Organised by :

UNIVERSITI TEKNOLOGI MARA

RICAEN
Research Industry Community Alumni Entrepreneurship Network

Programme by :

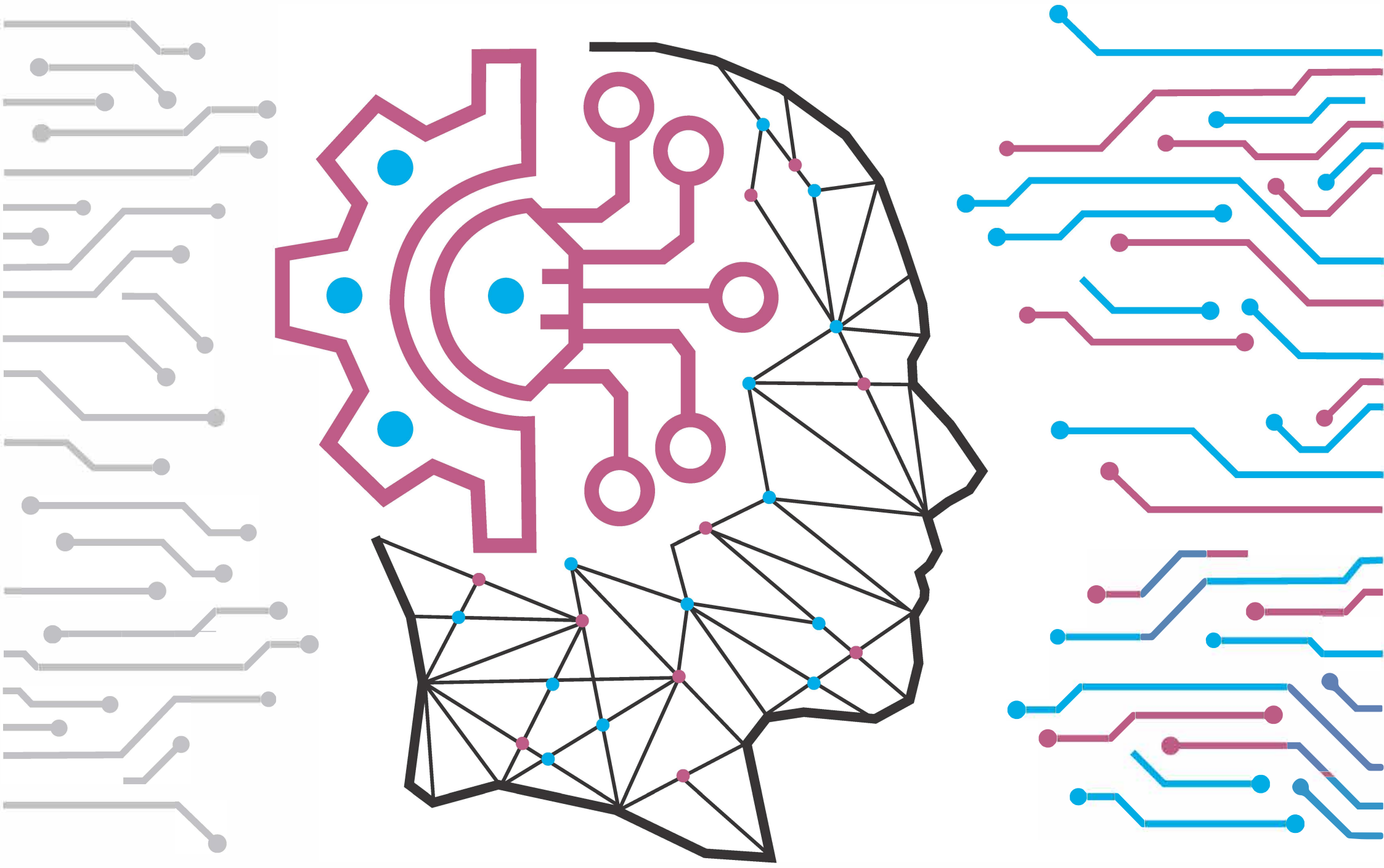
INSPIRED 2024
IPOH INTERNATIONAL SUMMIT ON PROFESSIONALISM, RESEARCH & EDUCATION

In Collaboration With :

