiring devices to be directly connected for charging during daylight hours, which can be inconvenient if immediate charging is needed.
- Integrating solar panels into hats or caps can add weight and bulkiness, potentially affecting comfort and wearability, especially for prolonged use or strenuous activities.

CHAPTER-7

APPLICATIONS

- Solar caps can be used during outdoor activities such as hiking, camping, fishing, or gardening to provide shade from the sun.
- It is used for charging small electronic devices like smartphones or GPS devices.
- In emergency situations or during power outages, solar caps can serve as a reliable source of power for lighting.
- Workers in construction or other outdoor labour-intensive industries can benefit from solar caps by having access to hands-free lighting and charging capabilities, enhancing safety and productivity on the job.
- Athletes and sports enthusiasts can use solar caps during outdoor sports activities such as running, cycling, or playing golf, to protect themselves from the sun.
- Solar caps can be used as educational tools to raise awareness about renewable energy and sustainability.
- Military personnel and law enforcement officers can utilize solar caps for outdoor operations, providing them with a reliable power source for communication devices, navigation tools, or night vision equipment.
- During disaster relief efforts or humanitarian missions in remote areas, solar caps can serve as essential tools for providing lighting, communication, and charging capabilities, helping to facilitate rescue operations and support affected communities.
- Healthcare workers who perform outdoor tasks, such as paramedics or field researchers, can benefit from solar caps by having access to hands-free lighting and charging capabilities for medical devices or communication tools while working in remote locations.
- Tour guides, park rangers, or event organizers can utilize solar caps to provide illumination during night time tours or outdoor events, ensuring safety and visibility for participants while also reducing reliance on traditional batteries or electricity sources.

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[2] SOLARCAP: Super Capacitor Buffering of Solar Energy for Self-Sustainable Field Systems Amal Fahad, Tolga Soyata, Tai Wang, Gaurav Sharma, Wendi Heinzelman, Kai Shen.

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