

YOLO-Based Identification and AI Generative Design of Nusantara Architectural Element through Kisho Kurokawa's Symbiosis Concept

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ABSTRACT

This research is rooted in the fundamental practice of combining two forms, long pursued by the Japanese architect Kisho Kurokawa, who gave rise to the concept of Symbiosis (Combining two different elements). The purpose of this research is to utilise artificial intelligence, such as YOLO v8, for identification and diffusion models to produce new building images with the Nusantara and Kisho Kurokawa concepts. The problem of this research is how Kisho Kurokawa's concept can be integrated into Nusantara architecture by re-identifying its elements and transforming them. The purpose of this research is to identify and transform the facade with the Nusantara and Symbiosis concepts. The method used is experimental, involving the collection of Lampung building datasets from the Nusantara era, followed by initial identification using YOLO v8 and classification of character similarities based on the symbiosis concept. The final step is to transform the Nusantara form (stable diffusion) for re-identification with YOLO v8 against the Nusantara facade elements. The results show that YOLO v8 can still identify various models of Nusantara architectural elements, even when they have changed shape, based on the contextual similarity to Kisho Kurokawa's Symbiosis concept.

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1. INTRODUCTION

The development of Indonesian architecture from the past to the present has resulted in a transformation of forms that continually adapt to the times. Nusantara Architecture exists as an "other" in viewing architecture. Nusantara Architecture pursues contemporary relevance by continuously developing, transforming, and globalising. It does not copy or paste existing architecture, while still respecting the architecture of the past [1]. Nusantara architecture was developed as a science, grounded in the philosophy of science and architectural knowledge [2]. Nusantara architecture today will grow, transform, and globalise, while still retaining strengths rooted in the local context [3]. The statement that Nusantara architecture must transform internationally (globally) suggests that it can be represented in different forms while still reflecting strong local wisdom and maintaining its principles and elements (Table 1).

Table 1. Principles and Elements of Indonesian Architectural Design

Number	Nusantara Architecture
1	Column architecture (stage)
2	Dominant building material: wood
3	Shelter
4	Swing structure (without nails)
5	Earthquake-resistant building construction
6	Based on cultural discipline

Source: Histanto & Prijotomo, 2023 [4]

There are various ways to define transformation in Nusantara architecture. One of them is looking at its basic structure, which is interpreted as the initial configuration that can change under certain treatments. According to Prijotomo (2011) in Cahyono et al., there are two methods, namely Binubuh with a basic form, and other forms added on top of it and Ginanda, which starts from the basic form of the building, and other similar buildings are placed around the base of the building, either attached or separate [5].

In the writings of Robert AM Stern, and as adopted by Josef Prijotomo, there is a different principle for working on the transformation of form, namely, by looking at visual composition through the impression created by the observer [6] . This transformation can only be achieved by carrying out conservation activities to maintain the existence of Nusantara architectural buildings and enable their development, for example, the Lamban Pesagi building (Figure 1). Cultural heritage buildings like this are increasingly difficult to find and are found only in several areas in Lampung. Over time, the number of these cultural heritage buildings has decreased, and they have undergone changes and developments [7].



Figure 1. Nusantara Architectural Elements Identified in Lamban Pesagi

Prompt handling will prevent the loss of Indonesian architectural heritage buildings. Efforts to preserve and document historical buildings are important steps that can be taken through various approaches, including the latest digital methods. The digital approach uses Artificial Intelligence (AI) technology. One development in AI is the conversion of images into text as one phase of searching for reference design ideas during the schematic stage [8]. AI provides architects with large amounts of data and processing power to generate analytical insights that significantly influence decisions at each design phase. Changes made through AI to the concept of symbiosis create a new context. This new context is achieved by integrating the architectural elements of old buildings into new ones (a form of symbiosis). World-class architects widely use this concept to address the interface between old and new buildings (Figure 2).

