ISCU 2025

17TH RISM INTERNATIONAL SURVEYING CONFERENCE FOR UNDERGRADUATES

Embracing Construction Revolution 4.0 (CR4.0): Transforming Malaysia's Built Environment

16th - 17th May 2025 I Friday - Saturday

E-ISBN PROCEEDING

VOLUME I

Published by
Royal Institution of Surveyors Malaysia
3rd Floor, Bangunan Juurukur
64 & 66, Jalan 52/4
46200 Petaling Jaya
Selangor

E- PROCEEDING 17th RISM ISCU 2025 Volume 1

Editors: Lizawati Abdullah, Nor Suzila Lop, Nor Nazihah Chuweni, Suriani Ngah Abdul Wahab, Hasnan Hashim

eISBN 978-629-94789-0-4

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(online)

WELCOME SPEECH FROM THE CHAIRMAN

RISM 17th International Surveying Conference for Undergraduates (ISCU 2025)

بسم الله الرحمن الرحيم السلام

عليكم ورحمة الله وبركاته

Greetings to all,

It is with great pleasure that I welcome you to the 17th RISM International Surveying Conference for Undergraduates (ISCU 2025), themed *"Embracing Construction Revolution 4.0: Transforming Malaysia's Built Environment."* On behalf of the Royal Institution of Surveyors Malaysia (RISM), I also wish to express our sincere appreciation to Universiti Teknologi MARA (UiTM), Perak Campus, for graciously hosting this significant event.

As we navigate the era of the Fourth Industrial Revolution (IR4.0)—or in our context, Construction Revolution 4.0 (CR4.0)—we are witnessing transformative advancements across the global construction sector. Technologies such as Building Information Modelling (BIM), the Internet of Things (IoT), artificial intelligence (AI), robotics, big data analytics, and cloud computing are redefining the way we build, manage, and interact with our built environment. For Malaysia, embracing CR4.0 is a strategic imperative to achieve our socio-economic and environmental goals.

This conference serves as a vital platform to unite surveying undergraduates from various disciplines, fostering critical dialogue on industry challenges, enhancing professional networking, and preparing a new generation of talent for the rapidly evolving construction landscape. It is also an opportunity for employers to engage with and inspire our future professionals.

I would like to extend my heartfelt thanks to all industry speakers, paper presenters, judges, and participants for their time, contributions, and support in making ISCU 2025 a success. I also commend the organising committee for curating a meaningful and dynamic conference experience.

May the knowledge gained, connections formed, and ideas exchanged during this event inspire all participants to lead and innovate in their future endeavours.

Wishing everyone a productive and memorable conference.

Prof. Ts Sr Dr. Adi Irfan Bin Che Ani'
Chairman, Universities' Partnering Committee
RISM Session 2024/2025
May 2025

WELCOME SPEECH FROM CO-CHAIRMAN

RISM 17th International Surveying Conference for Undergraduates (ISCU 2025)

Bismillahirrahmanirrahim.

السلام عليكم ورحمة الله وبركاته and greetings to all.

It is my great pleasure to welcome everyone to the 17th International Surveyor Conference for Undergraduates (ISCU 2025), proudly hosted by Universiti Teknologi MARA (UiTM) Perak Branch in collaboration with the Royal Institution of Surveyors Malaysia (RISM). This event is a meaningful platform for students in the built environment to share ideas, showcase innovations, and build professional networks. We are honoured by your presence and enthusiastic participation, with 135 accepted papers and 78 poster presentations this year.

UiTM Perak, home to the College of Built Environment, has long been a hub for academic excellence in architecture, planning, and surveying. Our commitment remains strong in nurturing competent graduates who meet industry demands and contribute to nation-building.

While you're here, we invite you to experience the heritage and culture of Perak Tengah from the architectural richness of Rumah Kutai to the historical towns of Pasir Salak, Bota, and Kampung Gajah.

