
A Review Using Artificial Intelligence-Generating Images: Exploring Material Ideas from MidJourney to Improve Vernacular Designs

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ABSTRACT

Artificial Intelligence (AI) was created to be an assistant to humankind. The architectural design process is one of them. Artificial Intelligence is starting to enter the realm of architecture and design. Lately, teams have developed many AI algorithms to generate random images based on the database they had just by texting a command for them. MidJourney is a discord-based Artificial Intelligence for generating images with the text-to-images method, and its database is infinite; it can suggest incredible things. Architects can use MidJourney as a design ideas generator with specific commands.

MidJourney, one of the AI pioneers in the design world, still has many shortcomings and limitations. Incorrect details and forms are one of its limitations. This exploration using AI should be deepened as part of MidJourney development. This study aims to discover how far researchers have done the command prompt in exploring MidJourney in architecture. This research can be the basis for further research in developing the text-to-image Artificial Intelligence Generator results. This paper uses a systematic literature review method on journals, books, and websites linked with Artificial Intelligence, architecture, and texture selection for building. The systematic literature review involves collecting questions, identifying keywords, screening articles, analyzing, discussing, and concluding.

The results explain the role of Artificial Intelligence in architectural design. MidJourney can choose the proper material for its innovations by generating concept ideas. However, MidJourney has yet to be able to implement the logic of structures and buildings in its design even though it has used architecture-related prompts, perhaps because it was not specifically designed to produce architectural drawings but graphic design only. The challenge is based on the user defining the limitation and the main ideas for generating Artificial Intelligence.

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1. INTRODUCTION

Artificial intelligence, according to the Oxford Dictionary, is a theory and development of computer systems in performing tasks that usually require the role of human intelligence. These tasks include visual perception, speech recognition, decision-making, and translation between languages [1]. Artificial Intelligence has a goal so that computer systems continue learning and can help human life. Artificial intelligence can be divided into Strong AI and Weak AI. Strong AI aims to enable computer systems to perform

multiple tasks and have their thoughts like humans, while weak AI aims to allow computer systems to perform one specific task.

The terms of Artificial Intelligence began in 1950. Alan Turing suggested a definition to determine whether the software has intelligence. In theory, software intelligence can be measured like human intelligence. The benchmark lies in human awareness when testing software. The software can be considered intelligent if humans do not realize that they are conversing with the software but feel like they are talking with other humans. The terms of artificial intelligence then began to be known since the development of this software was carried out [2].

Artificial Intelligence service collects, combines, and shares big data, including research, analysis, analytics, computations, storage, and volume of data needed for a specific project. Artificial Intelligence also can make a tool that contributes to architectural building longevity. Artificial intelligence will increase efficiency in the design and construction of buildings and create multiple solutions that will push the boundaries of architectural development. It is an opportunity to discover what ways the world could be improved through Artificial Intelligence [3].

Table 3. Artificial Intelligence Compared to Human Intelligence

Comparison	Artificial Intelligence	Human Intelligence
Location	Reside in Machinery	Reside in Human Brain
Source and lifetime	Artificial, can be inherited by the next human to use	Natural, will disappear when a human dies.
Processing System	Information stored in Big Data, processed in computer, resulting a new report.	Information gathered with five senses, processed with brain, resulting in a new idea.
Conscience	Artificial intelligence see thing objectively, depends on the boundary input.	Humans see things with sympathy and empathy.

Artificial Intelligence has now achieved an advanced degree of development. The study of deep learning of big data and data science is growing. Giant International Companies like Google, Amazon, and Facebook are harnessing Artificial Intelligence to create cutting-edge technology. The system is now gradually making a transition from research laboratories needs only to now can be implemented to practical industrial use.

1.1. History of Artificial Intelligence Involvement in Architecture

Architecture is a field of work that includes design and construction. Architecture and art can't be separated because they have a symbiotic relationship. In 1970, Artificial Intelligence-made artworks began to be used in CAD software programs. In 1990, Artificial Intelligence helped users to make and manipulate complex and realistic output. The presence of Artificial Intelligence in architecture has become a phenomenon because it can manage any information about three dimensions, simulating building design analysis to the visual stage results in more efficient work time than in previous times. Now we can generate Artificial Intelligence based images from text-to-image commands, especially for architects nowadays.