BITCOM
BUSINESS INNOVATION & TECHNOLOGY COMMERCIALIZATION CENTRE

MRM
MAJLIS REKABENTUK MALAYSIA

MDEC™



13TH IIDES 2024

ENVIRONMENTAL • SOCIAL • GOVERNANCE

THE 13TH INTERNATIONAL INNOVATION, INVENTION & DESIGN COMPETITION 2024

EXTENDED ABSTRACTS

e-BOOK

EXTENDED ABSTRACTS e-BOOK

THE 13th INTERNATIONAL
INNOVATION, INVENTION &
DESIGN COMPETITION 2024

Organized by:
Office Of Research, Industry,
Community & Alumni Network
UiTM Perak Branch

Perpustakaan Negara Malaysia Cataloguing in Publication Data

No e- ISBN: 978-967-2776-31-4

Cover Design: Dr. Mohd Khairulnizam Ramlie
Typesetting : Zarinatun Ilyani Abdul Rahman

EDITORIAL BOARD

BUILDTHERMO: AN ALGORITHM FOR VISUALIZING BUILDING HEAT DYNAMICS

Amira Shazlin Adnan[1], Adi Irfan Che Ani[2], [4], Mohamad Ezad Hafez Mohd Pahroraji[3], Mohd Asraf Ayob[3], Noraziah Wahi[1]

[1] Department of Quantity Surveying, Universiti Teknologi MARA, Sarawak Branch, Kota Samarahan Campus, 94300 Sarawak, MALAYSIA

[2] Department of Architecture and Built Environment, Faculty of Engineering and Built Environment, Universiti Kebangsaan Malaysia, Bangi 43600, Selangor, MALAYSIA

[3] Department of Building, Universiti Teknologi MARA, Sarawak Branch, Kota Samarahan Campus, 94300 Sarawak, MALAYSIA

[4] School of Liberal Studies, Universiti Kebangsaan Malaysia, Bangi 43600, Selangor, MALAYSIA

amirashazlin@uitm.edu.my, *adiirfan@ukm.edu.my ezad@uitm.edu.my, asraf808@uitm.edu.my, noraziahwahi@uitm.edu.my*

ABSTRACT

This paper introduces BUILDthermo, a groundbreaking approach that transforms the analysis of building heat dynamics through advanced algorithms and visualization techniques. By integrating microclimate data, building characteristics, and urban attributes, BUILDthermo provides holistic insights into the thermal conditions of building surroundings. Our innovative algorithm is rigorously developed and validated, delivering precise assessments and facilitating informed decision-making in urban development. With an intuitive interface, BUILDthermo empowers stakeholders to visualize and interpret building heat data effortlessly. Users can explore scenarios, evaluate design alternatives, and optimize outdoor environments for comfort and sustainability. The methodology details, including parameter considerations and algorithmic processes, are outlined. Case studies demonstrate the practical application and efficacy of BUILDthermo in real-world urban settings. As a significant advancement, BUILDthermo offers a powerful tool for urban planners, architects, and environmental engineers to create more livable and sustainable cities. This research contributes valuable insights to urban climate resilience and human-centric design.

Keyword: Building; Building Heat Assessment; Building Heat Dynamic; Outdoor Thermal Comfort

1. INTRODUCTION

In recent decades, urban environments have expanded significantly, characterized by rapid and often unplanned growth. This expansion has resulted in a reduction of environmental quality within urban areas and a simultaneous increase in the energy consumption of buildings. The construction and operation of built environments significantly influence the quality of life in urban areas. According to IPCC (2021), global mean surface temperatures within cities are projected to increase by 1.4–4.8°C by the year 2100. Consequently, urban areas face heightened susceptibility to the impacts of urbanization, including climate change, urban heat island, and elevated concentrations of pollutants. These adverse effects pose significant threats to the health and outdoor thermal comfort of urban residents. Despite its importance, outdoor thermal comfort assessment has received relatively less

attention compared to indoor thermal comfort studies (Aghamolaei et al., 2023). This gap in research reflects a critical need for innovative approaches to assess and improve thermal conditions in outdoor settings, especially in surrounding buildings of the new development area.

In response to this need, a study was conducted to develop a building heat assessment instrument that integrates microclimate data, building characteristics, and urban attributes parameters to analyze the dynamic of building heat. From this assessment, BUILDthermo is introduced as an innovative solution to provide stakeholders with holistic insights into the thermal condition surrounding buildings. By leveraging sophisticated algorithms and data processing techniques, this tool synthesizes information from detailed building heat assessments into interactive visualizations. These visualizations offer stakeholders a dynamic and intuitive platform to explore and interpret thermal data with precision.