To all presenters and winners, congratulations on your achievements. Let your work today be a catalyst for future success and academic growth. We hope this conference will inspire you to explore new ideas, foster collaboration, and make lasting memories.

My deepest thanks to the Royal Institution of Surveyors Malaysia (RISM) and the organising committee for making this event a success.

We hope your experience here will be rewarding and unforgettable.

Thank you. Selamat datang dan selamat berjaya.

Associates Professor Dr. Nur Hisham Ibrahim, *PMP*
Co-Chairman, Universities' Partnering Committee
RISM Session 2024/2025
May 2025

WELCOME SPEECH FROM THE PROJECT DIRECTOR

RISM 17th International Surveying Conference for Undergraduates 2025

Alhamdulillah, all praise to Allah S.W.T. for His guidance and blessings in making the RISM 17th International Surveying Conference for Undergraduates (ISCU) 2025 a reality.

It is with great honour and gratitude that I welcome all participants, guests, academicians, and industry professionals to this prestigious event, proudly organized under the Royal Institution of Surveyors Malaysia (RISM). This 17th edition of ISCU stands as a proud testament to our collective dedication toward academic excellence, professional collaboration, and youth empowerment in the field of surveying.

I extend my heartfelt appreciation to RISM for its unwavering support, to the hardworking ISCU 2025 Organising Committee, and to all 16 partnering universities across Malaysia for their commitment and contributions. Your efforts have shaped this conference into a dynamic platform for knowledge exchange, innovation, and professional growth.

To the academicians and practitioners present, your insights are invaluable in bridging the gap between academic theory and real-world practice. To our undergraduate participants, your passion, curiosity, and commitment are the very foundation of our future. May this conference not only deepen your academic journey but also ignite a spirit of leadership, integrity, and sustainable thinking.

Let this gathering serve as more than an academic milestone. May it foster lifelong networks, inspire transformative ideas, and chart new directions in our shared professional journey.

Wishing everyone a rewarding and inspiring conference experience.

Sr Dr. Nurul Fadzila Zahari
Project Director
RISM 17th ISCU 2025

AI-POWERED INSIGHTS FOR CORAL ECOSYSTEMS: AN INNOVATIVE APPROACH TO SEAFLOOR HABITAT MAPPING AND CLASSIFICATION

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ABSTRACT

Coral reefs represent one of the most significant marine ecosystems. They also offer numerous ecological, economic, and protective benefits. Their biological importance includes serving as habitats for marine organisms, safeguarding coastal areas from erosion, and contributing to economic growth through tourism and fisheries. However, coral reefs are increasingly threatened by climate change, pollution, and anthropogenic activities. Therefore, efficient and effective monitoring strategies required. Conventional field-based mapping techniques are often costly and time-consuming. Consequently, this study explores the viability of remote sensing as an alternative by utilizing Sentinel-2 satellite imagery and artificial intelligence (AI) algorithms, which Random Forest and Support Vector Machine to enhance coral habitat mapping in Redang Island, Terengganu, Malaysia. The study integrates satellite imagery, ground truth data, and spectral indices to improve classification accuracy. In the data preparation phase, image preprocessing is conducted on Sentinel-2 imagery, followed by data enhancement through performing spectral indices such as Normalized Difference Vegetation Index (NDVI) and Normalized Difference Water Index (NDWI). Subsequently, model training and accuracy assessment will be carried out using Overall Accuracy and Kappa statistics. The expected findings will demonstrate a significant improvement in mapping efficiency compared to conventional method and underscore the potential application of artificial intelligence in marine conservation, environmental management, and sustainable tourism development.

