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E-PROCEEDINGS

INTERNATIONAL TINKER INNOVATION & ENTREPRENEURSHIP CHALLENGE (i-TIEC 2025)

"Fostering a Culture of Innovation and Entrepreneurial Excellence"



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23 January 2025
PTDI, UiTM Cawangan Johor
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Electrical Engineering Studies, College of Engineering
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PREFACE

It is with great pleasure that we present the e-proceedings of International Tinker Innovation & Entrepreneurship Challenge (i-TIEC 2025), which compiles the extended abstracts submitted to the International Tinker Innovation & Entrepreneurship Challenge (i-TIEC 2025), held on 23 January 2025 at **PTDI, Universiti Teknologi MARA (UiTM) Cawangan Johor, Kampus Pasir Gudang**. This publication serves as a valuable resource, showcasing the intellectual contributions on the invention and innovation among students, academics, researchers, and professionals.

The International Tinker Innovation & Entrepreneurship Challenge (i-TIEC 2025), organized under the theme "Fostering a Culture of Innovation and Entrepreneurial Excellence," is designed to inspire participants at various academic levels, from secondary students to higher education students and professionals. The competition emphasizes both innovation and entrepreneurship, encouraging the development of product prototypes that address real-world problems and have clear commercialization potential. By focusing on technological and social innovations, i-TIEC 2025 highlights the importance of turning creative ideas into viable, market-ready solutions that can benefit users and society. The extended abstracts in this e-proceedings book showcase the diverse perspectives and depth of research presented during the event, reflecting the strong entrepreneurial element at its core.

We extend our sincere gratitude to the contributors for their dedication in sharing their innovation and the organizing committee for their hard work in ensuring the success of the event and this publication. We also appreciate the support of our collaborators; Mass Rapid Transit Corporation Sdn. Bhd. (MRT Corp), Universitas Labuhanbatu, Indonesia (ULB), Universitas Riau Kepulauan, Indonesia (UNRIKA) and IEEE Young Professionals Malaysia, whose contributions have been instrumental in making this event and publication possible.

We hope that this e-proceedings book will serve as a valuable reference for researchers, educators, and practitioners, inspiring further studies and collaborations in both innovation and entrepreneurship. May the knowledge shared here continue to spark new ideas and market-ready solutions, advancing our collective expertise and fostering the growth of entrepreneurial ventures.

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A-ST157: ADAPTIVE SUN-TRACKING SOLAR PANEL

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ABSTRACT

The Adaptive Sun-Tracking Solar Panel aims to design an intelligent solar panel system capable of tracking the sun's position using light-dependent resistors (LDRs) and an Arduino microcontroller. The primary objective is to enhance solar energy efficiency by optimizing the panel's orientation throughout the day. The system incorporates a Wi-Fi module, enabling real-time monitoring and data collection through a Telegram interface, ensuring easy access and analysis of solar panel performance. This innovative design enhances the conventional solar panel setup by providing automatic alignment with the sun, maximizing energy absorption, and improving overall system efficiency. The sun-tracking mechanism offers significant advantages over fixed solar panels, including higher energy output and reduced dependence on manual adjustments. The project also has the potential for positive socio-economic impact by contributing to the adoption of renewable energy sources, promoting sustainable energy practices, and lowering electricity costs for users. Environmentally, it supports the reduction of carbon emissions and fosters a greener, more sustainable future. With growing interest in clean energy technologies, the commercialization prospects for this sun-tracking system are promising, offering opportunities for widespread implementation in residential, industrial, and commercial sectors.

Keywords: Sun-Tracking, Solar Panel, Arduino Microcontroller, Wi-Fi Module, Renewable Energy.

1. Product Description

The Adaptive Sun-Tracking Solar Panel is an innovative solar energy solution designed to maximize the efficiency of solar power systems. This system features an intelligent sun-tracking mechanism that uses light-dependent resistor (LDR) sensors and an Arduino microcontroller to automatically adjust the position of the solar panel throughout the day, ensuring optimal alignment with the sun's path. This dynamic tracking capability significantly increases energy absorption compared to traditional fixed solar panels. In addition to the sun-tracking function, the system is equipped with a Wi-Fi module that allows real-time monitoring and data collection. Performance data, such as energy production (value of voltage) and value of angles tracking, is automatically recorded and can be accessed through Telegram, providing users with easy-to-view for better management and optimization of their solar energy output. The Adaptive Sun-Tracking Solar Panel offers a high-performance, user-friendly solution for those looking to harness the full potential of solar energy. It reduces dependency on manual adjustments, enhances energy efficiency, and

is ideal for residential, industrial, and commercial applications. With its combination of innovative technology and sustainability, this product supports a greener future by promoting the use of renewable energy and contributing to reduced carbon footprints.