Artificial intelligence will soon massively empower architects in their day-to-day practice. There are three concepts to improve Artificial Intelligence over time: (1) A statistical approach to design conception shapes Artificial Intelligence's potential for Architecture, (2) Our ability to design the right pipeline will condition Artificial Intelligence's success as a new architectural toolset, and (3) The application will facilitate its manageability and foster its development [4].

Artificial intelligence manifests itself in some software that architects can use. Artificial intelligence implemented in the software makes the architect's job easier. Therefore, the work can become shorter [4]. However, Artificial Intelligence can never equalize the creativity and flexibility of the human mind. Yet it can contribute to the efficiency of work. Therefore, it should be used to push the limits of the design further. The architect's role is to create and deliver designs that meet the building requirements. Not only that, but to create livable, inhabitable spaces that are aesthetically pleasing, stable, but comfortable. And no building is

perfect, but it should strive for perfection. That is why architects should work together with the constant advancements of technology that might provide the needed extra effort to improve designs.

Aref Maksoud, in his article, claims if we use Artificial Intelligence as a virtual assistant, the concept stage in the design process will no longer need to sketch down any ideas for a brainstorming part. The process can alternate between the architect's dreams to visualize ideas with high-quality pictures in seconds. Artificial intelligence could access big data that can alternate every image tagged by specific criteria, process it, and make some options [5].

1.2. Text-to-Image generation using Artificial Intelligence (MidJourney)

MidJourney is an independent research lab exploring new mediums of thought and expanding the imaginative powers of the human species. The team focused on design, human infrastructure, and Artificial Intelligence. They have a subscription plan for months and years, starting from \$8 a month for a yearly subscription. MidJourney Inc. was founded in San Francisco, California. MidJourney's Founder, David Holz, says he sees artists as customers, not competitors of MidJourney. Holz told The Register that artists use MidJourney to rapidly prototype artistic concepts to show to clients before starting work themselves.

MidJourney has a website called MidJourney.com, but they use Discord to generate results. Discord also has moderators, and the results of the Artificial Intelligence-generated images will be published on the website. MidJourney uses /imagine command in their discord group, followed by the direct specifications of the picture the user wants to generate. It will develop four options, and users can upscale and rate the results. When users go to the MidJourney home page, they will see a button, "Join the Beta," that takes them to a new screen, "Continue to Discord," which launches the app where they can register for the service. Once you do that, it lets you into the web-based Discord, or they can download the desktop app (recommended), and now they are in the community and can start creating art and images [6].

For a specific image generation, users need to write down the exact specification they want. They can write everything they want as a boundary for Artificial Intelligence to create. Figure 1 (a) shows that the user uses 30 different boundaries to make a more similar image than Figure 1 (b). Figure 1 (a) takes a more specific picture of a 10-year-old girl with red fabric around the waist and a goat beside her in the image generated by Artificial Intelligence for the first command. Figure 1 (b) uses the command a dog and black. The user didn't give the dog breed or the specification command, so the Artificial Intelligence makes different options the user can choose.

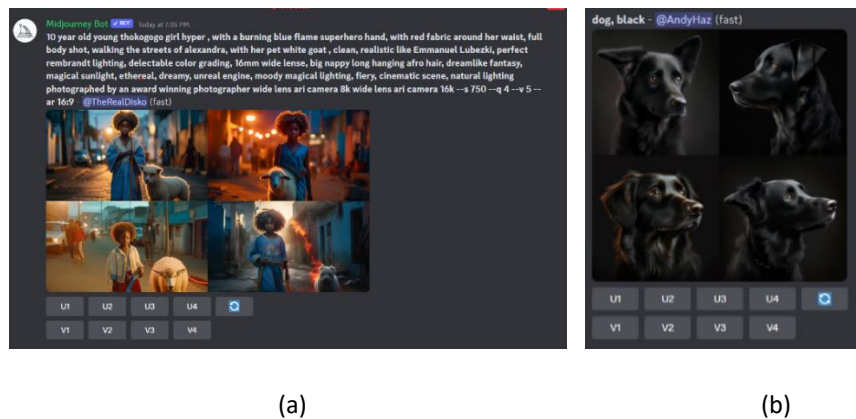


Figure 1. MidJourney in Discord Channel
 (a) the user using more boundaries, (b) user using fewer boundaries
 Source: MidJourney Discord Channel, taken by the author.

