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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
Universiti Teknologi MARA (UiTM) Cawangan Johor
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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-ST158: SUNLIGHT-RESPONSIVE TRACKING AND MONITORING SYSTEM FOR SOLAR PANELS

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ABSTRACT

The Sunlight-Responsive Tracking and Monitoring System for Solar Panels is designed to optimize solar energy capture by dynamically aligning solar panels with sunlight intensity throughout the day. Using light-dependent resistors (LDRs), servo motors adjust the panels' orientation, ensuring maximum energy absorption. The system incorporates a voltage sensor for performance monitoring and a Wi-Fi-enabled ESP32 microcontroller for remote control and data visualization via the Blynk app. By automating sunlight tracking and integrating IoT capabilities, this system significantly improves energy efficiency, reduces manual intervention, and extends the lifespan of solar panels. Addressing common inefficiencies in static solar setups, this scalable solution is adaptable to various applications, including residential and industrial use. The project represents a sustainable approach to renewable energy utilization, contributing to global efforts to reduce reliance on non-renewable resources.

Keywords: Solar Panel, Sunlight-Responsive Tracking, Remote Monitoring, Internet of Things (IoT), Energy Efficiency.

1. Product Description

The Sunlight-Responsive Tracking and Monitoring System for Solar Panels optimizes solar energy capture by aligning solar panels with the sun's position. The system integrates an Arduino Uno R3 microcontroller, photoresistor LDRs for sunlight detection, and servo motors for panel orientation. Voltage and current sensors monitor power performance, while the ESP32 Wi-Fi module provides real-time data visualization via the Blynk app. LEDs act as indicators to signal system status. **Figure 1** illustrates the system's architecture, where LDRs and energy sensors form the input layer. The Arduino processes this data to control servo motors, adjust panel orientation, and display performance metrics on an LCD. Additionally, the ESP32 module enables seamless remote monitoring. **Figure 2** details the operational flow. The system begins by initializing sensors and motors. LDRs detect sunlight intensity, and the Arduino calculates the optimal orientation, dynamically adjusting the servo motors. Voltage and current sensors record performance metrics, which are displayed on the LCD and transmitted to the Blynk app. The system operates continuously in a closed loop, ensuring high efficiency. This modular, IoT-enabled design is adaptable to various renewable energy applications, making it ideal for diverse environments and promoting sustainable energy solutions.

2. Block Diagram, Flow Charts and Schematic diagrams

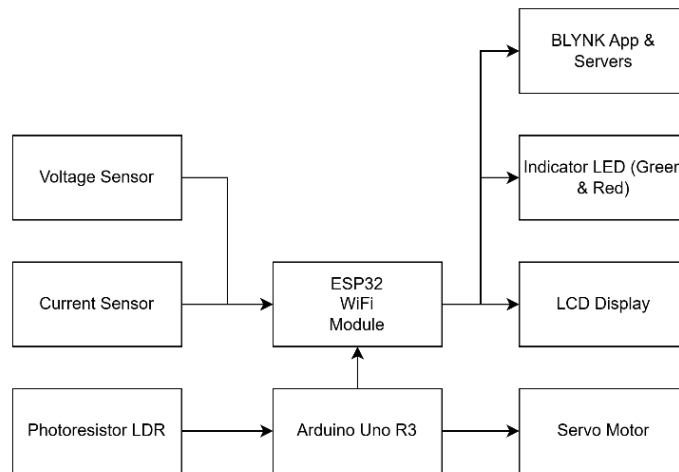


Figure 1. Block Diagram of the system.



Figure 2. Model flow chart.

