REVITALISING ARCHITECTURAL DESIGN THROUGH AI: INTEGRATING HISTORICAL INSIGHTS AND THEORETICAL FRAMEWORKS AS A CREATIVE CATALYST

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ABSTRACT

Artificial intelligence is rapidly developing and being implemented in various fields, now used as an architectural design and planning tool. Online platforms, such as *Dall-e*, *Midjourney*, and *Stable Diffusion*, offer robots that can produce 2D drawings and 3D models corresponding to conceived space of Lefebvrian triad perceived, conceived, and lived spaces. Robots working with neural networks can think like humans, and with GAN technology, they can access architectural data faster than humans. Space can be written by text since the production is based on a textual dialogue between the robot and the human. This article explores the role of human designers in establishing a dialogue with artificial intelligence, specifically with the *Midjourney* robot. It examines how knowledge of the history of architecture and terminology can be used as raw materials, change the quality of spatial production, and help artificial intelligence create its architectural style by using a history-grounded and performing research methodology approach. It aims to propose semiotics as a critical tool in human-robot cooperation. It demonstrates the crucial role of architectural history and terminology even in design with the latest technology, such as AI.

Keywords: Artificial intelligence and architecture, architectural history, theory and criticism, architectural semiotics, architectural education and technology, production of space.

INTRODUCTION

Artificial intelligence is an emerging technology with great architectural, urban, and spatial production potential. Dr Matias del Campo, the Architecture and Artificial intelligence coordinator at the University of Michigan and Professor Sandra Manninger from the New York Institute of Technology are co-founders of SPAN Architecture, where they blend architecture education and artificial intelligence technology. In Robotic Gardens, SPAN has collaborated with Michigan Robotics to test robots' outdoor abilities in complex terrain since 2019. They first explored harnessing neural style transfer techniques for architectural design in the baroque ceiling using 3D for the Australian Pavilion at the Dubai World Expo in 2020 (Campo, 2022). Since the development and production of space using AI robots are quick and easy, it can be used by anyone who wants to collaborate with. Artists and designers use AI robots like *Dall-E*, *Midjourney*, *Stable Diffusion*, *Jasper Art*, *DreamStudio AI*, and *DeepDream* to create non-existent human profiles, paintings, and architectural or urban designs. Production uses resources to meet consumption needs, while manufacturing uses labour, machinery, resources, and raw materials. Although spatial production appears different from manufacturing, AI robots make it into a digital manufacturing process by quickly producing space images with certain qualities through algorithms that process digital raw materials. These abstract, designed spaces produced with AI are considered mass-produced productions. At the same time, artificial intelligence is viewed as a technology that has the potential to create and visualise abstract space like humans.

While Descartes, Spinoza, Newton and Kant described space as absolute and evaluated body and space as two separate phenomena, in the 17th century, Leibniz treated space as embodied and produced together with the bodies (Garber, 2009). The Leibnizian philosopher Lefebvre examined the production and social aspects of space and the body as commodities. He was the first to introduce the terminology of spatial production into architecture and urban theory (Butler, 2012, p. 125). In his book, *The Production of Space* (2014), Lefebvre develops a spatial trilogy to explain that every society produces, consumes, and transforms its own space. According to this trilogy, conceived, perceived, and lived space are helically intertwined in spatial production. Firstly, conceived-designed space (or space representations), which are abstract or mental productions designed by the thinking and intelligent body (designer human) by blending materials, technologies, political ideologies, and laws that reflect the spirit of the age, are produced. Then, the perceived space (representation spaces) is created with the physical realisation and construction of these designs. Finally, the space practised by social bodies and living spaces (space practices) that change and adapt over time and are re-adapted according to the new social order is produced (Lefebvre, 2014). Space, therefore, cannot be understood as one fixed design since it always needs bodies it shapes or is shaped.

It is visible that Lefebvre divides space into mental and physical. While spatial representations are mental through imaginative and fictional processes, realising perceived spaces and spatial practices needs the physical body for embodied space. Since the central role of humans, the only human beings who could think and imagine in this imaginative mental production, can now be filled by intelligent and thinking robots, the production of designed

spaces, which are conceived spaces, can now be produced by artificial intelligence robots. Even though AI has spread to a wide range of research areas in medicine, software and technology environments, as stated by Matias del Campo, these potentials of artificial intelligence are not yet talked about enough in architectural design, theory and academic environments (Campo, 2023, p. 51). From the University of Nebraska, Brian Kelly works on ethical issues related to artificial intelligence and how it violates copyright law since its creative processes are precarious concerning ethics; David William Newton questions whether urban health can be improved through deep learning or not; Matt Baran's work *Meat Machines* discovers that it is possible to get images representing violations through uploaded images and unbanned words, even though robots have banned specific words to produce these images (Jacobus & Kelly, 2024). There are various questions raised around AI and its implementations. However, there are three significant issues that researchers gathered around: questioning AI's ethical problems, the originality of AI designs, and curation of the text and prompt for AI By considering these three aspects of AI design, this paper aims to focus on the curation of the text and the meaning of curation in terms of the order of words and letters to design in AI. The paper takes writing and texts as the new palettes for drawing the space and triggering the spatial production capability of AI It does not address the problem around ethics or promise solutions since it needs a team that includes robotic engineers and software engineers to collaborate with. Therefore, this research aims to offer AI as a new potential design tool to architectural educators, students and offices who want to collaborate with AI robots in their future production. It introduces AI to students and designers at the introductory level who may benefit from its creativity and promptness. As the curation of words and the use of language are critical for AI, this research concentrates on how semiotics and semantics are as essential as knowledge of terminology and the history of architecture to curate propositions in AI By considering artificial intelligence as an architectural production technology today, investigating the raw materials used in this production, the principle of processing them, and the partnership with humans.