After the user chooses one of the images offered by MidJourney, they can enlarge it for download up to 4K resolution and give any feedback for the result of the Artificial Intelligence given command. The results generated by Artificial Intelligence have codes known as seeds so users can track and make another image generated using offered seeds based on their past results. These codes can be searched in the mid-journey databases for future text-to-image generation.

Architects can use MidJourney as a starting prototype and brainstorm for shape and material ideas. After we researched the user needs and boundaries for the exact plan, architects found limits and specifications required for Artificial Intelligence to generate early design options. Because Artificial Intelligence can access big data quickly and efficiently, the results can be generated almost instantly, and we can take it as a rough idea or starting point for future development. But sometimes, for architectural purposes, Artificial Intelligence cannot generate building images with proper consideration about nowadays buildable structures, human psychology that will inhibit the building, human standards for moving, etc.

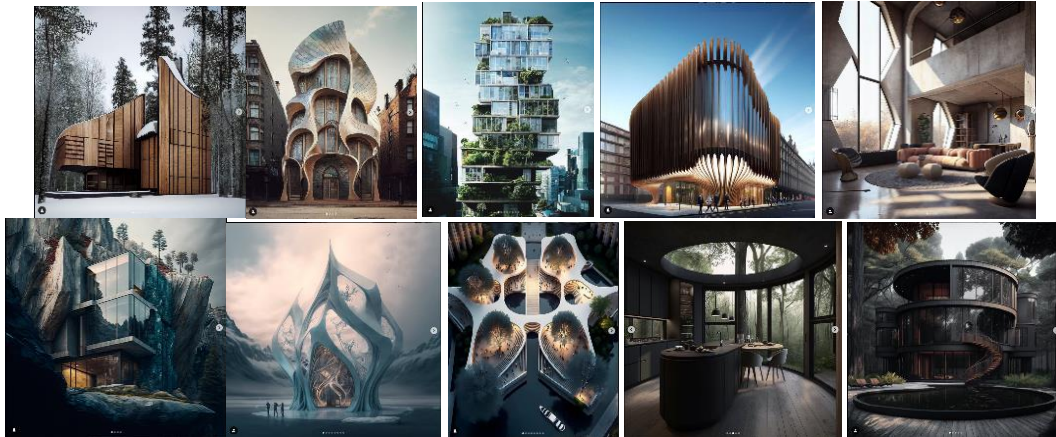


Figure 2. Architecture Generated by Artificial Intelligence
Source: <https://www.instagram.com/MidJourney.architecture>

1.3. The Material in Vernacular Architecture

In many cases, the term texture and material in all visual arts comes as a stimulant factor that gives different impressions and has several effects on the final products' surfaces. Ching defines texture as a surface characteristic of a form. It affects a form's surface's tactile and light-reflective qualities [7]. There are three trends in architecture in terms of the use of tactile textures: (1) Rough, (2) smooth, and (3) both textures. It must be noted that every material should be used by its character. Perception of a plane's shape, size, scale, proportion, and visual weight is influenced by its surface properties and visual context [6]. The color material enhances synthetic images' realism and provides the architect with a powerful design tool. This method enables the designer to organize libraries of texture samples and details extracted from digital images of color photographs or actual materials.

Material plays an essential part in construction, but they have a significant environmental impact. Some of it costs high energy impact on productions and installations. In the past, technology could not produce more advanced materials, and it needed to transport them over long distances. As a solution, materials used in vernacular constructions had low-tech profiles and were restricted to those available on sites. These were primarily natural, had low processing, low embodied energy, and consequently reduced environmental impacts [8].