2. METHODOLOGY

The building heat assessment is being conducted through field measurements in the vicinity of Dewan Bandaraya Kuala Lumpur (DBKL) towers 1, 2, and 3, located along Jalan Raja Laut (Towers 1 and 2) and Jalan Raja Abdullah (Tower 3). Ground surface temperature measurements are taken using the KESTREL 3000 environmental meter tool and Internet of Things (IoT) devices. Data collection will span seven consecutive days, with measurements recorded at hourly intervals.

Following data collection, a systematic logging and processing approach was implemented using Google Sheets, which facilitated the creation of visual representations via Google Charts. This process was further augmented by applying a newly developed algorithm known as BUILDthermo, specifically designed to visualize and interpret results within an academic framework. Figure 1 provides a schematic depiction of the conceptual framework supporting BUILDthermo.

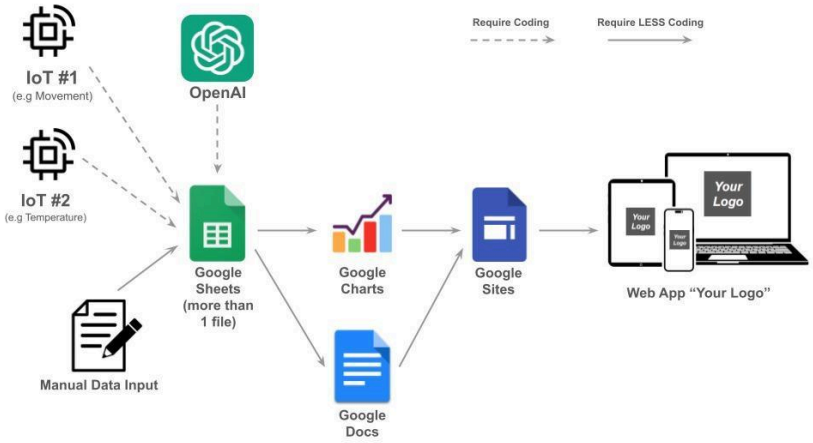


Figure 1 Framework of BUILDthermo Vision

3. COMMERCIALISATION/COPYRIGHT

The BUILDthermo tool exhibits strong potential to be extensively utilized by regulatory authorities, urban planners, architects, environmental engineers, and researchers. Its multifaceted functionality makes it a versatile tool for comprehensively analyzing building heat dynamics, which supports

informed decision-making and interventions to create more sustainable, resilient, and livable urban environments. This new algorithm is in the process of being registered with an IP from MyIPO.

4. FINDINGS

The analysis of the data revealed distinct thermal profiles across the study area, indicating variations in heat index influenced by a combination of environmental factors and urban characteristics. Figure 2 illustrates these thermal profiles generated by BUILDthermo, showcasing the fluctuations in heat index corresponding to diurnal variations over the course of the study period. During daytime hours, from approximately 11 am to 5 pm, the heat index exhibited peaks, which is typical due to the midday sun. These peak temperatures coincide with the peak solar intensity, resulting in elevated heat levels in the surrounding environment. Conversely, there was a general decrease in heat index values during the evening and early morning hours.

Moreover, differences in the heat index were observed between the areas surrounding the DBKL towers on Jalan Raja Laut and Jalan Raja Abdullah. These variations can be attributed to several factors, including differences in building orientation, surface materials, and urban morphology. Buildings with varying orientations may receive different levels of solar exposure throughout the day, impacting the heat absorption and emission rates of surrounding surfaces (Li et al., 2023). Additionally, differences in surface materials, such as asphalt, concrete, or green spaces, can influence the heat retention and dissipation characteristics of urban areas. Furthermore, variations in urban morphology, such as the presence of tall buildings or narrow streets, can affect airflow patterns and exacerbate heat buildup in certain areas (Ahmad Zaki, 2020).