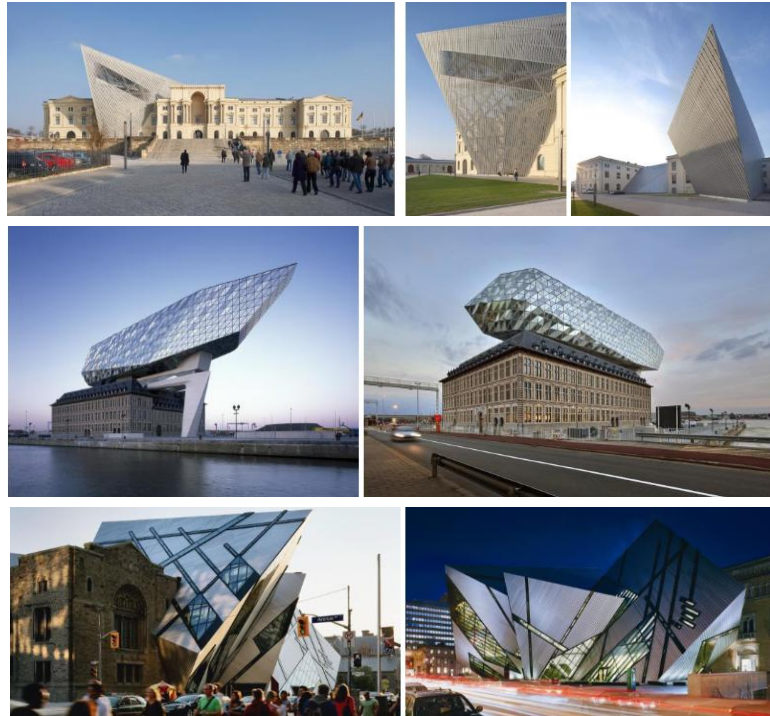


Figure 2. Several Architectural Works Employing the Symbiotic Concept
Source: Velibeyoglu & Sedes, 2024 [9]

The symbiotic approach itself is an architectural approach that originates from the ideas of Kisho Kurokawa [10]. Symbiosis, as a new world order, is used to describe the relationship between two fundamentally different, mutually exclusive elements. Philosophically, symbiosis is also a mixture of two different cultural elements in one entity, where both elements are still independent, but mutually beneficial to each other so that they can maintain the historical traces of Nusantara Architecture buildings and introduce them to the wider community from time to time so that their value or essence is maintained but of course appears with a new and contemporary context through a symbiotic concept.

The research gap in this study is that no research has identified vernacular architectural buildings (Nusantara) using YOLO, whereas previous work has relied on diffusion models. YOLO (You Only Look Once) is a new object detection system which functions in real time. YOLO uses a single neural network to detect and recognise objects, directly predicting bounding boxes and class probabilities [11]. The YOLO used is YOLO v8. The YOLOv8 model provides ready-to-use support for object detection, classification, and segmentation tasks, accessible via Python and a command-line interface [12]. Meanwhile, the diffusion model used is Stable Diffusion. This model utilises natural language processing (NLP) and computer vision techniques to understand and interpret text descriptions, then generate images that match the given descriptions [13]. Stable Diffusion uses CLIP to convert text descriptions into vectors into a space, where text and images are related [14]. Therefore, this research seeks to identify the essential elements of Nusantara architecture and to transform them while preserving the original historical essence/value they embody. The transformation itself must not abandon the old context. Still, it can create a new one through symbiosis, resulting in a change in form while remaining identifiable as Nusantara architecture.

2. RESEARCH METHOD

This research method uses an experimental method with several steps carried out sequentially, such as:

1. Field observations, image dataset collection, and identification of buildings related to facades and vernacular (Nusantara) architectural elements in Lampung Province. Lampung was chosen because this research is a follow-up study exploring the facades of traditional Lampung buildings that are 350 years old.

2. The dataset was collected from various sources, primarily through direct field surveys. The process involved taking photographs directly and then using image augmentation. This resulted in over a thousand images.
3. Dividing Nusantara architectural periods over time. This period explains that at all times there was a mixture of traditional facades and facades of each era.
4. Classifying similarities in the characteristics of the Symbiosis concept with Nusantara architectural concepts. The similarities observed are based on Kisho Kurokawa's method, applied to the built works and buildings of the Indonesian archipelago, and result from stable diffusion.
5. Labelling dataset images using Roboflow.
6. YOLO v8 training to identify Lampung vernacular architectural elements.
7. Generating Lampung architectural images into Nusantara architectural designs based on time periods using a diffusion process.
8. Finally, testing the identification of the combined Symbiosis concept with Nusantara architectural concepts using YOLO v8.

3. RESULTS AND DISCUSSION

3.1. Update on Nusantara Architecture

Updating the Nusantara architecture is a fundamental step in maintaining continuity among the past (read: Indonesian Classical Architecture), present, and future. Updating does not mean returning to the past; rather, past architecture serves as a source of creativity and a reflection of architecture's roots in Indonesia [6]. This research marks the emergence of a "new" Nusantara architecture in a different context, with a more contemporary understanding and character.

