E-PROCEEDINGS

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

"Fostering a Culture of Innovation and Entrepreneurial Excellence"

23 January 2025
PTDI, UiTM Cawangan Johor
Kampus Pasir Gudang

ORGANIZED BY:

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.

A-ST156: SOLARALIGN: DUAL-AXIS INNOVATION FOR SUSTAINABLE ENERGY SOLUTIONS

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ABSTRACT

SolarAlign: Dual-Axis Innovation for Sustainable Energy Solutions is designed to optimize solar energy capture by adjusting the orientation of the solar panel toward the most intense light source throughout the day. The system integrates several components, including a temperature sensor (LM35), photoresistor, LDR module, servo motor, LED, LCD, solar cell, and an Arduino MEGA microcontroller. By using real-time data from the sensors, the system adjusts the panel's position to improve energy absorption efficiency. This project utilizes cost-effective, widely available components, providing an innovative solution to enhance solar energy systems. The combination of a simple control system and modular design sets it apart from other solar trackers. By improving solar energy efficiency, the SolarAlign contributes to the transition to sustainable energy and helps reduce dependence on fossil fuels.

Keywords: Solar Tracker, Photoresistor, Temperature Sensor, Arduino MEGA, Solar Energy Optimization, Sustainable Energy

1. Product Description

The SolarAlign is an innovative and cost-effective solar tracking system designed to optimize solar energy capture throughout the day. This smart system uses advanced sensing technology and dynamic orientation to ensure that solar panels are consistently aligned with the most intense light source, improving their energy output. By employing dual-axis tracking, the SolarAlign adapts to the sun's movement across the sky, maximizing exposure to sunlight. Key features of the system include intelligent sensors such as photoresistors and temperature sensors, which provide real-time data to adjust the panel orientation accordingly. The system also features a user-friendly interface, making it accessible and easy to operate. Beyond enhancing energy efficiency, the SolarAlign contributes to sustainable energy solutions by reducing reliance on non-renewable resources, supporting global efforts for a greener, more sustainable future. With its combination of smart technology, efficiency, and cost-effectiveness, the SolarAlign presents a significant step forward in solar power systems, offering an environmentally friendly alternative to traditional energy sources.

