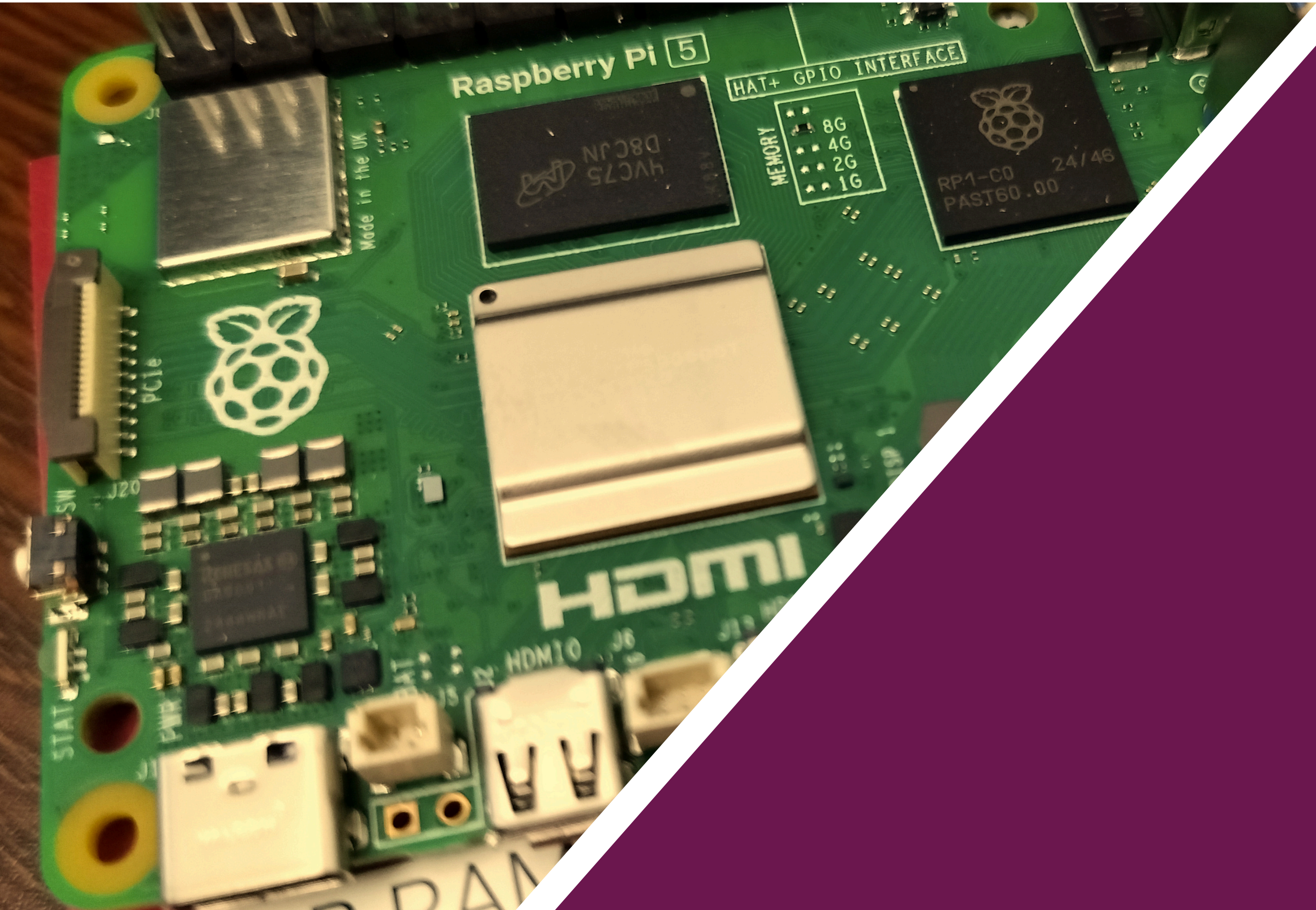




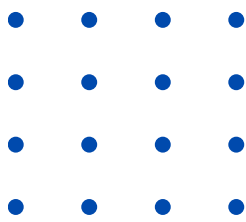
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EESEE 2025