2. Methodology and Results

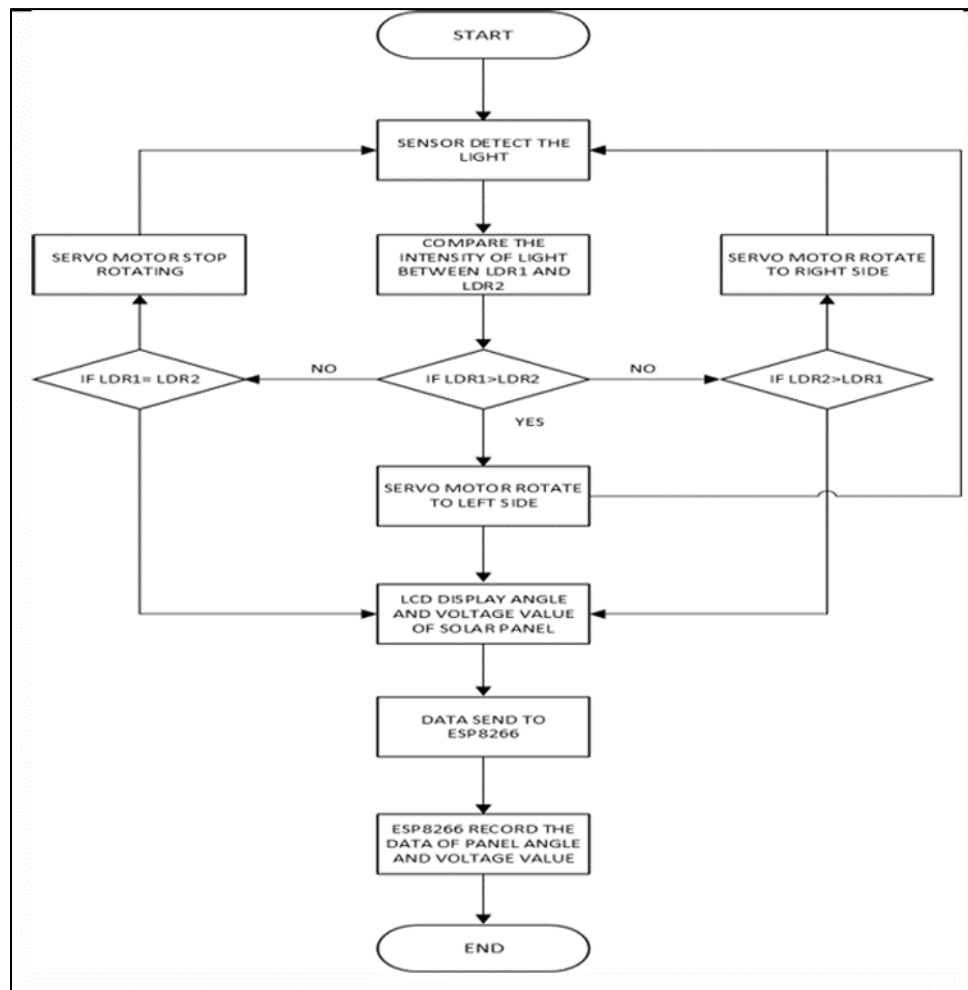


Figure 1. Flowchart of Adaptive Sun-Tracking Solar Panel.

Figure 1 illustrates the process of the Adaptive Sun-Tracking Solar Panel. The process begins with the sensor detecting ambient light. The system then compares the light intensity readings from two light-dependent resistors (LDR1 and LDR2). If LDR1 detects a higher light intensity than LDR2, the servo motor rotates the solar panel to the left to align it with the stronger light source. Conversely, if LDR2 detects a higher light intensity, the servo motor rotates the panel to the right. If the light intensities are equal, the servo motor stops moving. Once the optimal position is achieved, the LCD displays the solar panel's angle and the corresponding voltage output. This data is then sent to the ESP8266 module, which records the panel's angle and voltage for further analysis or monitoring. The system ensures that the

solar panel continuously adjusts its position to maximize light absorption, thereby improving energy efficiency. The cycle concludes, and the system remains ready for the next light detection and adjustment sequence.