Keywords: Machine Learning, Coral, Habitat Mapping, Sentinel-2, Random Forest

I. INTRODUCTION

Coral reefs are remarkable structures studied by geologists to understand how they form, as their existence in the early 19th century raised questions. It provides food and resources for a variety of species and are declining at a rapid rate due to various problems such as overfishing, declining water quality and climate change. Then, these coral reefs experienced massive coral bleaching in 1979 when it was first reported (Sheppard, 2021). At the turn of the 20^{th} century, coral reefs described as crucial components of marine science and management (Burns et al., 2022), recognized for roles in maintaining biodiversity, and monitoring their benthic composition, helps in understanding and managing the ecological health of these habitats. In fact, coral reefs represent less than 0.01% of the total ocean area on Earth. Despite this small percentage, coral reefs host around 25% of all marine species, showcasing their ecological significance. Plus, as well as being among the most diverse marine ecosystems, they play a crucial role for nations by providing valuable ecosystem service and coastal protection (Sambrook et al., 2019). This statement is supported in research by which showing that coral reefs contribute goods and services with an estimated economic value reaching 172 billion USD per km² of US dollars annually (Martínez et al., 2007), ranking among the highest quantified biomes. Unfortunately, coral reefs are now in a critical state, facing numerous impacts at both local and global levels, including coastal sedimentation (Leão et al., 2016), climate change (Hughes et al., 2007), and overfishing (Sully et al., 2019).

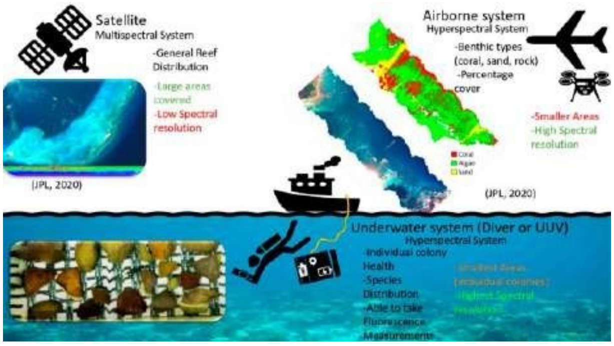

Figure 13.0 The types of data at different level from satellite to underwater system (Teague et al., 2022).

The public is becoming increasingly aware of the serious threats facing coral reefs, recognizing the negative impacts threats could have on various sectors. People have also started to realize that, with adequate attention and monitoring, coral reefs can grow healthily and provide numerous benefits across multiple areas. This awareness highlights the importance of coral reef monitoring as a crucial effort to evaluate the success intervention to positively influence coral reef's changes and accelerate conservation and restoration. This monitoring involves the collection of data to conduct the mapping, there are various techniques of data collection, and some of them used sensors and advanced technology to measure various parameters, including physical, chemical, and biological factors. For example, satellite imagery, divers which represent in-situ method, drones and boats that equipped with underwater imaging or lidar, which shown in Figure 1.0 (Goodman et al., 2013). However, the disadvantage of in-situ method began to be questioned as this method is time-consuming, limited in coverage as it used divers and labor-intensive. As the monitoring itself were required to routinely visited the study area (Apprill et al., 2023) meanwhile, Coral Reef Expert Group recommends satellite imagery is used for change detection and habitat mapping on a large scale (Nguyen et al., 2021).

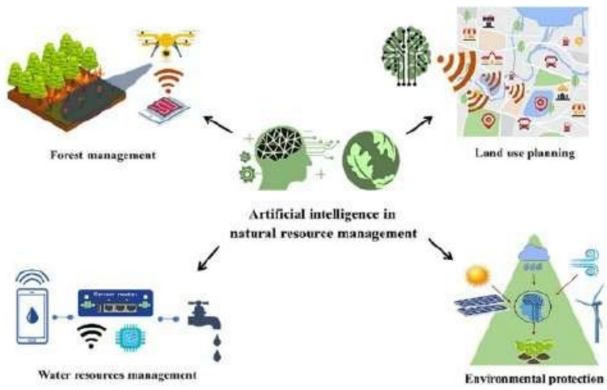

Figure 2.0 AI in natural resource management (Pattyam, 2021).