10TH ELECTRICAL ELECTRONICS SYSTEMS
ENGINEERING EXHIBITION 2025
VOLUME 1



FACULTY OF ELECTRICAL ENGINEERING
UNIVERSITI TEKNOLOGI MARA
JOHOR BRANCH
PASIR GUDANG CAMPUS



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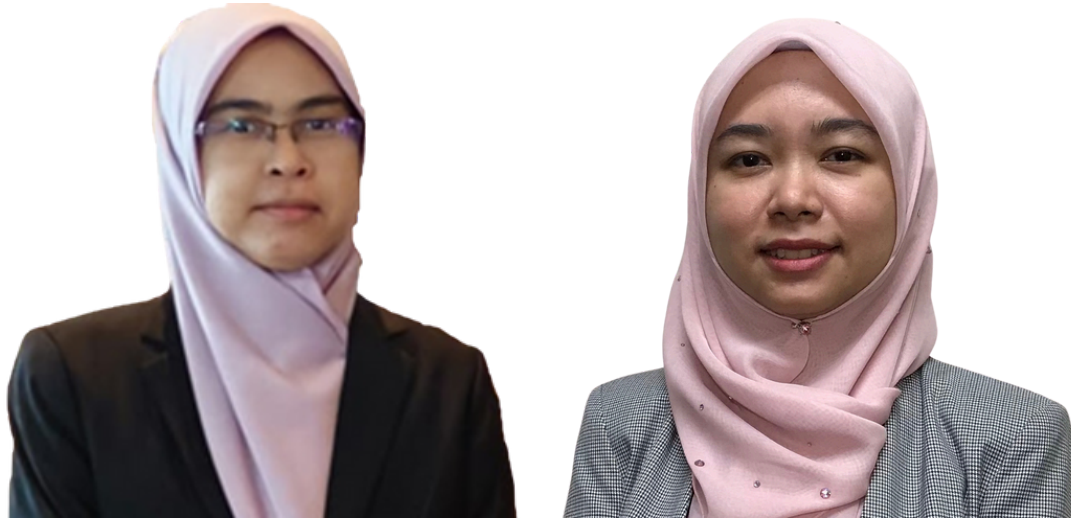
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FOREWORD BY THE PROGRAM CHAIR



Greetings from the Electrical, Electronics, and Systems Engineering Exhibition 2025 (EESEE 2025).

As the Program Chairs, it is our great pleasure to present this compilation of extended abstracts, showcasing the remarkable projects developed by our final-semester students from the Diploma in Electrical Engineering (Power) and Diploma in Electrical Engineering (Electronics) programs at Universiti Teknologi MARA, Cawangan Johor, Pasir Gudang Campus.

This exhibition marks a significant milestone in our students' academic journey, representing the culmination of years of dedication, perseverance, and learning. It also serves as an essential step toward the successful completion of their diploma studies. The projects featured this year are centered on the theme *Engineering Excellence: Bridging Technology and Life*, reflecting current trends and innovations in the engineering field.

This extended abstract book highlights not only the students' technical expertise but also their creativity, problem-solving skills, and ability to engage meaningfully with peers and industry professionals. Within these pages, you will find a diverse range of projects that embody a unique blend of knowledge, innovation, and practical application.

We warmly invite you to explore this collection, which celebrates the achievements of our aspiring engineers. Welcome once again to the Electrical, Electronics, and Systems Engineering Exhibition 2025. May the insights shared here inspire and pave the way for the next generation of innovative engineers.

Warm regards,

Dr. Fatimah Khairiah binti Abd Hamid

Dr. Atiqah Hamizah binti Mohd Nordin

Program Chairs

Electrical, Electronics, and Systems Engineering Exhibition 2025 (EESEE 2025)