METHOD

This study uses both theory and practice as a research method model based on qualitative research. The theoretical part discusses the historical development of artificial intelligence, from its first emergence to its current use in architectural-spatial production. Although AI is used in many disciplines today, its rapid development dates back to the 19th century. The study will clarify why and how robots think like humans by explaining the working principles and production strategies of GAN and StyleGAN algorithms, which are Artificial Neural Networks (ANNs) used to develop artificial intelligence. These networks enable robots to design like humans by imagining like the human brain. Using Artificial Neural Networks, robots can work from text to image, so anyone who can write to the robot can start a dialogue about the design process. Since online robot platforms can test the experimental discovery of this theoretical part, this study will also try to practice spatial production with robots by explicitly using the *Midjourney* (2022) robot since it has better resolution and creativity than its contemporaries. Midjourney forbade words related to adultery words, drugs, female body parts and clothes, taboo, censored, nudity, gore words, blood, death, dark, violence and harassment; the robot does not respond and produce visuals when those banned words are sent (Midjourney Community Guidelines, URL). Therefore, in

the practice part of this research, only the words that do not contain any violence and harassment were used and shared as screenshots within the article.

To practice the process, performing research methodology will be applied. To do so, human and robot interaction will be experienced on Midjourney. The robot will be asked to produce urban space that has never existed. Thus, the robot must describe the space asked to illustrate. Therefore, first, it will be asked "an ancient city". Then, it will be developed with rich and detailed architectural and historical terminologies to see the development of the result. It will be both the production of new space through dialogue with the robot and the evaluation of its style. It will be discussed that, compared to humans, they can quickly create unique spaces that can rapidly change, transform, and reproduce with one click. Finally, since all these productions are constructing textual signs (semiotic), the importance of the history of architecture and the ability to use architectural language in this production is emphasised. Designers who want to work with artificial intelligence or those working with artificial intelligence and want to develop these designs should use semiotics as the most powerful tool of this dialogue.

As Midjourney rejects the prompt that contained violation and harassment, all the ethical rules of the Midjourney robot were followed and shared in the text. Moreover, any suspicious, unethical, or violent pictures can be reported to Midjourney. As it is not a free robot, there are different membership options. All the images are produced as open to the public in this essay. Therefore, there is no privacy in the images created for this essay; they can be copied, shared, and checked by public accounts.

Therefore, this study did not need ethics committee approval since all the dialogue between robots and the author (human) is shared as pictures.

DIGITAL TURN IN ARCHITECTURE AND ARTIFICIAL INTELLIGENCE

After Ada Lovelace, the first computer programmer, discovered that analytical machines could be programmed and compose music in 1842 (Hurt, 2017), the use of programmable machines spread in many areas. During the Cold War, intelligent machines were used to decipher cryptic codes. Some others are used daily to give mathematical calculation results and translate a foreign language into another. Today, it has evolved into a version that makes people's lives easier but makes them dependent on themselves. It has voice-equipped algorithms to describe addresses, make automatic searches, or write texts. Artificial intelligence (AI), in its simplest definition, is a form of intelligence offered by machines instead of humans (Warwick, 2012). AI, which has been developed since the 1950s, has gained profound learning ability through the development of Artificial Neural Networks (ANNs), created with algorithms that can learn and imitate the working mechanism of the human brain (Graupe, 2019, p. 1). In 2014, Ian Goodfellow introduced the Generative Adversarial Network (GAN) model, which can identify the standard features of the data it has and create similar new sets and variations by combining them; it has made it possible to produce life-like fakes of pictures, videos, music, text, and 3D models (Kanimozhi, Dhivya and Paiva, 2021, p. 134). A GAN is a type of artificial intelligence comprising two neural networks, one generator and one discriminator. These networks are specifically designed for visual recognition

and discrimination and are trained on a dataset. They learn to create new datasets based on the original ones. For example, if given a set of images of people, a GAN can generate a new set of similar images but not identical to the original set. GANs can also be used for facial recognition, hair analysis, and exam result scanning. StyleGAN is a newer version of GAN that produces more realistic images. It combines pixels with standard features in the original dataset, blending them and creating an intermediate value. This process is called interpolation. With StyleGAN, it is possible to generate familiar images that are not easily identifiable as belonging to a specific person or object. (Campo & Leach, 2022, p. 10).