Vernacular designs are architecture based on a particular place, accepted as a preferred style due to its affinity to local traditions. Architects, when using local cultural elements and style and employing available local materials, it becomes vernacular architecture. Vernacular architecture is pleasing to the senses because they outwardly echo the traditional socio-cultural aura and internally pleases the psychological aspect of the user. [9] Using vernacular architecture means collaborating the cultures, histories, and local materials available in the building. Local material is easy to find nearby, makes less of a carbon footprint, and tends to be affordable. In vernacular architecture, material and texture selection plays an essential part in the design process.

Some traditional building materials offered in many places are timber, clay, and stone. They can be found in forests, rivers, and even wastelands. Clay that can be processed as brick, timber, and rocks as a building material provides an aesthetic value to a building's facade and the structural value a building needs to stand. These three materials are often used in many buildings, especially residential ones [10].

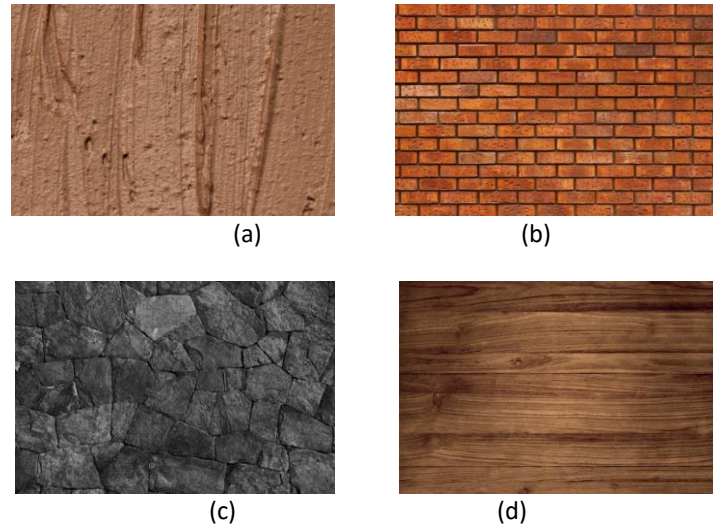


Figure 3. Traditional building materials (a) clay, (b) brick, (c) stone, and (d) wood
Source: Freepik.com

2. OBJECTIVES

- **Problem in the Field**

The phenomenon of using Artificial Intelligence as an assistant in doing human work is getting higher. Many parties develop and offer Artificial Intelligence as an alternative to make the job easier, making users need trial and error to find the right AI.

- **Problem in this Research**

Artificial Intelligence is starting to enter the realm of architecture and design. One of them is MidJourney. MidJourney, one of the AI pioneers in the design world, still has many shortcomings and limitations. Incorrect details and forms that do not allow it to be built are one of the limitations of this AI. This exploration using AI should be deepened as part of MidJourney development.

- **Objectives**

This study aims to determine how far researchers have taken the command prompt in exploring MidJourney in architecture. This research can be the basis for further study in developing the text-to-image Artificial Intelligence Generator results.

3. RESEARCH METHOD

This paper uses a systematic literature review method on journals, books, and websites linked with Artificial Intelligence, architecture, and texture selection for building. This literature review consists of (1) collecting questions, (2) identification of keywords, (3) screening articles, (4) analysis and discussion, and (5) conclusion.

- **Research Question**

The question suitable for this article is, "How deep can artificial intelligence provide ideas in the world of vernacular architecture, especially from the field of material selections?"

- **Identification of Keywords**

The keywords needed for searching journals, books, and websites that are linked for this article are:

- Artificial Intelligence and Architecture.
- Artificial Intelligence text to image generator.
- MidJourney application.
- Vernacular architecture.
- Artificial intelligence in vernacular architecture.

• **Screening Articles**

The keywords will be searched using journal generation applications called Publish and Perish, version 8.8.4275 (updated to January 11, 2023). The search is limited to journals in the last three years, from 2020-2023. The journals and articles generated from PoP 8 are limited to 200 results. In the initial section, 200 articles intersect with keywords. The next step, screening, was carried out according to the research topic "MidJourney related to architecture," which obtained nine relevant articles. There are articles related to the keyword, sorted manually from PoP 8.