Environmental monitoring plays a significant role in conservative the ecological health of our planet. Human interactions with the environment now demand robust approaches to environmental monitoring. The integration of AI in this field relates to a broad area of computer science, covering both Machine Learning and Deep Learning. For machine learning method, it allows machines to learn from environmental components, identifying trends or patterns and making predictions based on received data without exact programming, such in Figure 1.2 (Pattyam, 2021). Since it is widely used across large range of field (Jordan & Mitchell, 2015), AI will take a step in data processing of coral reef monitoring. Random Forest and Support Vector Machine is pixel-based classification algorithms, each pixel classified independently, without considering surrounding context or assigned a specific class without considering the influence of surrounding pixels (Kulkarni & Lowe, 2016).

XV. STUDY AREA

This study was conducted on one of the islands in Terengganu, namely Pulau Redang in Figure 2.0. It has diverse coral reef, which are among the most numerous and widespread in Malaysia. Additionally, Pulau Redang is a popular tourist destination and highlighting the need for efficient monitoring tools to support effective management and conservation efforts.

Figure 14.0 Pulau Redang, Terengganu

XVI. DATA AND RESEARCH METHOD

The methodology in Figure 3.0 is employed to achieve the three research objectives which identify the distribution of coral habitats in Redang Island, Terengganu; developing an AI-based model to classify images and map coral habitats using satellite imagery; and assessing the performance of the developed AI model through accuracy assessment. The methodology utilizes satellite data, specifically Sentinel-2, along with bathymetric data and artificial intelligence techniques such as Random Forest and Support Vector Machine. Software tools including ArcGIS Pro will be applied to ensure efficient and accurate data processing. These tools support various essential steps.