PWM Solar Charge Controller

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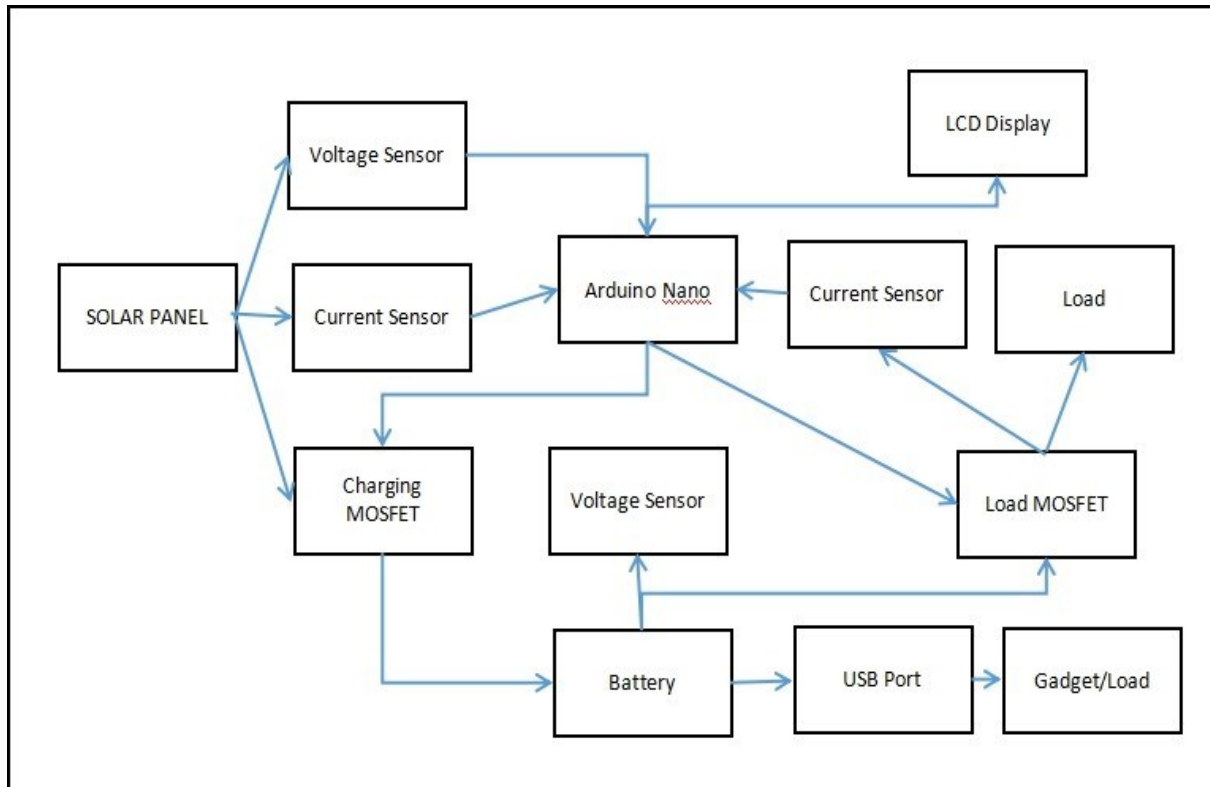
ABSTRACT

The project outlines the design and construction of a PWM- (Pulse Width Modulation)-based solar charge controller to enhance the efficiency of solar energy systems by proper charging of batteries. The controller, based on the Arduino Nano microcontroller, is also designed to limit the voltage and current from solar panels to avoid overcharging or deep discharge of batteries. Integration of a buck converter allows the solar system to set its output according to battery requirements, providing consistency in power supply. Real-time monitoring of solar panel and battery voltage, coupled with temperature sensing, is achieved through different sensors feeding their data to the Arduino for, consequently, a real-time adjustment of the charge cycle. The charge controller uses three charging stages-i.e., bulk, absorption, and float-to achieve maximum battery life and energy storage efficiency. An LCD display in the GUI works as an interface, providing updates on system status, such as battery level and solar input. This design presents a cheaper yet expandible alternative for solar applications, right from off-grid energy settings up to portable solar appliances. The project further asserts the viability of adopting more advanced, cheaper technologies to promote renewable energy development. This invariably will lead to the greater adoption of sustainable energy solutions all over.

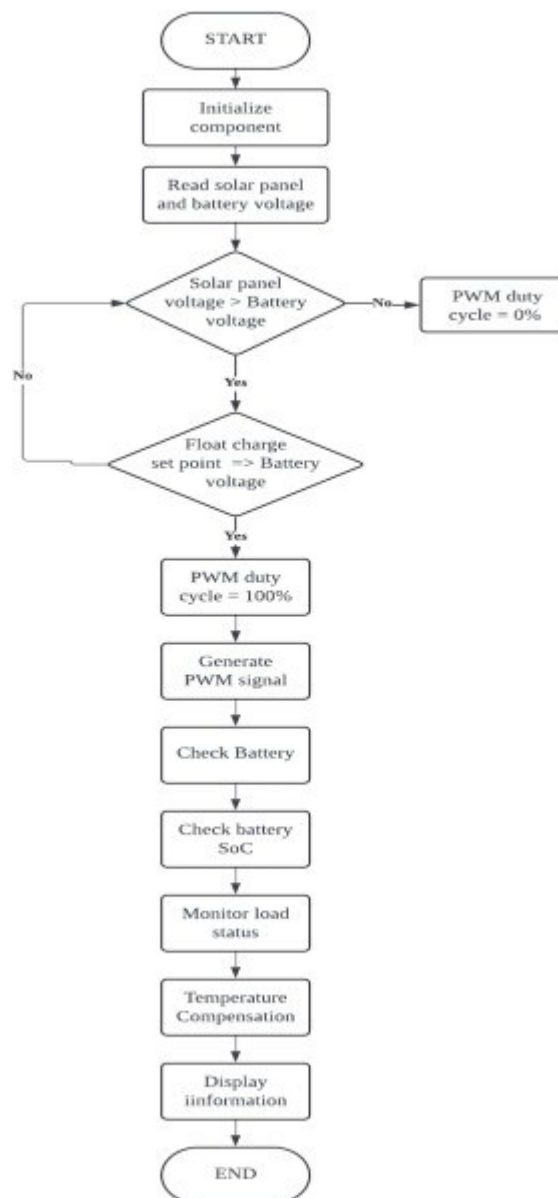
KEYWORDS: PWM, solar charge controller, Arduino Nano, renewable energy, battery management, solar energy efficiency.

