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e - Proceedings

IUGeT

Proceeding for International Undergraduates Get Together 2024 (IUGeT 2024)

"Undergraduates' Digital Engagement Towards Global Ingenuity"

2nd Edition

Organiser :

Department of Built Environment Studies and Technology, College of Built Environment, UiTM Perak Branch

Co-organiser :

INSPIRED 2024. Office of Research, Industrial Linkages, Community & Alumni (PJIMA), UiTM Perak Branch

Bauchemic (Malaysia) Sdn Bhd

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Publication date :

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Perpustakaan Negara Malaysia Cataloguing in Publication Data

No e- ISBN: 978-967-2776-42-0

Cover Design: Muhammad Anas Othman
Typesetting : Arial

e-ISBN: 978-967-2776-42-0

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e-ISBN: 978-967-2776-42-0

SMART SOLAR LOUVRE SHADING SYSTEM FOR RESIDENTIAL BUILDING IN MALAYSIA

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Abstract
Solar louvre shading or awning prevents solar radiation from entering the building. However, dirt and debris on the solar panel can affect solar louvre shading performance. Many studies have shown that the current louvre shading requires regular maintenance to clean the panels. Furthermore, the overheating problem could also affect the technology's sustainability and reduce the performance of solar panels. Therefore, this project aims to improve solar shading technologies by innovating the smart solar louvre shading system. Three research objectives have been developed to achieve this aim, i.e., identify the common problem with the existing solar shading devices, propose a smart solar louvre shading system for residential buildings in Malaysia, and suggest the marketability potential of smart solar louvre shading system. This study adopts several research methodologies, such as reviewing literature, idea creation and 3D simulation modelling using SketchUp and Lumion software. Key findings of this study reveal that present solar louvre shading systems have issues such as high startup costs and debris buildup that makes maintenance difficult. Self-cleaning mechanisms and rain sensors in the intelligent solar louvre shading system improve efficiency and reduce maintenance costs. This study found that sophisticated solar louvre shading systems can optimise lighting, cleaning mechanisms, and maintenance to reduce building energy usage, as well as improve the outdoor atmosphere, supporting modern home construction's sustainability goals.

Keywords: *Smart solar louvre system; self-cleaning mechanism; energy efficiency*

1. INTRODUCTION

The main goal of this study is to improve solar shading technologies by innovating the smart solar louvre shading system in residential buildings in Malaysia. Recent studies reveal that solar louvre performance was affected by dirt and debris on the solar panel (Baghbani, 2021) and high maintenance costs highlighted by Baker et al. (2013). Therefore, this study seeks to optimize the effectiveness of solar shading technology while adhering to sustainable construction principles. The study's objectives can be classified into three categories: to identify the common problem with the existing solar shading devices, to propose a smart solar louvre shading system for residential buildings in Malaysia, and to suggest the marketability potential of smart solar louvre shading system. The procedure involved a comprehensive review of existing literature, meticulous analysis of observations, and the utilization of models. There are several existing solar louvre shading systems have been developed, such as Hydro One Picola (Hydro One Marketing Sdn Bhd,2023), Artares Louvered Roof (Solar Sunshades, 2024) and SolarGaps (SolarGaps, 2019). The key findings indicate that existing systems encounter challenges such as power reduction of more than 1 % per day and can reach up to 80 % per each month due to dust deposition depending on climate conditions, particularly in high radiation arid and semi-arid climate conditions (Kazem et al., 2020 as cited in Al-Sharafi et al., 2024). The suggested system combines self-cleaning mechanisms and rain sensors, enhancing efficiency and decreasing maintenance costs. The simulation findings demonstrate significant improvements in energy efficiency and visual comfort.

The results suggest that intelligent solar louvre shading systems can substantially decrease building energy usage and promote sustainable building methods, providing advantages for both the environment and the economy.

2. METHODOLOGY

The study explores the techniques and substances employed in developing Smart Solar Louver Shadings. The data-gathering methodology section establishes three principal ways to get crucial information for the advancement of the product. An extensive literature assessment was initially undertaken, gathering information from academic publications and online sources regarding the current solar louvre shading systems. This review offered insights into several aspects, substances, characteristics, technologies, and configurations relevant to the suggested innovation. Furthermore, an idea creation was established after reviewing the current products for the identification of specific areas that need enhancement. Finally, 3D simulation modelling using SketchUp and Lumion software was utilized to annotate the product with specific material information and showcase the shading system's concept and effectiveness through video simulations. Lumion offered 3D modelling and visualization, showcasing the tangible elements and characteristics of the shading system, such as sensor responses and the self-cleaning process. Figure 2.1 shows the assembly of Smart Solar Louver Shading.