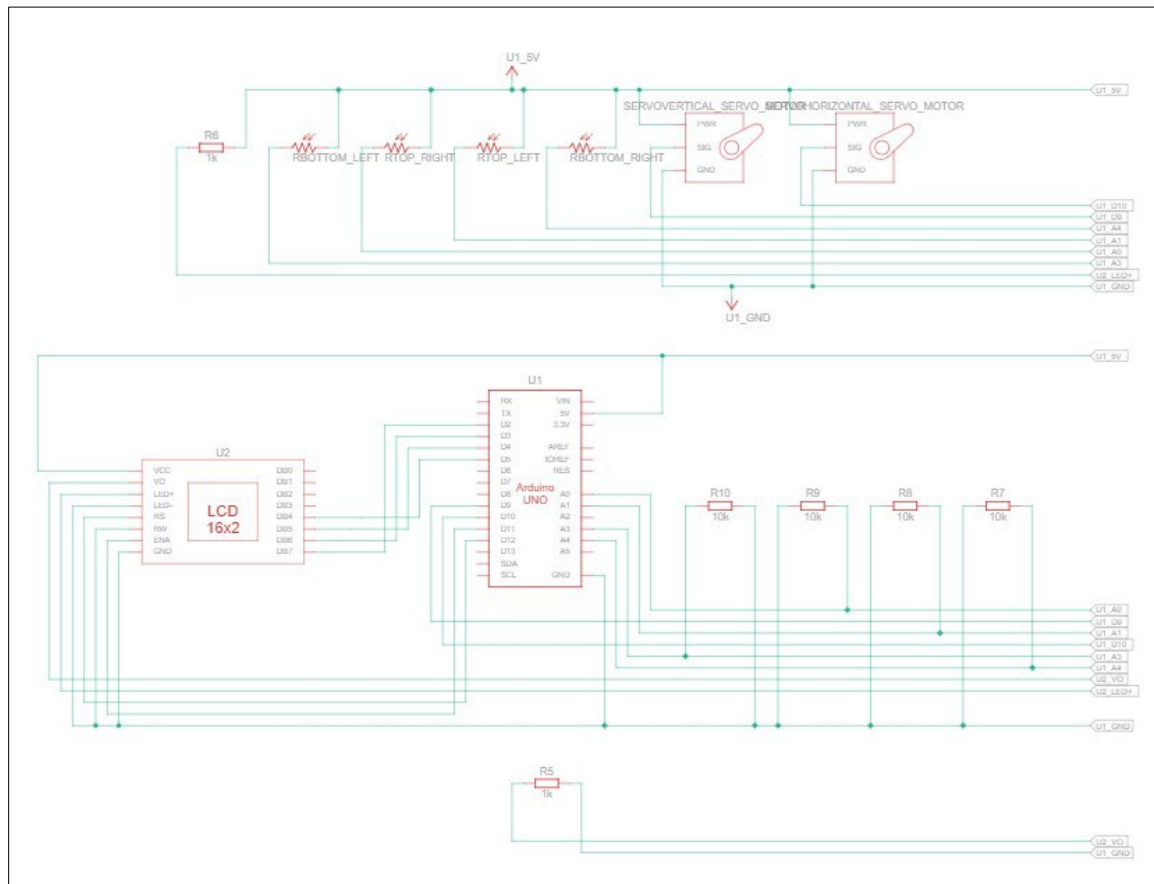


Figure 3. Schematic diagram.

The schematic diagram in **Figure 3** provides detailed hardware connections, demonstrating the efficient integration of sensors, microcontrollers, and output devices for reliable and continuous operation.

3. Novelty and uniqueness

This system's novelty lies in its integration of sunlight-responsive tracking, IoT capabilities, and real-time voltage monitoring. Unlike static panels, it ensures optimal sunlight exposure throughout the day. The Wi-Fi-enabled ESP32 microcontroller facilitates remote access, enabling proactive maintenance and performance optimization. These features collectively enhance energy efficiency and operational reliability.

4. Benefit to mankind

The system addresses inefficiencies in conventional solar panels, ensuring consistent energy production and reducing reliance on non-renewable energy sources. By integrating IoT for remote monitoring, it minimizes maintenance costs and enhances accessibility. Its adaptability supports sustainable energy solutions, benefitting urban and rural communities alike.

5. Innovation and Entrepreneurial Impact

The system showcases innovation through its integration of dynamic sun tracking and IoT capabilities, enabling real-time remote monitoring and control via the Blynk app. Unlike static solar panels, this solution maximizes energy efficiency by continuously adjusting the panel's orientation to follow the sun's movement. Voltage and current sensors provide precise performance monitoring, while the Wi-Fi-enabled ESP32 ensures seamless data accessibility. Its modular design supports scalability and adaptability for various applications. By combining advanced automation with renewable energy technology, the system offers a forward-thinking approach to enhancing solar energy utilization and addressing global energy challenges.

6. Potential commercialization

This technology is ideal for diverse markets, including residential, industrial, and rural applications. Its scalability and ability to maximize energy yield align with global renewable energy trends, making it a viable product for mass deployment. The system's innovative features, such as real-time monitoring and automated sun tracking, enhance its appeal to customers seeking advanced and efficient renewable energy solutions. By addressing the demand for sustainable energy, this technology has the potential to gain significant traction in the renewable energy market.

7. Acknowledgments

Gratitude is extended to Electrical Engineering Studies faculty for providing resources and facilities essential for this project's success. The guidance and support from them were invaluable in bringing this concept to completion.

8. Authors' Biography



Muhammad Dinie Imran Bin Abdul Haizul Faisal is pursuing a Diploma in Electrical Engineering (Power) at UiTM Pasir Gudang. Throughout his academic journey, he has demonstrated a passion for innovation, problem-solving, and hands-on application of engineering concepts, particularly in renewable energy systems and automation technologies.



Siti Aliyah Mohd Saleh obtained her Bachelor of Electrical (Hons) Engineering from UTM in 2009 and a Master in Engineering (Applied Science) from Tokai University, Japan in 2012. She is currently serving as a lecturer at Universiti Teknologi MARA, Johor Branch, Pasir Gudang Campus, in Electrical Engineering Studies in the Power Department. Her main research interests are high voltage and power systems.



Norbaiti Sidik received her Bachelor Engineering Degree in Electrical, Electronics and System from Universiti Kebangsaan Malaysia, and she further developed her academic and professional skills by obtaining Master Engineering Degree in Communication and Computer also from the same university in 2002. She is very committed, passionate and dedicated in education line who is now a senior lecturer and having experienced more than 15 years in teaching & learning and lecturing at Electrical Engineering Studies, College of Engineering, Universiti Teknologi MARA Johor Branch, Pasir Gudang Campus, Johor Darul Takzim.



Muhammad Farid Abdul Jalil is currently pursuing a Diploma in Electrical Engineering (Power) at UiTM Pasir Gudang Campus. He has consistently excelled in both his academic coursework and extracurricular activities, earning a place on the Dean's List for every semester. This achievement highlights his intellectual abilities and strong commitment to success in his field, as well as his active involvement in campus life.