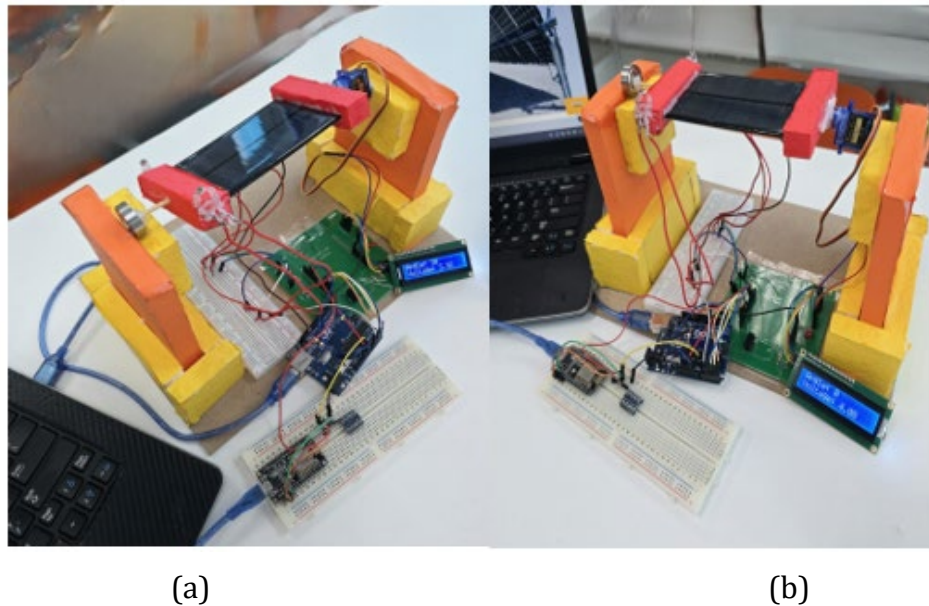


Figure 2. LCD Display showing the voltage of the solar panel and servo angle at different angles. (a) Solar panel at 30° (b) Solar panel at 0°.

Figure 2 shows the voltage of the solar panel and the servo angle on an LCD screen at different panel angles. In part (a), the solar panel is tilted at a 30-degree angle, and in part (b), it is positioned flat at a 0-degree angle. The **Figure 2** demonstrates how the change in the panel's angle affects both the voltage output and the servo position, as shown on the LCD display.

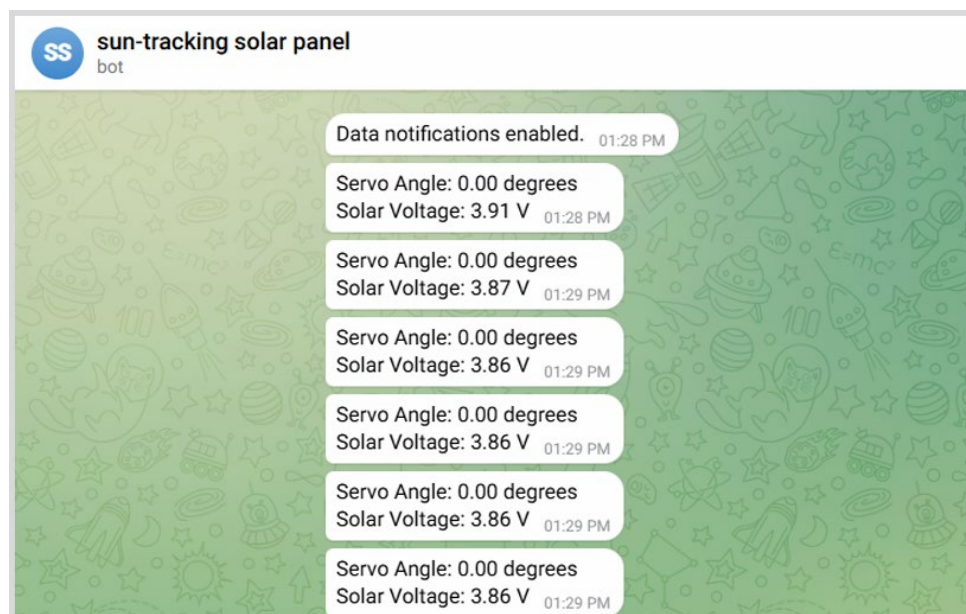


Figure 3. Telegram Interface for Monitoring and Data Collection.