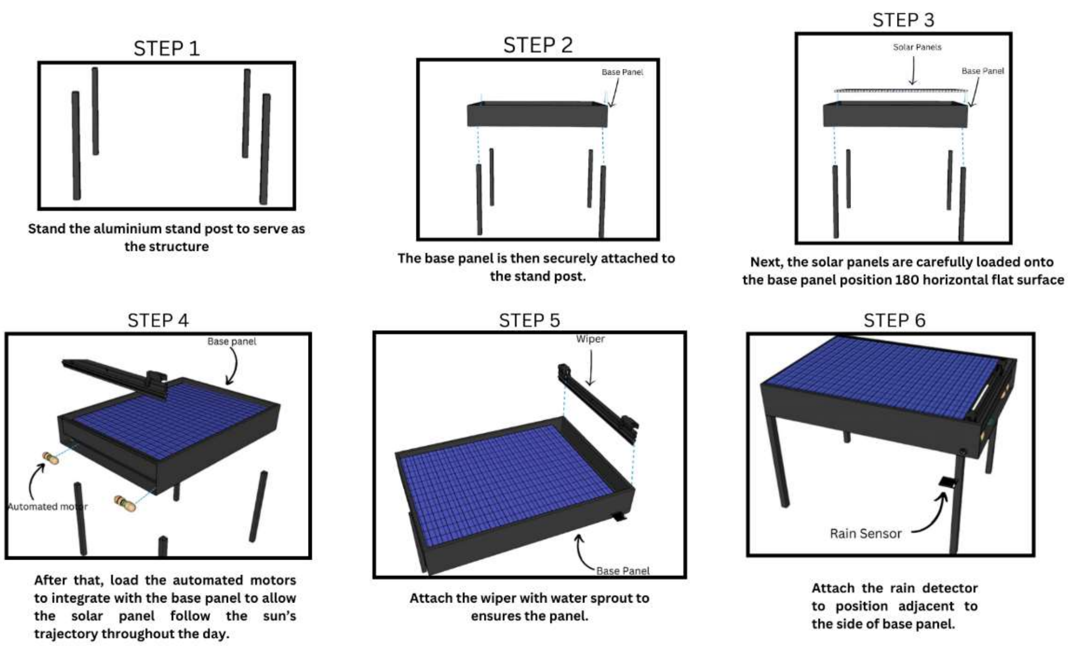


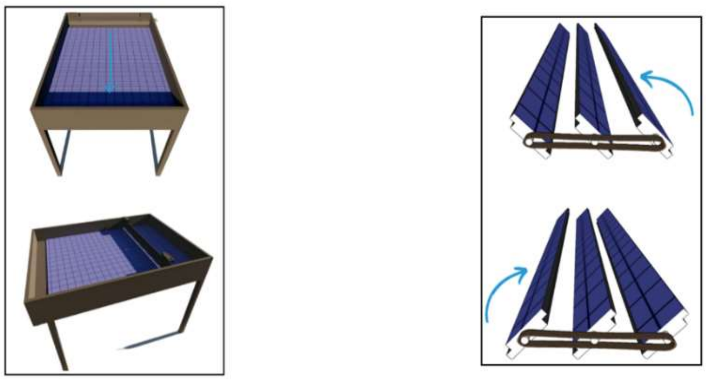
Figure 2. 1: Assembly procedure for Smart Solar Louver Panel

3. RESULTS AND DISCUSSION

The study results focus on identifying issues in the existing solar shading devices. In proposing an innovative solution, the study introduces the concept of Smart Solar Louver Shadings integrated with a rain sensor, automated monitoring and self-cleaning mechanism. The benefits and limitations of using the Smart Solar Louver Shading are discussed. The Smart Solar Louver Shading is an innovative solution that tackles current shading and energy efficiency challenges while aligning with various Sustainable Development Goals (SDGs). Integrating solar technology and intelligent controls into shading systems contributes to sustainable energy, climate action, and responsible consumption and production.