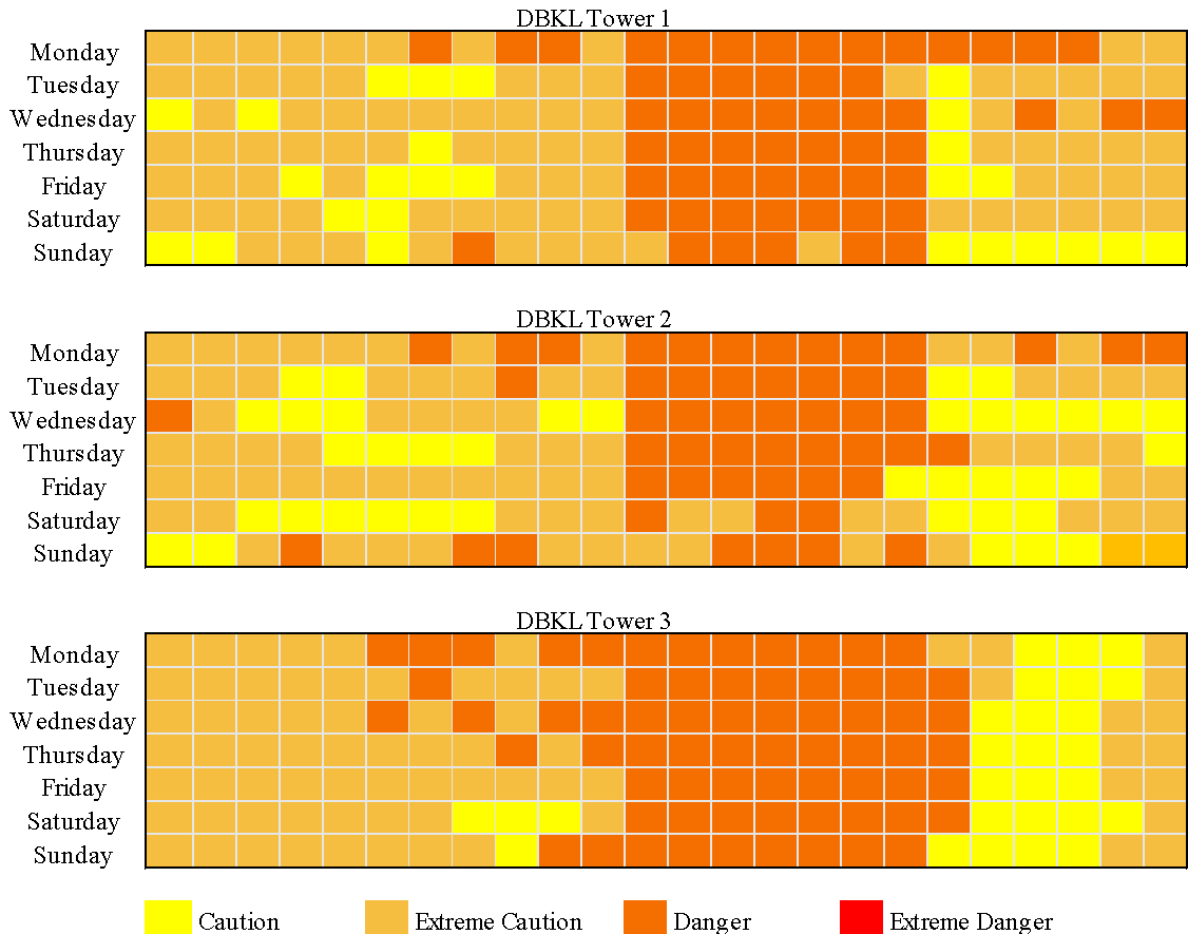


Figure 2 Heat Index for Every Hour Daily

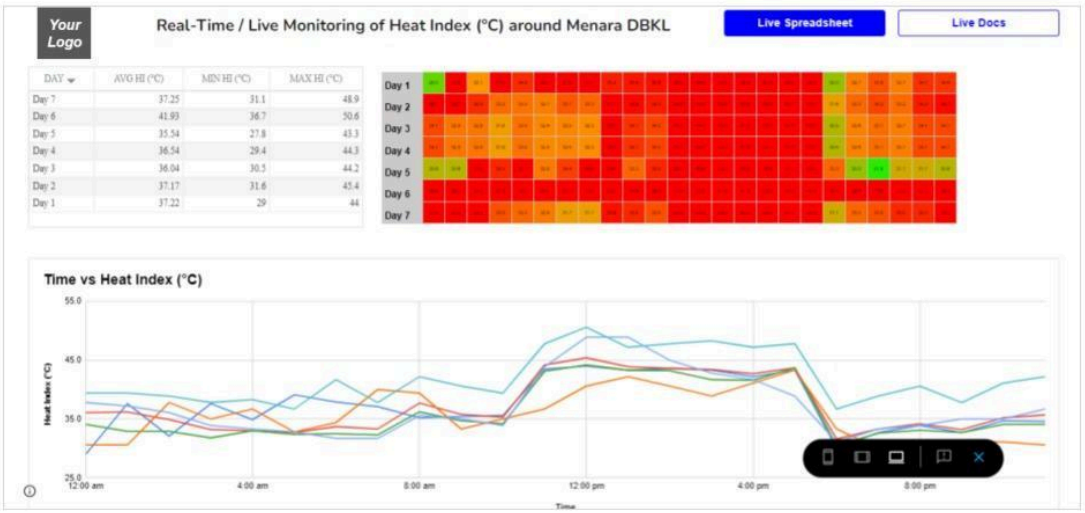


Figure 3 User Interface BUILDthermo

The interface of BUILDthermo, as shown in Figure 3, is also able to provide live updates on heat index values, allowing users to effectively monitor current conditions. It combines multiple visualization tools, such as tables, heat maps, and line graphs for a comprehensive analysis. This integration allows for a detailed understanding of thermal data patterns and trends.