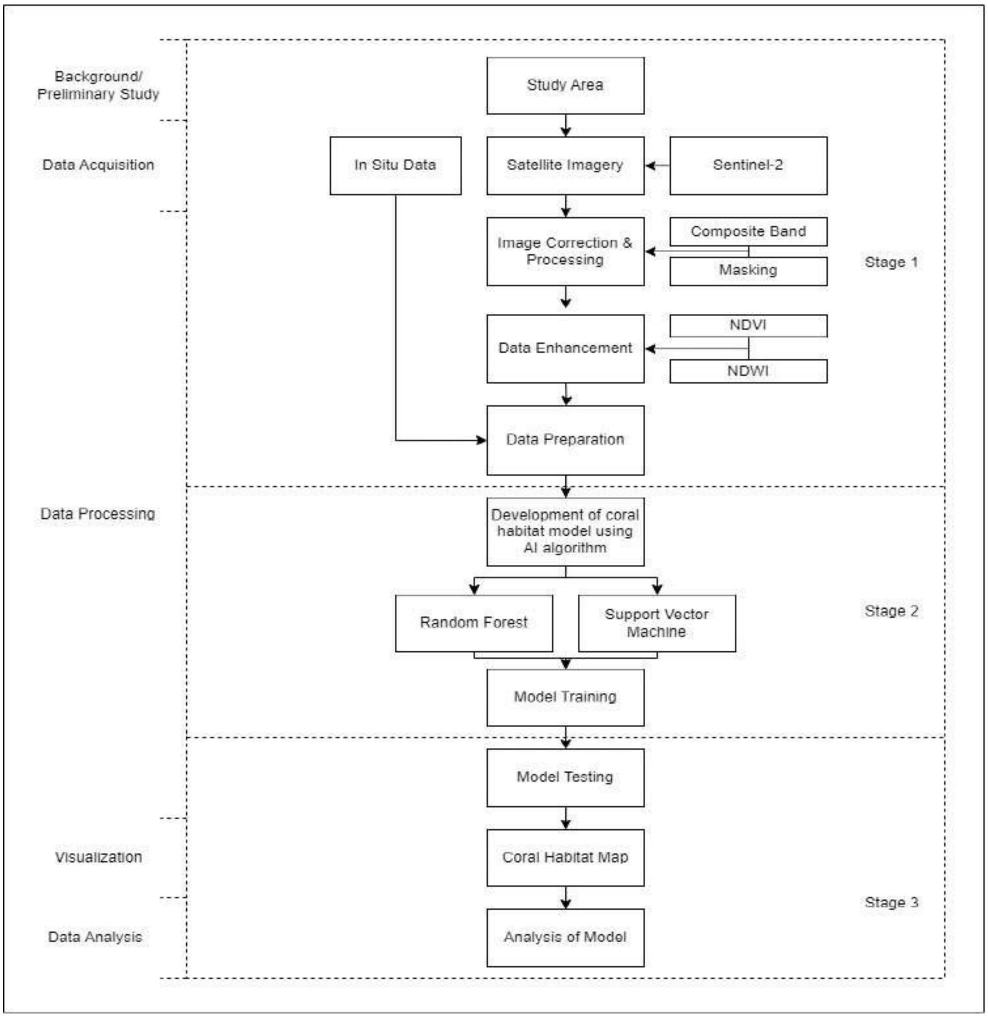

Figure 3.0 Flowchart of methodology.

A. *Data Acquisition*

Table 1.0 Characteristics of Sentinel-2A satellites images.

Spatial Resolution (m)	Bands	Central Wavelength (nm)	Bandwidth (nm)
10	Band 2 (Blue)	492.4	66
	Band 3 (Green)	559.8	36
	Band 4 (Red)	664.6	31
	Band 8 (NIR)	832.8	106
20	Band 6 (Red edge)	740.5	15
	Band 7 (Red edge)	782.8	20
	Band 8A (Narrow NIR)	864.7	21
	Band 11 (SWIR)	1613.7	91
	Band 12 (SWIR)	2202.4	175
60	Band 1 (Coastal aerosol)	442.7	21
	Band 9 (Water vapour)	945.1	20
	Band 10 (SWIR)	1373.5	31

In this study, a combination of satellite imagery and in-situ measurement data were utilized to achieve the study's objectives in the study area, Pulau Redang. Satellite images from the Sentinel-2a, accessed through Copernicus Open Access Hub platform. This imagery was downloaded from 2018 and 2022 and captured at a spatial resolution of 10 meters.

B. *Data Processing*

This phase focuses on preparing raw satellite imagery for accurate and reliable interpretation. Satellite images from Copernicus need undergo composite band by using Composite Band tool and Extract by Mask, which mask removes unwanted features. Such as, clouds, land, boats from Sentinel-2 imagery to focus on relevant areas, enhancing the performance of classification algorithms. Several spectral indices, such as NDVI in Equation 1 and NDWI in Equation 2 (Bahadur, 2018), are used to improve data accuracy. NDVI helps differentiate vegetated areas from non-vegetated ones, while NDWI distinguishes water from land. These indices are calculated using the red, green, and NIR bands of Sentinel-2 imagery. Integrate satellite imagery with in-situ data is to improve mapping accuracy. Both datasets are resampled to match in spatial resolution.

$$NDVI = \frac{NIR\ Band - Red\ Band}{NIR\ Band + Red\ Band} \tag{1}$$

$$NDWI = \frac{Green\ Band - NIR\ Band}{Green\ Band + \ NIR\ Band} \tag{2}$$

Where:
NIR Band: Band 8
Green Band: Band 3
Red Band: Band 4

For development of model, data is split into training, validation, and test sets which, the training set is 70% of data is used to train the model, with 15% for validation for monitoring performance and testing is 15% for final evaluation. Random Forest and Support Vector Machine algorithms are used for classification. This data split is used to prevent overfitting and to ensure the model is trained fairly. It allows the model to be tested on unseen data, which helps assess its ability to generalize. The test set will be used to measure the accuracy of the trained model. Accuracy is evaluated using the validation set and a *confusion matrix* R Package. From the *confusion matrix*, metrics such as seen in Equation 3 and 4 (Dung et al., 2023), overall accuracy and the kappa statistics are used (Muhamad et al., 2023).