This research began by selecting one example of a Lampung vernacular building as a representative of traditional architectural forms in the Lampung region: the traditional house in Kenali Village, as it is the oldest among traditional buildings in Lampung (Figure 3).



Figure 3. Traditional House of Kenali Village

Then the researcher tried to divide the simulated forms based on the period of the Nusantara architectural era, with several vernacular architectural styles as the basis of all architectural styles in Indonesia, which were then continued sequentially such as the architectural style of the Dutch East Indies era, Islamic architectural style, colonial architectural style, independence architectural style, modern architectural style and contemporary architectural style (Figure 4).

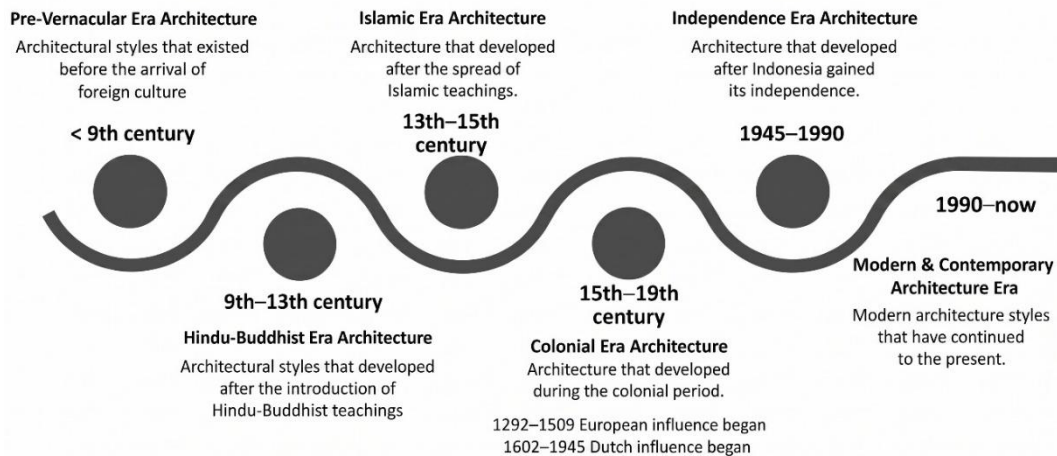


Figure 4. Timeline of Architectural Eras in the Indonesian Archipelago
Source: Pratomo & Prihatmaji, 2024 [15]

This research is also in line with the Nusantara concept, as articulated by Josef Prijotomo in Adiyanto [6], where each era reflects a mix of traditional facade concepts and era-specific ones (Figure 5). But the researcher only took four architectural styles, such as the architectural style of the Dutch East Indies era, the Islamic architectural style, and the colonial architectural style, to be manipulated (generated) as research sampling.

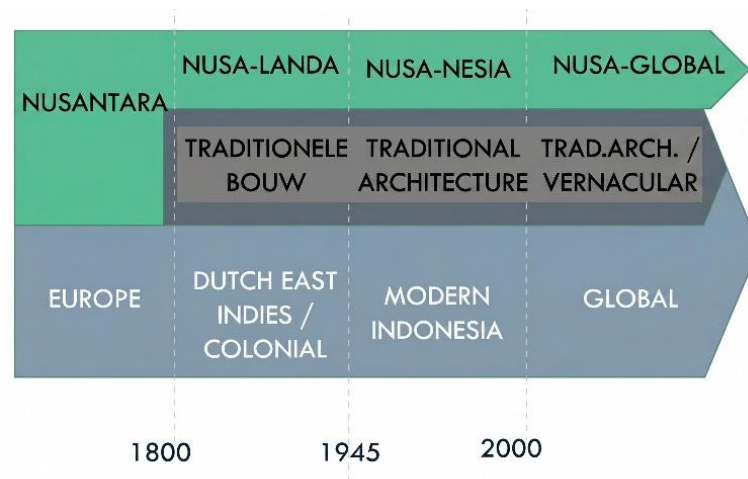


Figure 5. Evolution of the Nusantara Concept
Source: Adiyanto, 2021 [6]

3.2. Translation of Kisho Kurokawa's Concept in the Context of Symbiosis

Kisho Kurokawa explains that “Symbiosis” can be seen from various perspectives [10], namely the symbiosis of history and the present; the symbiosis of tradition and the latest technology; the symbiosis of nature and man; the symbiosis of art and science; and the symbiosis of regionalism and universalism.