Figure 3 shows how data is monitored and collected using a Telegram interface. The image demonstrates how the system sends data, such as voltage readings or sensor information, to a Telegram chat for easy monitoring and tracking.

3. Novelty and uniqueness

The novelty and uniqueness of the Adaptive Sun-Tracking Solar Panel lie in its integration of automation, real-time data monitoring, and energy efficiency optimization. Unlike traditional fixed solar panels, this system utilizes Light Dependent Resistor (LDR) sensors to detect sunlight intensity and automatically adjust the solar panel's orientation throughout the day. This dynamic sun-tracking capability ensures that the panel is always positioned for optimal sunlight exposure, significantly enhancing energy capture compared to static systems. This project uniqueness apart is the combination of smart tracking with a Wi-Fi module that enables remote monitoring. Through the use of Telegram interface, users can access real-time data on the solar panel's performance, such as energy production and panel angle, from anywhere with internet access. This innovative feature provides valuable insights into energy efficiency and allows for easy troubleshooting and system optimization. Moreover, the use of an Arduino microcontroller for processing sensor data and controlling the servo motors adds flexibility and scalability to the design, making it adaptable for various applications, from residential to commercial solar installations. The integration of renewable energy with cloud-based monitoring offers a user-friendly, low-cost solution that enhances the effectiveness of solar energy systems, fostering sustainable practices and contributing to a greener future.

4. Benefit to mankind

The Adaptive Sun-Tracking Solar Panel offers significant benefits to mankind by enhancing the efficiency of solar energy systems. By automatically adjusting the panel's position to follow the sun's path, the system maximizes energy absorption throughout the day, leading to higher energy production and reduced reliance on fossil fuels. This innovation promotes the use of clean, renewable energy, helping to reduce carbon footprints and combat climate change. Additionally, the integration of remote monitoring via Wi-Fi and Telegram interface provides users with real-time insights into solar panel performance, making it easier to manage energy usage and ensure optimal efficiency. This contributes to lower electricity costs for individuals, businesses, and communities. The project also encourages the widespread adoption of solar power, making it a viable and sustainable energy source for both rural and urban areas. Ultimately, this project promotes a more sustainable future by encouraging the transition to renewable energy and contributing to environmental preservation.

5. Innovation and Entrepreneurial Impact

The Adaptive Sun-Tracking Solar Panel fosters innovation by combining solar technology with automation and real-time data monitoring. The use of Light Dependent Resistor (LDR) sensors, an Arduino microcontroller, and a Wi-Fi module to optimize solar panel performance introduces a novel, cost-effective solution that enhances energy efficiency. This

innovative approach sets the project apart in the renewable energy sector, encouraging further technological advancements in solar power systems. The project also contributes to a culture of entrepreneurship by offering scalable solutions that can be commercialized in the growing renewable energy market. By demonstrating the practical applications of smart solar technology, it inspires entrepreneurs to explore new business opportunities in clean energy, from product development to service offerings such as system installation, maintenance, and data analytics. This encourages investment in sustainable solutions, promotes local job creation, and empowers communities and institutions to adopt greener energy practices, driving positive economic and environmental change.

6. Potential commercialization

The Adaptive Sun-Tracking Solar Panel has strong potential for commercialization due to the increasing demand for renewable energy solutions and energy efficiency. The system's ability to automatically adjust the solar panel's position to maximize sunlight absorption offers a clear advantage over traditional fixed panels, which makes it an attractive product for both residential and commercial sectors. The integration of a Wi-Fi module for real-time data monitoring adds significant value, making the system ideal for users who seek to optimize their energy consumption and monitor performance remotely. This feature opens up opportunities for additional services such as cloud-based energy management platforms, data analytics, and system maintenance, further enhancing the product's appeal.

7. Acknowledgment

It is acknowledged that this project is supported by Electrical Engineering Studies, College of Engineering, Universiti Teknologi MARA, Johor Branch, Pasir Gudang Campus, Masai, Malaysia.

8. Authors' Biography



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