2. Method Flow Charts and PCB Layout Design

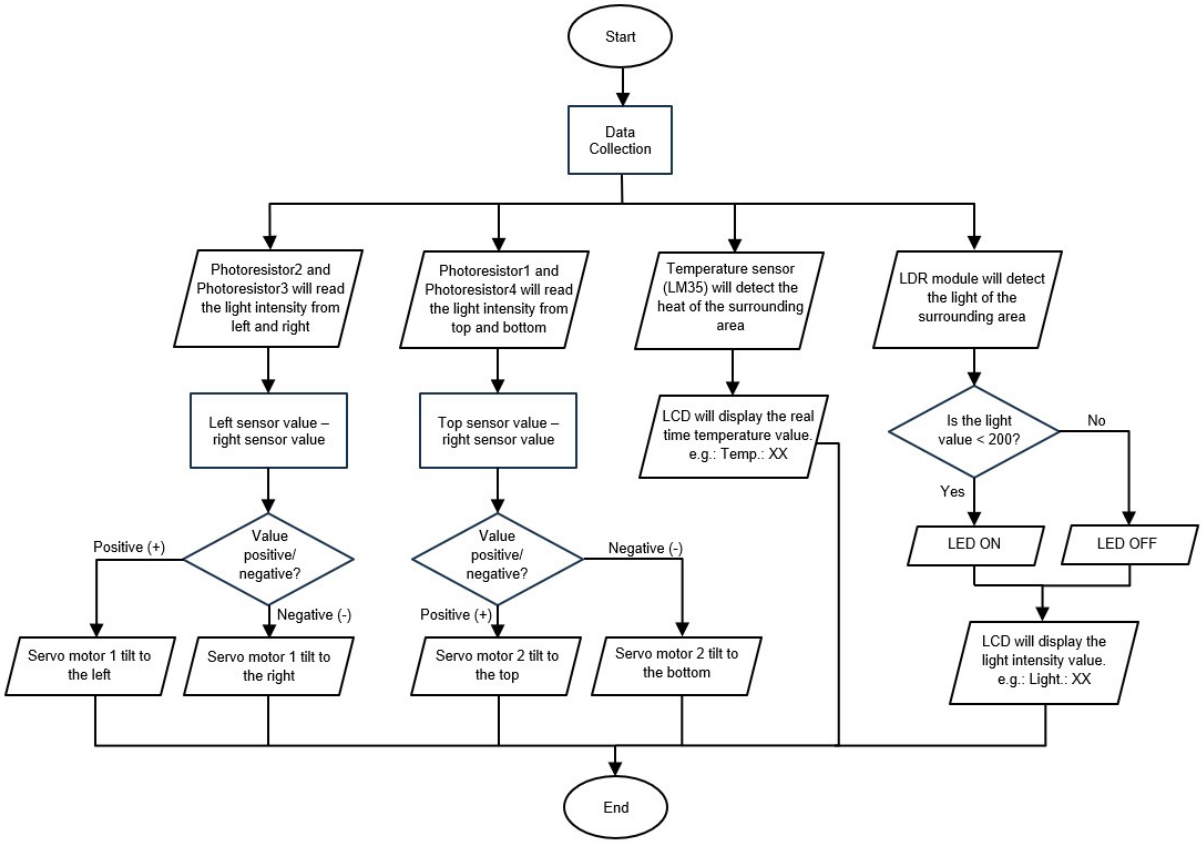

Figure 1. System Flow Chart.

The flowchart for the SolarAlign outlines the sequential steps for data collection and decision-making. The system gathers light intensity data from four photoresistors, temperature readings from an LM35 sensor, and ambient light levels using an LDR module. The data is processed to adjust the position of the servo motors based on light intensity from different directions. If the light intensity drops below a predefined threshold, an LED indicator is activated to signal low light conditions. Additionally, real-time data, including temperature and light intensity, is displayed on an LCD, providing valuable feedback for monitoring system performance. This continuous feedback loop ensures efficient operation, maximizing energy generation while adapting to changing environmental conditions.

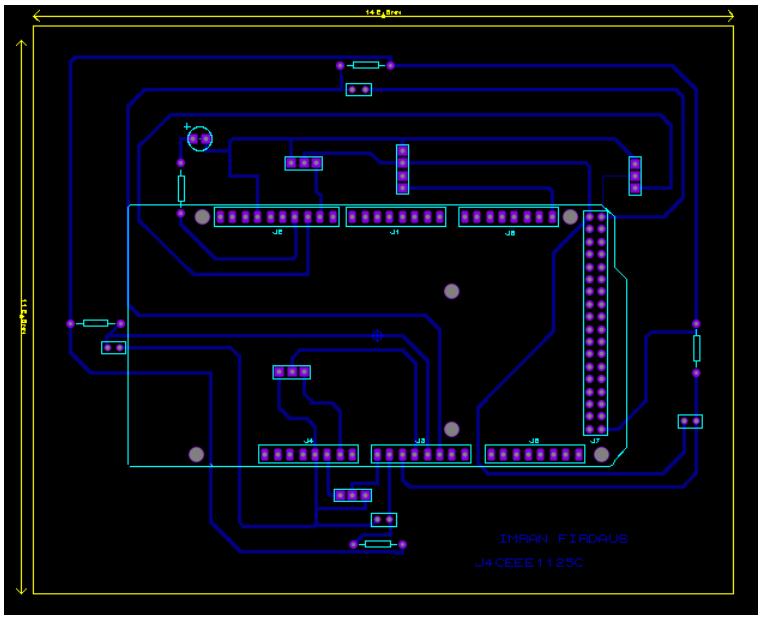

Figure 2. Printed Circuit Board (PCB) Design for a SolarAlign: Dual-Axis Innovation for Sustainable Energy Solutions.