Based on research by Widagdo et al (2013), it was stated that the building objects by Kisho Kurokawa have the following characteristics [16]:

- Kisho Kurokawa's forms are predominantly geometric, but he also incorporates organic forms.
- The materials he uses tend to be modern.
- The colours he uses are mostly modern materials, such as white, grey, and black. He also uses brown to create a warm impression.

Kisho Kurokawa's symbiosis method is explained in several ways, including [17] : (1) Understanding the philosophy and principles of traditional architecture contained therein; (2) Finding a form of conformity between Modern Architecture and Local Architecture; (3) Simplifying traditional forms; (4) Symbolising local philosophy in the form or shape of the building or its parts; (5) Paying attention to the ongoing environmental and socio-cultural context (contemporary) to be accommodated in the design; (6) Making one of the local elements a must-have in every design (design tradition), in this case the asymmetrical element found in all Kisho Kurokawa museum buildings. Kisho Kurokawa's symbiosis method with the configuration: Modern Architecture – Tradition – Philosophy (Figure 6).

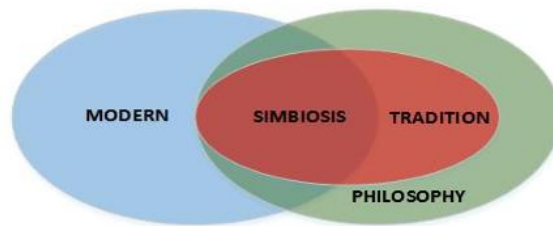


Figure 6. Conceptual Diagram of Kisho Kurokawa's Symbiosis Method
Source: Abdillah, 2018 [17]

Reflecting on Kisho Kurokawa's work (Figure 7), such as the Nagakin Tower, the Nagakin Tower's core clearly symbolises the Buddhist philosophy of emptiness or *sūnyatā* (emptiness) from the traditional Japanese concept with the modern (contemporary) concept at the bottom (body).



Figure 7. Application of Kisho Kurokawa's Symbiosis Concept in Architecture
Source: Abdillah, 2018 [18]

The character of Kisho Kurokawa's concept is taken based on similarities with the context of Nusantara architecture, including geometric dominance, for example, Hindu, Buddhist, Islamic, and colonial architecture, which tends to have symmetrical geometric shapes. Then, modern materials are the same as those used in colonial architecture in the context of Nusantara architecture. Lastly, the dominant colour is white, like Buddhist and Colonial architecture.

Therefore, only four samples were selected (Dutch East Indies-era, Islamic, and colonial architectural styles) to reflect the similarities between Kisho Kurokawa's concept and Nusantara Architecture.

3.3. Artificial Intelligence Process with Diffusion Model (Stable Diffusion)

This study uses a diffusion model to generate images based on criteria to be developed by the researcher. The simulation used four samples, based on the Hindu, Buddhist, Islamic, and colonial eras, with the architecture of Kenali Village as the sample. The most significant changes were made to the building's body (walls), as this section is the most modifiable part of a building and aligns with the principles and elements of Nusantara architecture (Table 2).

Table 2. AI-Generated Architectural Style Transformations of a Vernacular House

		
Hindu Building	Buddhist Building	
		
Islamic Building	Colonial Building	Vernacular Building (Original)

The evaluation indicator for the stable diffusion algorithm is the change in the facade in response to the written prompt. The basic principle is to change the wall area of the facade according to the prompt. The written prompts are divided into four categories, shown in Table 3. The prompt selection is based on the context of the building style to be used, so that the AI can generate results in that style.

Table 3. Writing Prompts Based on Building Type

Number	Building Type	Prompt
1	Hindu buildings	Hindu building facade, Hindu architecture, the colours are the same as the original, only the walls have changed
2	Buddhist buildings	Buddhist building facade, Buddhist architecture, the colour is the same as the original, only the wall part has changed
3	Islamic buildings	Islamic building facade, Islamic architecture, the colours are the same as the original, only the walls have changed
4	Colonial buildings	Colonial building facade, colonial architecture, the colours are the same as the original, only the walls have changed

(Source: Researcher, 2025)

3.4. Comparison of facades between Nusantara architecture and Symbiosis architecture

Other researchers have conducted previous research on facades with stable diffusion and local values. One such study was conducted by Jo et al [19]. In that study, changes were made to the facade with a local Korean building style. The next study was conducted by Xu et al [20]. This study combined grasshopper and diffusion models (Control Net & LoRA) as part of the facade renovation step. This study raised the context of local Chinese values. Meanwhile, the current research uses the Nusantara Architecture style juxtaposed with Kisho Kurokawa's Symbiosis Concept.