- Is MidJourney-Ai the New Anti-Hero of Architectural Imagery & Creativity? by Ar. Mohesh Radhakrishnan
- Artificial Intelligence Art in Architecture by Joern Ploennings
- Artificial intelligence as part of future practices in the architect’s work: MidJourney generative tool as part of a process of creating an architectural form by Anna Jaruga-Rozdolska
- Stable Diffusion, DALL-E 2, MidJourney and Metabolic Architectures by Dennis Dollens
- Text-to-Image Generation Artificial Intelligence in Architecture by Erdem Yildirim
- Computational Design for Futuristic Environmentally Adaptive Building Forms and Structures by Aref Maksoud
- Artificial intelligence as a pedagogical tool for architectural education: What does the empirical evidence tell us? by Mohammad Sadek
- The Form of Islamic Architecture: Using Artificial Intelligence to Develop a Language for Contemporary Islamic Architecture by Zain Mankani
- Text-to-image artificial intelligence in a basic design studio: spatialization from a novel by Erdem Yildirim

4. ANALYSIS AND DISCUSSION

4.1. Using MidJourney as an Architectural Ideas

Since Artificial Intelligence Technologies is new, most of these journals still see text-to-image generators from the surface. Architect Radhakrishnan mentioned the Artificial Intelligence tool has been recognized with multiple controversies, especially in architectural images. In the benefit function, MidJourney tools can generate any illustration more creative for the beginning of the project concept and spreading dream-like ideas. The results are faster than human work, giving four early options and four more choices based on the first. It’s merely 16 options in a single text prompt.

Contrary to the benefit functions, MidJourney’s systems have some deficiencies too. MidJourney is considered to lack the capacity to understand the value of the sublime. Because the term sublime is very ambiguous, it is hard to teach Artificial Intelligence about the value of sublime. The sublime values in every region and culture are different. However, Artificial Intelligence cannot portray any cultural relevance during stances of architectural imagery [11].

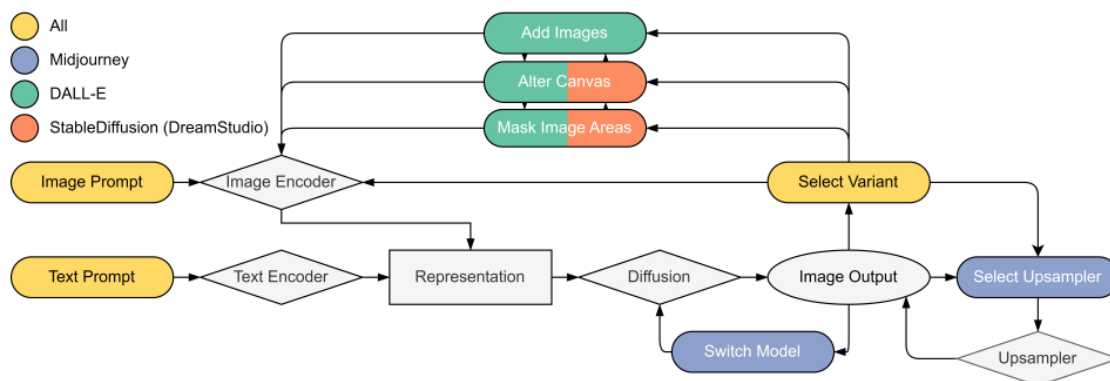


Figure 4. Model architecture and image generation process in different models

Source: [13]

An architect can make a new relationship to Artificial Intelligence text-to-image generator by directly tying human cognition as a text language to Artificial Intelligence as a programming code input and boundaries. It gives Artificial Intelligence a cue to morph images based on that text language. Dollens claims architects' minds can enter autopoietic unions with Artificial Intelligence to share in the designing process coextensively. In other words, design thinking with Artificial Intelligence image generation mixes the collaborative systems of Artificial Intelligence and human cognition, played out in generative images as covalent machine visualizations, and makes Artificial Intelligence a human-extended comprehension [12].