This PCB layout integrates key components: two photoresistors (each with a 2-pin connection), an LM35 temperature sensor (with a 3-pin connection), and an LDR module (with a 4-pin connection). The system is controlled by an Arduino Mega microcontroller, which manages sensor inputs and drives the outputs to two servo motors, each connected via a 3-pin connection for precise control.

3. Novelty and uniqueness

The SolarAlign is unique in its approach to maximizing solar energy efficiency using dynamic dual-axis tracking. Unlike traditional fixed or single-axis solar systems, this technology allows the solar panel to adjust its orientation both horizontally and vertically, ensuring optimal sunlight exposure throughout the day.

What sets the SolarAlign apart is its use of cost-effective, readily available components, including photoresistors, an LM35 temperature sensor, and an LDR module, all controlled by an Arduino Mega microcontroller. This integration of simple sensors and an efficient control system makes it both affordable and highly functional. The system also features real-time monitoring via an LCD display and provides feedback through an LED indicator for low light conditions. Its combination of intelligent sensors, dual-axis tracking, and ease of use makes the SolarAlign an innovative solution that improves solar energy efficiency while remaining accessible for a wide range of applications.

4. Benefit to mankind

The SolarAlign has the potential to significantly improve solar energy efficiency by optimizing solar panel alignment with sunlight through dynamic dual-axis tracking. This system increases solar panel energy generation, making renewable energy more reliable and efficient. By offering a cost-effective solution, the SolarAlign could contribute to the widespread adoption of solar energy, reducing reliance on fossil fuels and promoting sustainability. Its affordability makes it ideal for both residential and industrial applications, especially in regions with limited access to reliable, clean energy. In the long term, this innovation could help combat climate change by reducing carbon emissions and improving energy access. The SolarAlign supports global efforts toward cleaner, more sustainable energy solutions, fostering a greener future and providing a more energy-independent society.

5. Innovation and Entrepreneurial Impact

The SolarAlign demonstrates significant innovation by integrating dynamic dual-axis solar tracking with affordable, widely available components. This combination enhances solar panel efficiency, making renewable energy more accessible for both residential and commercial users. By reducing energy loss due to fixed solar panel angles, the SolarAlign maximizes solar energy capture, providing a sustainable and cost-effective solution for energy generation.

From an entrepreneurial perspective, the SolarAlign has the potential to disrupt the solar energy market by offering a scalable, affordable alternative to traditional solar tracking systems. Its use of inexpensive materials and user-friendly design makes it an attractive option for regions with limited access to advanced energy infrastructure. Furthermore, the system can inspire future startups and businesses focused on sustainable energy solutions, contributing to the growth of green technologies and encouraging the widespread adoption of clean energy.

6. Potential commercialization

The SolarAlign has strong potential for commercialization due to its cost-effective design and ability to improve solar energy efficiency. By using affordable components like photoresistors, sensors, and Arduino microcontrollers, it can be easily adapted for both residential and industrial solar applications. This makes it an attractive option for regions looking to adopt renewable energy solutions at a lower cost. The system's dual-axis tracking offers better performance than traditional fixed solar panels, making it a valuable product for solar energy companies. Its simple, modular design also allows customization to meet different energy needs. As demand for renewable energy grows worldwide, the SolarAlign could appeal to businesses in the solar industry, helping to expand the adoption of solar technologies and contribute to a more sustainable future.

7. Acknowledgment

Gratitude is extended to all those who contributed to the development and success of the SolarAlign project. Special thanks to all team members for their collaboration in building and testing the system. Appreciation is also given to UiTM Pasir Gudang for providing the necessary resources and equipment to complete the project.

8. Authors' Biography

Muhammad Imran Firdaus Bin Mohd Safarin is a dedicated final-year student currently pursuing a Diploma in Electrical Engineering (Power) at UiTM Kampus Pasir Gudang. He is in Semester 5 of his studies and is preparing to transition into his internship. As part of his academic journey, Imran has gained practical experience and developed a keen interest in various aspects of electrical engineering, particularly in solar energy applications, Arduino-based systems, and electrical circuits.

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