At this stage, researchers will compare the results of the AI-generated (diffusion model) work with Kisho Kurokawa’s built work and adopt the concept of Symbiosis (Table 4).

Table 4. Comparison of Nusantara (AI Stable Diffusion) and Kisho Kurokawa Concept (Symbiosis)

Comparison	Nusantara Building (Generated AI)	Real Building of Kisho Kurokawa Concept (Symbiosis)
		 [21]
Result	The roof and wall elements use a traditional concept, and the wall section uses a timeline concept (changes) for each architectural era	The top element of the tower represents traditional elements, and the middle and lower elements use a modern concept (different eras/symbiosis)

The concept of symbiosis can be demonstrated through experiments with stable diffusion using the context of Indonesian architecture. Changes can be seen in the walls, which change while the roof and columns remain the same. This is similar to the concept presented in Kisho Kurokawa's Nagakin Capsule Tower. In this section, the researchers found that the changes made by AI through the diffusion model were not yet optimal, particularly in the roof elements relative to the walls and the walls to the foundation pillars (columns), which were not yet fully integrated. This is because the modelling used was an existing model without any justification. The proportionality obtained was also suboptimal because the existing dataset still used the original dataset from the stable diffusion model. The similarity between the Nusantara concept and Kisho Kurokawa's concept in this study lies in the process of change, where the essence of regional elements is maintained, especially on the roof (top) and the lower part of the building.

3.5. Identify Building Elements with YOLO v8

The next step is to identify each architectural element of the Lampung vernacular buildings used. This stage begins by labelling the dataset in the Roboflow application, dividing it into sections (classes) for later training to identify Nusantara architectural elements (Figure 8).

Search classes...		Sort By Class Ascending
COLOR	CLASS NAME	COUNT
	Roof	67
	Window	121
	Column	512
	Ornament	77
	Door	19
	Staircase	20
	Wall	73

Figure 8. Classification and Labelling in Roboflow

The next stage is training and identifying original building elements from the Lampung architecture dataset, where the YOLO v8 model performs well at detecting each element (Figure 9). In the YOLO v8 test, each element can be correctly identified, allowing it to proceed to the next stage: identifying buildings generated by the AI Generator (Stable Diffusion) of Nusantara architecture. The evaluation indicators for the YOLO v8 process are no errors during the epoch. Training the model using the Roboflow model yields an mAP above 50%, and the training graph shows good performance (Figure 10).