Ploennings explains Artificial Intelligence's method in text-to-image and image prompt generation applications, including MidJourney. Figure 4 presents the role of MidJourney, Dall-E, and Dream Studio in the part generating image output. As shown in Figure 4, only MidJourney offers an upsampler of resolution with multiple sizes. Thus, MidJourney's workflows center on generating and comparing image variants from different text-to-image models and then upsampling the best image, with limited possibilities to mix new pictures to the original text prompt. Based on Ploennings' research, 6.8% of users' queries are potentially architectural intent, and 2.6% explicitly use architectural vocabulary as a command prompt. But most users do not formulate entire sentences but only refer to content and architectural or specific architectural style. MidJourney's users are not professional architects or designers using MidJourney as an Artificial Intelligence assistant to help their work.

Rozdolska claims that the aim of MidJourney image generating is no more than to create a visually appealing picture. But as an Artificial Intelligence, MidJourney continues to analyze user choices with the help of its teams and users. Allows the script to evolve as it learns to generate better and better visualizations. With further trials and errors, she concludes that if MidJourney is used appropriately, it can be a valuable tool for the architect and support the creative thinking process [14].

MidJourney and other Artificial Intelligence text-to-image generators' capacity to integrate unrelated thoughts is one of the most promising qualities. This capability may affect architecture because it enables architects to pick unrelated ideas. Because the result is fast, MidJourney empowers architects to explore better ideas from different perspectives. They can facilitate data manipulation and generate inventive variations to answer the architect's creative issues.

Zain Mankani, in his article in Archi Times, states Artificial Intelligence can be used to develop a language for any architectural style. With generative Artificial Intelligence with its massive datasets and its ability to fast learning, architects can short-list to describe their notions of ideology in some architectural style [15]. Mankani believes that Artificial Intelligence can answer the creative ideas of simplicity, flexibility, purity, transcendence, timelessness, introversion, etc., that architects had difficulty determining and collaborating with them.

4.2. Using MidJourney as a Material Selector

MidJourney can understand textures and material detail in their draft, upscaling options, and final image generation. They care about minor details like different wood grains or bricks size that can be specified later in the upscaling process or even start over another project based on the result known as seed. In his trial and error, Ploennings applies some keywords that result in options for interior designs. The keywords are the cozy living room, wood paneling, television, large sofa, natural light, lived-in, realistic, and full view. And this is the result.



Figure 5. Ploennings' Result of MidJourney Generated Images

Source: [13]

In Figure 5, we can see how much wood texture changes in every MidJourney option. From the original query, we can see low-textured wood. It was without any details, just like an oversized wood texture applied without concern. But after users selected their variant, MidJourney became concerned about room shape and texture details. MidJourney suggests using rough bark texture in the upscale set, which is uncommon for that texture to be applied in ceilings. But the wood texture is finalized in a smoother material in the final upscale and remaster. Even the exposed structure of the ceiling and lighting details are offered by MidJourney. This condition shows that the design developments that took place while generating images from mid-journey are gradually improving.

4.3. Using MidJourney as an Ornament Decoration

Rozdolska tried MidJourney as an ornament and decoration generator based on architectural style. She uses a prompt of “baroque style façade by Gian Lorenzo Bernini detailed ornament,” which shows the result in Figure 6. The writer compares what MidJourney does with the real baroque-style ornament in France, and the result is acceptable. Even MidJourney presents other new ornament ideas that feel like baroque-style architecture but with a modern touch.



Figure 6. (left) MidJourney concept result of Baroque style facade, compared to (right) the architectural details of baroque pillar ornament in Dome des Invalides, France.

Source: [14], [16]

In the matter of details of style, MidJourney can be used for making an ornament or shapes that represent a unique architectural type or specific architectural style. The results are always visually satisfying but diverse in terms of formal correctness. Rozdolska proves the MidJourney ability to make somewhat correct decisions, even though it still needs to be evaluated by architects furthermore. The scripts have great potential in creating outlines of an architectural concept in any given style.



