

SUPER CAPACITOR TO OPTIMIZE THE PERFORMANCE OF PV SYSTEM

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ABSTRACT

The purpose of this paper is to outline the development of an internal real-time electrical phenomenon monitoring system. The system is designed to monitor key parameters such as voltage, current, solar radiation, and temperature in a photovoltaic (PV) system. The implementation of this system involves developing an electrical phenomenon system, building the necessary electronic equipment for accurate readings, and creating an analysis information work that displays the monitored information through an easy-to-use charting interface. The proposed model has the potential to be adapted for use in different types of PV systems, ensuring proper functioning and reliable data monitoring. With this real-time monitoring system, it is possible to detect and address issues in a PV system before they become major problems, thereby optimizing its performance and extending its lifespan. Additionally, the ability to collect and analyse data in real-time provides valuable insights that can be used to improve the overall efficiency and effectiveness of the PV system.

Keywords: Super Capacitor, Solar panel, PIC Microcontroller, Relay.

1. INTRODUCTION

Photovoltaic (PV) systems have become increasingly popular as a renewable energy source due to their ability to convert solar energy into electrical energy. However, one of the challenges of using PV systems is the intermittent nature of solar energy, which can result in power fluctuations and other issues that affect their performance. To optimize the performance of a PV system, various technologies and techniques can be employed, including the use of super capacitors. Super capacitors, also known as ultracapacitors or electrochemical capacitors, are energy storage devices that can charge and discharge quickly and have a longer lifespan than traditional batteries. By incorporating super capacitors into a PV system, the system's performance can be optimized for both high power and energy density. Super capacitors can provide short-term power bursts during periods of high demand, reducing the load on batteries and extending their lifespan. They can also be used to provide power during periods of low demand, when the solar panels are generating excess energy. The integration of super capacitors into a PV system requires careful consideration of the specific requirements of the system, including the power and energy demands, the capacity of the batteries, and the available space and resources. However, when properly implemented, the use of super capacitors can significantly improve the performance and efficiency of PV systems, making them a more viable option for renewable energy generation. This paper will explore the potential benefits of using super capacitors in PV systems and discuss the considerations and challenges involved in their integration. The use of super capacitors in PV systems is not a new concept, and there have been several studies and experiments conducted to evaluate their effectiveness. One study found that incorporating super capacitors into a PV system increased its efficiency by up to 15%, compared to a system that used only batteries for energy storage. Another study found that super capacitors could provide the necessary power for a PV system during periods of cloud cover, reducing the need for backup power sources. One of the main advantages of super capacitors is their ability to handle high current and voltage levels, making them well-suited for use in high-power applications like PV systems. Additionally, their long lifespan and low maintenance requirements make them an attractive option for energy storage in remote or off-grid locations. However, there are also some limitations to the use of super capacitors in PV systems. For example, they have a lower energy density compared to batteries, which means they can store less energy per unit of volume. This makes them better suited for short-term energy storage and applications where quick charge/discharge cycles are required. Additionally, they can be more expensive than traditional batteries, although their longer lifespan can offset some of the costs. The use of super capacitors in PV systems is not a new concept, and there have been several studies and experiments conducted to evaluate their effectiveness. One study found that incorporating super capacitors into a PV system increased its efficiency by up to 15%, compared to a system that used only batteries for energy storage. Another study found that super capacitors could provide the necessary power for a PV system during periods of cloud cover, reducing the need for backup power sources. One of the main advantages of super capacitors is their ability to handle high current and

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In summary, the use of super capacitors in PV systems can significantly improve their performance and efficiency, providing a more reliable and sustainable source of renewable energy. While there are some challenges and limitations to their integration, continued research and development in this area could lead to further advancements in energy storage technology and the widespread adoption of PV systems as a viable source of clean energy.

Overall, the use of super capacitors in PV systems has the potential to significantly improve their performance and efficiency, making them a more viable option for renewable energy generation. Continued research and development in this area could lead to further advancements in energy storage technology and the widespread adoption of PV systems as a sustainable source of energy.

2. LITERATURE SURVEY

Super capacitors have become increasingly popular in recent years as a promising technology for energy storage and power management. In the context of photovoltaic (PV) systems, super capacitors can be used to optimize the system performance by providing a stable source of energy and improving the efficiency of energy conversion.

A literature survey on the topic reveals several studies that have investigated the use of super capacitors in PV systems. For example, a study by Reddy et al. (2019) proposed a hybrid energy storage system that combines super capacitors with batteries to improve the efficiency of a standalone PV system. The study found that the hybrid system increased the overall efficiency of the PV system by reducing the load on the batteries and improving the energy management.

Similarly, a study by Banzhaf et al. (2016) investigated the use of super capacitors in grid-connected PV systems to provide fast response energy storage and improve the system stability. The study found that super capacitors can provide effective energy storage and management in grid-connected PV systems, and can help to reduce the impact of voltage fluctuations and system disturbances.