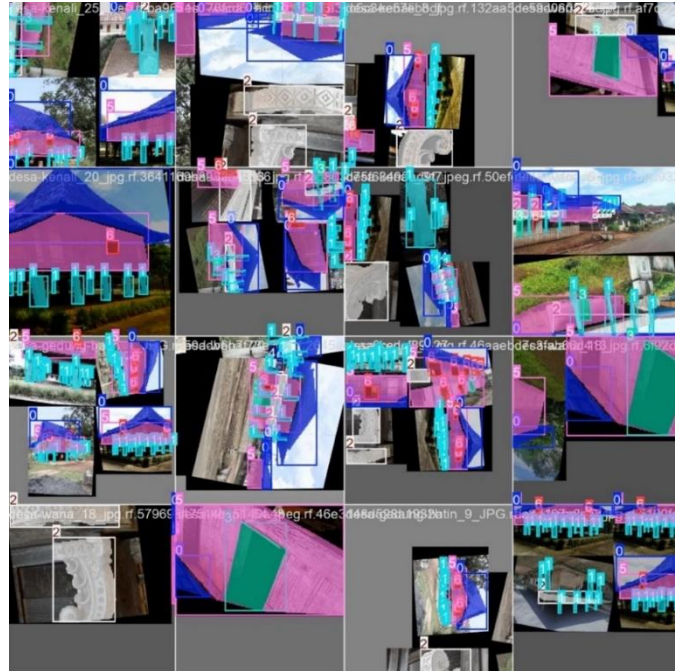


Figure 9. YOLO v8 Detection Results of Lampung Vernacular Buildings

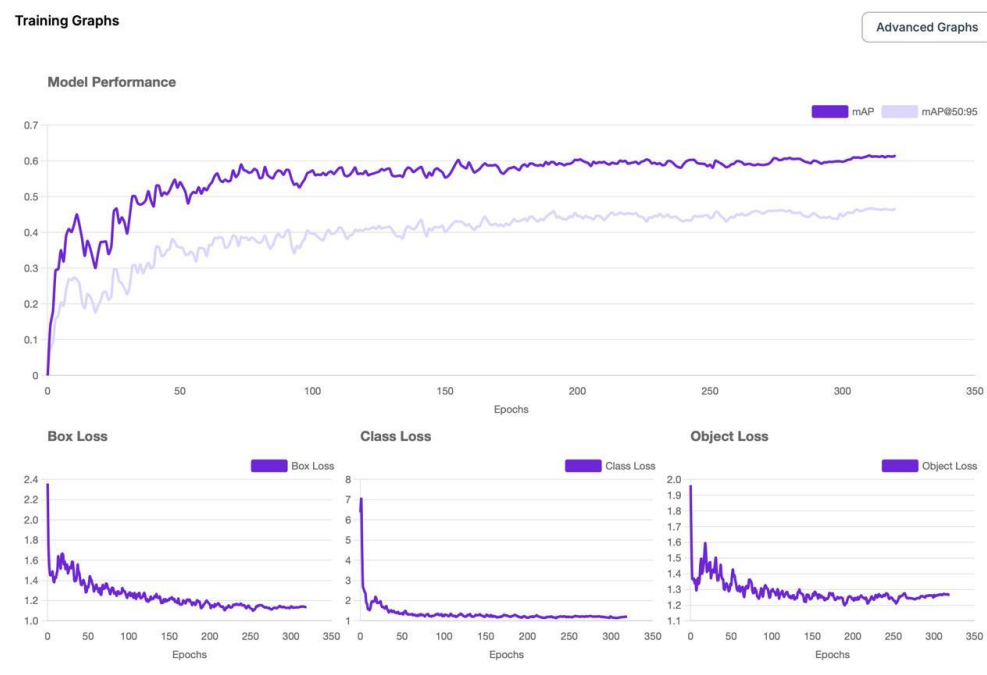


Figure 10. Training Graph Results on Model Performance

The final stage is testing Nusantara architectural buildings from various periods, using four samples (Dutch East Indies-era, Islamic, and colonial architectural styles). The results show that YOLO v8 can correctly detect the vernacular architectural elements in the generated images (Table 5). Yolo v8 can still identify elements of Indonesian architecture when trained on traditional buildings. The identified items include the roof and the lower columns of the foundation.

Table 5. YOLO v8 Identification Results for Indonesian Architectural Buildings (Modification)

Hindu Building	Buddhist Building
Islamic Building	Colonial Building

4. CONCLUSION

The results of this study demonstrate similarities between Kisho Kurokawa’s Symbiosis concept and the Nusantara architecture concept, including symmetrical geometry, modern materials, and natural colours. The first test, conducted with YOLO v8, demonstrated accurate identification of the characteristics of the Nusantara and Symbiosis architecture across four samples, based on results from the AI generator (Stable Diffusion). The second test, on the facades of Nusantara buildings, revealed significant differences in AI results (Stable Diffusion), particularly in wall elements that do not directly connect to the roof and columns. The proportions of the non-traditional building (the walls) do not match the dimensions of the other elements (the roof and columns). However, in general, AI results (stable diffusion) can be used to combine traditional elements with those from various eras, in accordance with the Nusantara context and the guidelines. The Symbiosis concept shares similarities with the Nusantara concept by combining several facade elements from various eras; for example, the Nagakin Capsule Tower combines two elements: traditional and modern (contemporary).

The researchers have several targets for further research. While YOLO v8 can already correctly identify buildings, a newer version with a larger dataset could be utilised, not only from traditional Lampung

buildings but also from other regions in Indonesia, to expand the scope beyond Lampung Province. Another limitation of this study is the disproportionality of the stable diffusion results for building elements generated by the AI when combining two different elements between the original image and the available dataset image in the stable diffusion model, resulting in less than 100% accuracy.

Suggestions for further research include expanding the Nusantara context beyond visual facade elements to include interior spaces. Furthermore, the philosophy of the facade, which was not linked to the context of Kisho Kurokawa and the Nusantara, could provide new ideas for developing prompts for future diffusion models. Within the context of the diffusion model, elements from text or audio (historical narratives) to visuals could be a potential future discovery related to the Nusantara. Comparing the Nusantara concept with Asia is also interesting to explore beyond Japan, such as in the context of Kisho Kurokawa. Furthermore, combining AI with other fields, such as the metaverse and neuroscience, could enrich future research. The researchers hope this study will lead to more interesting follow-up research, particularly utilising AI technologies such as YOLO and diffusion models related to Indonesia (Nusantara).

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