$$Overall\ Accuracy = \sum_{i=1}^{r} x_{ii} \tag{3}$$

$$Kappa\ Statistics = \frac{N \sum_{i=1}^{r} x_{ii} - \sum_{i=1}^{r} (x_{i+}.x_{+i})}{} \tag{4}$$

$$N^2 - \sum_{i=1}^{r} (x_{i+.} x_{+i})$$

XVII. EXPECTED OUTCOME

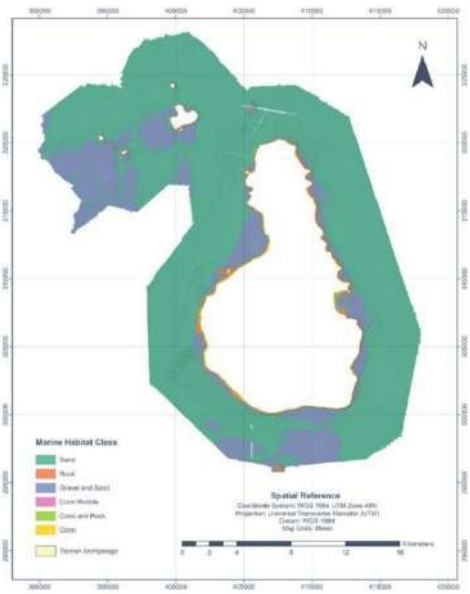

Figure 4.0 Expected outcomes of coral habitat mapping (Muhamad et al., 2023).

Figure 4.0 shows the integration of AI enables the creation of accurate coral habitat maps and providing detailed information on distribution of coral habitat. The classified image was assessed using statistical methods and showed a high overall accuracy of 98% with a Kappa value of 0.88, which means the results are very reliable. Figure 4.1 shows six coral habitat classes and labelled with different colours. Sand was the most common habitat class detected, covering about 78.70% of the surveyed area, while sand and gravel covered around 18.75%, making it the second most common habitat class. The other four habitat class types were found in small amounts, each making up less than 1.60% of the total area. (Muhamad et al., 2023). This can facilitate restoration efforts by targeting at-risk areas and early detection of potential threats as possible.

CONCLUSION

This study explores the use of remote sensing and AI to improve coral reef mapping in Pulau Redang, Terengganu. By combining Sentinel-2 satellite imagery and machine learning techniques like Random Forest and Support Vector Machine, it aims to create a more accurate and cost-effective way to monitor coral habitats. Coral reefs are vital ecosystems but are increasingly threatened by climate change and human activities. Accurate mapping helps in conservation efforts by identifying reef conditions and guiding protection strategies. AI-based mapping offers a faster, scalable alternative to conventional methods, making large-scale monitoring more efficient. Although this study demonstrates reliable outputs in coral habitat mapping, several challenges and data limitations exist. Such as, current spatial resolution of Sentinel-2 imagery limits the ability to overlook finer-scale of coral reef features, in terms of narrow coral reef zones. Sediments or coastal runoff variations also caused variations of water clarity which may obscure key habitat details and reduce classification accuracy. Plus, atmospheric conditions such haze may complicate reflectance values, even after standard atmospheric corrections. Hence, for better coral reef management, future studies should focus on using higher-resolution datasets and selecting satellite imagery during southwest monsoon, avoiding northeast monsoon to improve the effectiveness and reliability of coral reef habitat mapping using AI techniques.

ACKNOWLEDGMENT

I would also like to extend my sincere appreciation to College of Built Environment, UiTM Shah Alam for providing the necessary resources and facilities that made this research possible. Special thanks to my lecturers and peers for their insightful discussions, advice, and encouragement, which have greatly contributed to my academic growth.

Also, I am immensely grateful to my family for their unwavering support, patience, and motivation throughout this journey. Their encouragement has been a source of strength and perseverance and lastly, I would like to acknowledge everyone who has contributed, directly or indirectly, to the completion of this research. Your support and assistance have been invaluable, and I truly appreciate your efforts. Thank you.

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