Another study by Patel et al. (2018) proposed a super capacitor-based energy storage system for a PV-powered water pumping system. The study found that the super capacitor-based system provided stable and reliable energy storage, which improved the overall efficiency and reliability of the water pumping system.

Additionally, a study by Qian et al. (2020) investigated the use of super capacitors in PV systems for peak shaving and load leveling. The study found that a super capacitor-based energy storage system can effectively reduce peak loads and improve the system's energy management, resulting in significant cost savings and improved system performance.

In another study by Venkatesan et al. (2021), a super capacitor-based energy storage system was designed and implemented for a rooftop PV system. The study found that the use of super capacitors improved the system efficiency and reduced the dependence on the grid, resulting in significant energy savings and reduced carbon emissions.

Furthermore, a study by Bishnoi et al. (2018) proposed a hybrid energy storage system that combines super capacitors with batteries and flywheels for a standalone PV system. The study found that the hybrid system improved the energy management and efficiency of the PV system, resulting in reduced energy costs and improved system reliability.

Overall, the literature survey highlights the potential benefits of using super capacitors in PV systems for efficient energy storage and management. The studies suggest that the use of super capacitors can improve the system efficiency, reliability, and stability, resulting in cost savings and reduced carbon emissions.

3. RESEARCH METHODOLOGY

After decide the topic of project we search the paper. Related to super capacitor all are listed in reference block. So, we realize that super capacitors are one of the best concepts to improving the PV system. Because fast charging time, sustain the spark of current, life cycle and good energy storage capacity. Also, we searched where the actually super capacitor used. And the answer is, in china super capacitor are using in transportation (inter-city) Bus in the place of Battery because of their fast charging property. So, we sure that it's really works.

The analysed during this analysis work system consists of three main components PV panels, Controllers, Super-capacitor is operating short- time storage unit and load. Unit is glad the least bit times a bonus of such a mix is that

just in case of depleted power from PV Panels because of short-time massive power from needs or low radiation. The deliver high electric power in a short time with the help of super Capacitors (secondary energy source).

If the shadow falls on panel then the output of the Panel is decreases, Panel output give 11 V is less than tolerance that's why the inverter will be off be-because it works only in allows tolerance voltage and MPPT only increases overall generated voltage its does not increases power efficiency.

In normal condition Solar panel supply to DC bus with the help of relay1. The solar panel give power to the load using relay 1 is ON at the same time super capacitor start charging using relay2. when Solar panel gives output is less than reference voltage then relay1 and relay3 is off and super Capacitor gives power to load using relay 3. A All relays are off and then system will not work.

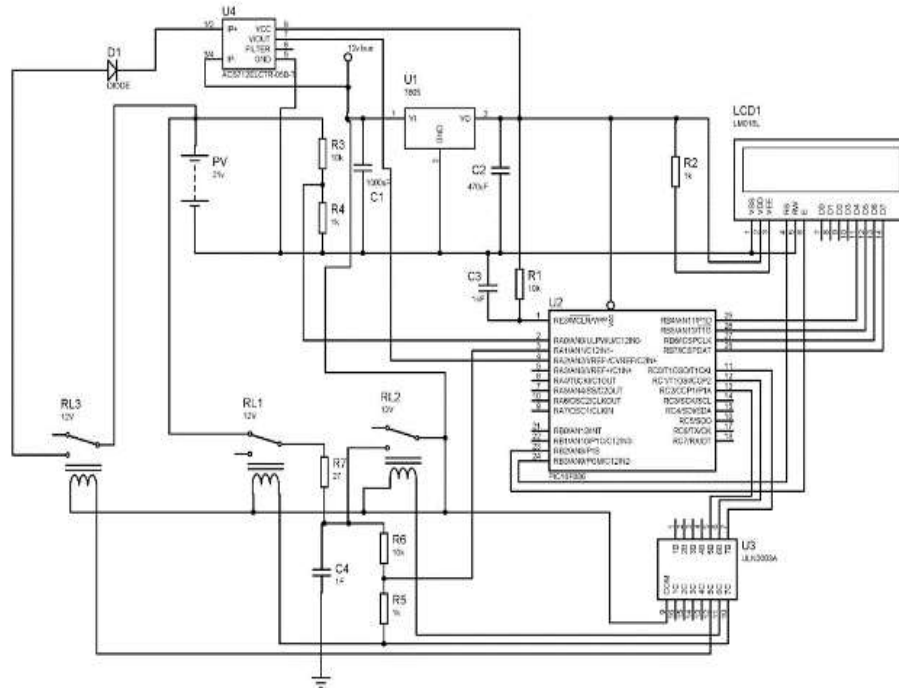


Fig. 1 Circuit Diagram of Proposed System

The solar panel 12V,20W generated the power and supply to the DC bus(12V) with help of relay1, here we used current transducer (CT) to measure the current of output of solar panel and super capacitor. There are three relays (RL), relay 1, relay 2, and relay 3 operated at 12V respectively. That relays are operated by driver because we used 5V Pic-Microcontroller is not sufficient to operate 12V relays so we used driver. In that driver there are 7 outputs. Driver is made up of darling type pairs.