e-ISBN: 978-967-2776-42-0

This technological advancement improves energy efficiency by lessening reliance on traditional energy sources and decreasing the environmental impact associated with conventional shading systems, thereby supporting the aim of SDG 7 to ensure universal access to affordable, reliable, sustainable, and modern energy. In addition to addressing sustainable energy needs, the Smart Solar Louver Shading plays a role in climate action by encouraging environmentally friendly practices. Through the reduction of energy consumption and carbon emissions, it helps build resilience against the impacts of climate change. Offering a sustainable alternative to traditional shading systems, it optimizes energy use. It promotes product longevity through innovative design, aligning with the goals of SDG 12, which focuses on responsible consumption and production. Figure 3.1 shows the operating functions of the innovation.



The self-cleaning wiper with a water sprout for solar panels is designed to maintain optimal panel efficiency by removing debris such as dust, dirt, and bird droppings. First, the solar panel will adjust to 180 flat surfaces for cleaning process. Then, the panels will be lowered aligned with the wiper surface. After that It will sprout the water while wiping the solar panels.

Dual-axis trackers adjust panels in both directions, ensuring precise alignment with the sun throughout the day and across seasons. By maintaining the ideal angle between sunlight and panels, these trackers significantly enhance energy capture

Figure 3. 1: Operational procedure of a smart Solar Louvre Shading System

Smart Solar Louvre Shading maximise solar energy and boosts energy efficiency in residential structures. The systems may be handled manually or automatically using sensors and smart home technologies, providing homeowners with more comfort and decreased energy costs. The growing demand for energy efficiency solves the rising energy costs, and a global desire for sustainable living has raised the demand for energy-efficient household solutions like Smart Solar Louver Shading. The added cleaning mechanism also solves the high maintenance cost. The integration of IoT and smart home technologies is becoming increasingly common. Smart Solar Louver Shading are easily connected to these systems, allowing homeowners greater control over their living spaces.

4. COMPARISON OF SMART SOLAR LOUVER SHADING WITH EXITING SOLAR SHADING DEVICES

Table 4.1 compares the Smart Solar Louver Shading system with the existing product. It proves that the Smart Solar Louvre Shading System is far superior to the existing product in terms of its performance.

Table 4. 1: Comparison Specification between Smart Solar Louver Shading and existing solar shading devices

Product Features	**SolarGaps**	**Artares Louvered Roof**	**Hydro One Picola**	**Smart Solar Louver Shading**
Panels	Adjustable	Adjustable	Manual	Adjustable
Orientation	Vertical	Horizontal	Horizontal	Horizontal
Cleaning Mechanism	Ethylene tetrafluoroethylene (ETFE)	None	None	Wiper with water sprout
Wind Resistance	Less Durability	High Durability	High Durability	High Durability
Control System	Flexible	Switch	Flexible	Flexible
Rain Detector	None	Automated	Motorized	Automated

5. CONCLUSION

In conclusion, the paper introduces the Smart Solar Louver Shading breakthrough in sustainable construction technology. This innovation efficiently tackles the difficulties of energy efficiency and interior environmental quality in residential buildings by combining photovoltaic technology with movable louvre systems. The intelligent louvres offer effective shading to minimize heat absorption and improve thermal comfort. Additionally, they utilize solar energy to produce electricity, supporting a building's self-sufficiency in energy. Using a self-cleaning mechanism and integrating a rain sensor guarantees that the solar panels sustain their efficiency over time without needing maintenance. This characteristic is especially advantageous in the Malaysian setting, where frequent rainfall can impede the effectiveness of traditional solar panels. Moreover, the system's automation and smart control features enable it to adjust dynamically to current weather conditions, maximizing energy efficiency and improving user comfort. From a marketing standpoint, the Smart Solar Louvre Shading system is not just a product, but a commitment to sustainability. It caters to the increasing need for environmentally friendly construction solutions and is in line with worldwide sustainability objectives. This innovation's potential for substantial energy savings, together with its environmental advantages, makes it an appealing choice for both residential developers and homeowners.

6. ACKNOWLEDGMENT

We want to extend our sincere gratitude to the UiTM Perak Branch for the generous financial support in funding the publication of this innovation competition. With their assistance, this work was possible.

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Sekian, terima kasih.

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