Figure 7. MidJourney concept result from Sadek's student's experiment

Source: [17]

In his journal, Sadek tries to make image ideas from narrative text. He asked his students to make a different narrative text to input to MidJourney. One of his students gave long narratives written like a personal experience of visiting this fictional building. Even input some unimportant details and not related sentences in the text. These are the correlated keywords that shape the results: (1) a mountain-like tower; (2) Al-Galala city, Egypt; (3) Building skin using prefabricated stone; (4) A cool cave entrance; (5) well-ventilated; and (6) garden near the tower [17].

From the keywords input above, writers try to compare the essence of the narrative and the picture's result in Figure 7. (1) A mountain-like tower defines the main shape of the building. It is monumental and aesthetic as the result generated by MidJourney. MidJourney also uses modern architectural styles in the image (2) Al-Galala city is a city in Egypt where the giant biomes are deserts. So MidJourney responds with a desert background and dusty pictures so we can perceive the hot and sandy area. But MidJourney needed help to determine the culture applied in Egypt, like their traditional ornament or their local resources. (3) MidJourney translates the prompt prefabricated stone as a big pile of rough stone. It affects the dynamic of every building story, and it will be hard to apply in the real world. But from what the writer thinks, prefabricated stone should refer to wall materials since Sadek's student mentioned building skin. (4) MidJourney answered an excellent cave entrance prompt with their big, asymmetrical entrance look area at the bottom of the buildings. (5) Well-ventilated and (6) Garden near the tower was answered only in the image on the right since there are gardens and that building has windows.

5. Conclusion

5.1. Conclusion to the Journal Research Question

Based on the analysis in 3.1, 3.2, and 3.2, MidJourney proved its ability to generate appreciable results in the context of architectural images. The results generated by it often ignored the area of building structure and function limitation because MidJourney is an Artificial Intelligence with a design function in general, not only specific to structural or architectural design. Since the research question is "How deep can artificial intelligence provide ideas in the world of vernacular architecture, especially from the field of material selections?" MidJourney can provide some brief design options based on the location and architectural style the architect wants and provide general material selection, but not specific because the results are images without any feedback description to the user. Meanwhile, other Artificial Intelligence can describe any image uploaded to them.

Since vernacular architecture is based on local resources available, human socio-cultures, and traditional characteristics, MidJourney should be capable of generating some brief images to answer these sections. But architects must take a self-overview and further test material and ornament details around vernacular architecture's functional and cultural sustainability. So, in the future, architects must possess knowledge about basics and every material available and update the knowledge continuously. Artificial intelligence must be developed further, and architects must be good judges and decision-makers. A good architect can produce a building design that is both functional and artistic and will be more efficient with the help of Artificial Intelligence.

In this case, the following steps will be the workflow for utilizing MidJourney as a virtual assistant to generate ideas. (1) Architect as an initiator of the design collecting data, and finalizing the data research. The result will be the boundary and limitation for the Artificial Intelligence to search, (2) Architects fill the description of the data results to Artificial Intelligence to generate some brief images, ideas, and concepts. The results from Artificial Intelligence can be repeated one after another until the architects are convinced and satisfied with the main ideas, (3) Architects should test the results from Artificial Intelligence around livability, structure logic, and cultural and material correctness. and (4) Architects develop the final design.

5.2. How can Artificial Intelligence be better and help architects in the future?

From the author's perspective, Artificial Intelligence needs more big data and deep learning from the available data. With Artificial Intelligence's impressive capabilities to memorize a lot of data scattered worldwide, the results will be more satisfying. A back-and-forth improvement between programmer and Artificial Intelligence is needed to increase Artificial Intelligence's correctness result.

For the further development of MidJourney, another part of MidJourney will focus on architecture-only image generation. So, they can consider many more aspects like scale, livability, function, access,

circulation, culture, resources, etc. It will be more efficient for architects to develop the design process in time. With that feature, the bias about art and architecture can be separated, resulting in more efficient and correct images.

In the future, Artificial Intelligence will allow architects to be tasked with imaginative design ideas in a digital environment before entering the actual design or construction phase. They will validate and develop more correct and imaginative designs that help architects in the design process. With the early stages of digital environmental studies through the architect's AI Image generator, architects can seek inspiration for alternative designs and visualize and arrange small, medium, to large-scale projects more effectively and efficiently in terms of time use.

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