We cannot measure solar panel voltage directly from Pic-Microcontroller i.e. we used divider, it divides the voltage and gives 5V output to the Pic-microcontroller. By using voltage regulator to gives the constant 5V supply to the microcontroller from 12V DC bus. LCD display show all information of rating collected from the Pic-microcontroller.

4. WORKING

The module is a prototype system that incorporates a 12V, 25W solar panel connected in series with a super capacitor rated at 2.7V/100F. The system also features three relays with different functions, two integrated circuits (ICs), and one transistor.

The system is designed to detect stable or constant radiation from the sun using a PIC-microcontroller. When this stable radiation is not detected, the PIC-microcontroller activates the relays to perform various functions, which are not specified in the given information. The system is also equipped with an LCD display that shows information from the PIC-microcontroller.

The purpose of this module is not explicitly stated in the given information. However, it appears to be a proof-of-concept system that demonstrates the potential of using a super capacitor in a solar panel system to improve its performance and efficiency. The use of a PIC-microcontroller and other electronic components suggests that the system is designed for automation and remote monitoring, which could be useful in various applications such as remote power systems, portable devices, or off-grid installations.

5. RESULTS

The system incorporates five super capacitors rated at 100F and 2.7V connected in series to increase the voltage to a maximum of 16.2V. This maximum voltage is reached because super capacitors can charge up to 20% greater than their capacity.

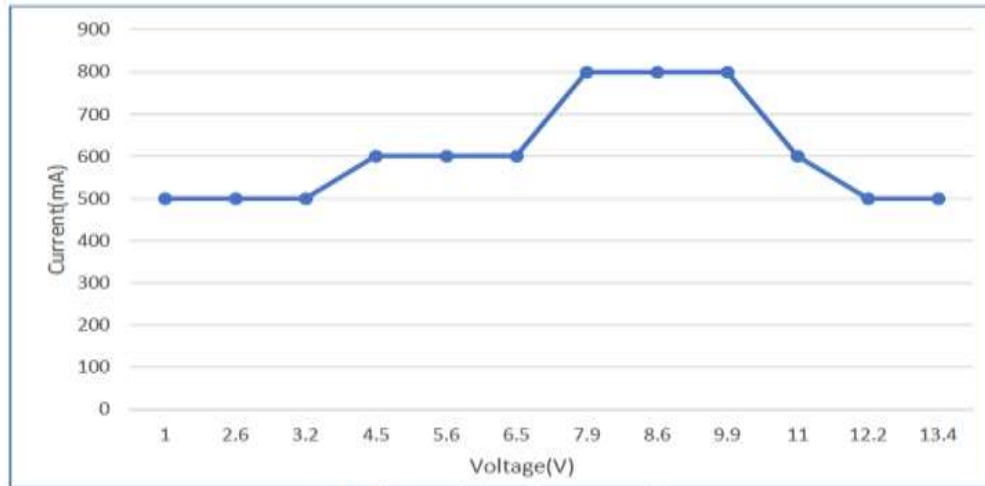


Fig. 2 V-I Characteristics of Super capacitor

The system is designed to connect the load to the super capacitor if the voltage from the solar panel falls below 12V. The load remains connected to the super capacitor until the voltage of the super capacitor falls to 11.0V. To charge the super capacitor from 11V to 16.2V, a current of 500mA is used. It takes approximately 3 minutes for the super capacitor to charge completely at this current.

The purpose of this system is not stated in the given information. However, it appears to be a small-scale system that demonstrates the potential of using super capacitors in energy storage applications. The system is designed to store excess energy generated by the solar panel and supply it to the load when the solar panel voltage falls below a certain threshold. The use of super capacitors, which have a high-power density and can be charged and discharged quickly, allows for efficient energy storage and delivery.

6. CONCLUSION

The use of a photovoltaic system equipped with super capacitors to increase renewable energy utilization and decrease fluctuations. The study also evaluated the impact of the electrical load temporal resolution on the energy flows of the PV system, aiming to find the optimum load temporal resolution that ensures low error of calculation. The results of the study demonstrated that the temporal load resolution significantly affects the energy flows and energy self-consumption, even for a single household system. This suggests that careful consideration and optimization of the load temporal resolution is crucial for maximizing the performance and efficiency of PV systems equipped with super capacitors. Overall, this study adds to the existing literature on the potential benefits of using super capacitors in PV systems and highlights the importance of optimizing system parameters to achieve maximum efficiency and performance.

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