PRODUCT DESCRIPTION

PWM Solar Charge Controller is an intelligent energy management tool meant to control the charge on batteries being charged by solar panels. At the core of the system is an Arduino Nano microcontroller, which guarantees accurate control of the charging process by generating pulse-width-modulated signals to regulate the charging current according to the battery's voltage levels. The system employs a buck converter to step down voltage from the solar panel, ensuring compatibility with battery specifications. Key components include MOSFETs for switching, temperature sensors for thermal monitoring, and voltage/current sensors for tracking energy flow. The system is designed to have a three-stage charging process including bulk, absorption, and float mode, such that batteries are continuously charged in an optimal float condition without fear of damage. The LCD interface displays vital data, such as battery status, solar panel voltage, and charging mode, providing users with real-time feedback. Temperature compensation has been incorporated to further enhance efficiency by modifying charging parameters depending on the surrounding conditions. The system in question is the perfect low-cost solution for small-scale solar energy projects, portable solar systems, and off-grid installations balancing the importance of affordability with performance.

PICTURES/ SCHEMATIC DIAGRAMS/ FLOW CHARTS/ SCREENSHOTS/ GRAPHS AND OTHER RELATED VISUALS**Block Diagram**

Flowchart



NOVELTY AND UNIQUENESS

The novelty of this PWM Solar Charge Controller lies in its combination of modern control algorithms and inexpensive components, offering an efficient and reliable alternative to traditional solar charge controllers. An Arduino Nano microcontroller allows implementing modern sophisticated charge management usually found in more advanced systems. This design is different compared with basic solar controllers. Here, there are although it depends upon environmental aspects, real-time temperature sensing and variable charging stages to accommodate for such changes. This modular design means that it will be easy to cheaply source these components, keeping costs down and allowing for expansion, a welcome feature for both DIY solar works and bigger installations within the renewable energy field.

BENEFIT TO MANKIND

This project provides an array of benefits such as promoting the transition towards cleaner and renewable sources of energy. The PWM Solar Charge Controller minimizes energy waste and prolongs the life of batteries by supporting effective battery management. This technology can be adopted in remote areas to give off-grid communities a reliable supply of power. The installation and maintenance of the system contributes toward minimizing carbon footprints, thus promoting environmental sustainability. In addition, this will empower the users with affordable, self-sustaining energy solutions, thus supporting energy independence and reducing the burden of dependence on fossil fuels.

COMMERCIALIZATION POTENTIAL

The PWM Solar Charge Controller has significant commercial potential, especially in the renewable energy sector. Its low-cost design that can be scaled easily makes it appealing to small and medium solar providers, DIY enthusiasts, and off-grid energy solution companies. Some possible markets are rural electrification projects, portable solar devices, camping gear, and emergency backup systems. Increased demand for affordable and efficient solar technology, particularly in developing zones, further augments the commercial viability of this product.

CONCLUSION

The development of the PWM Solar Charge Controller surely is the most significant advancement made so far in solar energy management. Through the integration of adequate charge control mechanisms, real-time monitoring, and adaptive charging stages, this project attempts to combat critical limitations associated with conventional charge controllers. This is done with the aim of educating users regarding sustainable practices to enhance battery lifespan and utilization of energy from solar panels. Future efforts might work on improving the design of large-scale controllers, building IoT capabilities for remote monitoring, and developing compatibility for all kinds of battery and solar panel arrangements. This advance will make significant contributions to the penetration of renewable energy and aid global sustainability initiatives.

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