5. CONCLUSION

BUILDthermo represents a groundbreaking advancement in addressing the complexities of urban heat and thermal comfort. By seamlessly integrating microclimate data, building characteristics, and urban attributes, this innovative tool provides stakeholders with a powerful means to comprehend and tackle the impacts of building heat in urban environments. Its intuitive interface and advanced analytics empower urban planners, architects, and environmental engineers to make informed decisions, fostering the creation of more sustainable and resilient cities. As cities confront the challenges of rapid urbanization and climate change, BUILDthermo stands as an encouragement for progress, offering a pathway towards healthier, more equitable, and more sustainable urban environments for future generations.

ACKNOWLEDGEMENTS

The authors are grateful to Universiti Teknologi MARA and Universiti Kebangsaan Malaysia for the support given via DCKM Grant (RMU. 5/2) (19/2022/KCMT). Thank you to all parties who contribute significantly to this piece of work.

REFERENCES

Aktas, Y. D., Wang, K., Zhou, Y., Othman, M., Stocker, J., Jackson, M., Hood, C., Carruthers, D., D'Ayala, D., & Hunt, J. (2020). Outdoor thermal comfort and building energy use potential in different land-use areas in tropical cities: case of Kuala Lumpur. Atmosphere, 11(6), 652.

Li, T., Liu, Q., Mao, Q., Chen, M., Ma, C., Wang, D., & Liu, Y. (2023). Optimization design research of insulation thickness of exterior wall based on the orientation difference of solar radiation intensity. *Applied Thermal Engineering*, 223, 119977.

The Intergovernmental Panel on Climate Change. IPCC (2021).

Zaki, S. A., Azid, N. S., Shahidan, M. F., Hassan, M. Z., Md Daud, M. Y., Abu Bakar, N. A., Mat Ali, M. S. & Yakub, F. (2020). Analysis of urban morphological effect on the microclimate of the urban residential area of Kampung Baru in Kuala Lumpur using a geospatial approach. Sustainability, 12(18), 7301.

Pejabat Perpustakaan
Librarian Office

Universiti Teknologi MARA
Cawangan Perak
Kampus Seri Iskandar
32610 Bandar Baru Seri Iskandar,
Perak Darul Ridzuan, MALAYSIA
Tel: (+605) 374 2093/2453 Faks: (+605) 374 2299

UNIVERSITI TEKNOLOGI MARA

Surat kami : 700-KPK (PRP.UP.1/20/1)
Tarikh : 20 Januari 2023

UNIVERSITI TEKNOLOGI MARA PERAK
TERIMA
25 JAN 2023
Tindakan
Universiti Teknologi MARA Perak
PEJABAT REKTOR

Prof. Madya Dr. Nur Hisham Ibrahim
Rektor
Universiti Teknologi MARA
Cawangan Perak

Tuan,

PERMOHONAN KELULUSAN MEMUAT NAIK PENERBITAN UiTM CAWANGAN PERAK MELALUI REPOSITORI INSTITUSI UiTM (IR)

Perkara di atas adalah dirujuk.

2. Adalah dimaklumkan bahawa pihak kami ingin memohon kelulusan tuan untuk mengimbas (*digitize*) dan memuat naik semua jenis penerbitan di bawah UiTM Cawangan Perak melalui Repositori Institusi UiTM, PTAR.

3. Tujuan permohonan ini adalah bagi membolehkan akses yang lebih meluas oleh pengguna perpustakaan terhadap semua maklumat yang terkandung di dalam penerbitan melalui laman Web PTAR UiTM Cawangan Perak.

Kelulusan daripada pihak tuan dalam perkara ini amat dihargai.

Sekian, terima kasih.

"BERKHIDMAT UNTUK NEGARA"

Saya yang menjalankan amanah,

SITI BASRIYAH SHAIK BAHARUDIN
Timbalan Ketua Pustakawan

nar

Setuju.

27.1.2023

PROF. MADYA DR. NUR HISHAM IBRAHIM
REKTOR
UNIVERSITI TEKNOLOGI MARA
CAWANGAN PERAK
KAMPUS SERI ISKANDAR