GAN technologies have been used in biology, medicine, and engineering. However, they are now being utilised in art, design, and architecture, making them more accessible in the digital world. Computer-aided designs are now commonplace in all architectural schools and offices, but in the past, hand drawings were the norm before being replaced by digital tools. The first digital revolution in architecture began between 1992 and 2012, when computers, digital drawing visualisation tools, and cloud technology were first used (Carpo, 2013). Today's computers have neural networks that allow quick learning and transmission. GANs can create data sets by storing sketches, drawings, or other visual data in digital libraries. These stored materials are categorised by name and content, allowing robots to use visual text and learn from their semantic equivalents. Each drawing set is separated by scale and detail and stored as a set depending on the given name and content. As a result, the raw materials stored by artificial intelligence for use in spatial production are digital sets waiting to be used in digital libraries (Campo, 2023). When requesting a GAN to create a space, the instructions must be given through a linguistic path that helps the robot access suitable raw materials and sets. This is done through a text-to-image process. If a user wants the robot to create an original visual set, they must define the space using text. The creation process involves a sequence of appropriate words corresponding to the visual image in the designer's mind. For instance, if a user envisions a house with a high roof of red tiles, they must arrange the words to ensure the robot understands the semantics correctly. The robot uses a neural network to access visuals that match the text. It then produces visual sets from scratch using data sets that have been melted and reformatted. The essential tools that shape and direct this production are the grammar and meaning of the text. Therefore, producing space with artificial intelligence can be considered a sign of construction (Campo, 2023, p. 72).

Construction of Architectural Semiotics

Semiotics, also known as semiology, is an activity that deals with the production of meaning and signification. It is rooted in the Greek word "semeion" and the French word "semiologie" (Rifat, 2018, p. 29). John Locke (1632-1704), a philosopher from the 17th century, defined the doctrine of signs as a tool used by the mind to understand things and communicate information to others. The American logician Charles Sanders developed the foundations of contemporary semiotics after the second half of the 20th century (Hoopes, 1991). It was put forward simultaneously by Pierce and the Swiss linguist Ferdinand de Saussure without being aware of each other (Sebeok 2001, pp. 4-5). Semiotics has become a branch of science that spans many fields, including architecture. Umberto Eco and Roland Barthes both studied architectural semiotics. Eco's system is based on Peirce's visual

symbols and signs, while Barthes' system is based on Saussure and inspired by grammar. Both systems have an interpretive subject, a signifier, and an act of making sense based on what is signified.
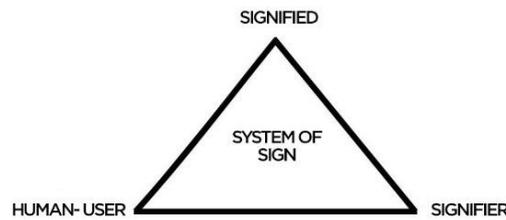

Figure 1. The triangle represents the trilateral system of sign (created by the author, 2023)

Signs can be anything, like objects or images that convey a specific meaning. A person interprets these signs based on their own understanding of them. The signifiers, which could be text or visuals, are presented to the subject or put forward by them. For instance, drivers know they must stop when they see a red traffic light. In this case, the driver is the one who interprets the sign and acts accordingly. The signified, which is the meaning conveyed by the sign, depends on the signifier, which is the image or text. This relationship between the signified and the signifier is similar to René Magritte's famous painting, 'This is not a pipe (Ceci n'est pas une pipe)'. After reading Foucault's *Words and Things* (Foucault, 2019, p. 8), which emphasises that words correspond to all emotions or objects, Magritte believed that everything is a sign. They all have textual or visual representations. Artificial intelligence robots use a similar working principle. They are designed to reach the signified through textual-linguistic signifiers, which are then interpreted to produce visual signified(s). When a person asks an AI robot to create a space, they define the image in their mind and construct textual representations that show this space. The sign, or the signifying system, is structured by the display of a space pointed out by this textual language through an interpretive robot.

FINDINGS

When interacting with AI robots, the dialogue and interpretation process starts by typing in the chatbox. *Midjourney* robot is one of the most innovative robots, offering a vast library. To request a visualised data series from the robot, a designer should begin by typing "/imagine prompt" in the opened box, enter a description for the robot to imagine, and then describe the imagined place to be visualised; once done, press enter to the send button (Figure 2).
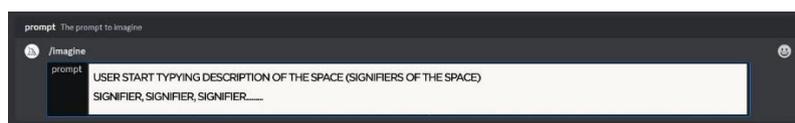

Figure 2. Midjourney Chatbox, to start a dialogue, the user type "imagine prompt" and enter the description (created by the author on Midjourney, 2023)

After sending the command, the artificial networks quickly call corresponding images from big data or datasets in their special libraries. The networks then produce a new image by merging the pixels based on the standard features of these images. While this semantic fiction written in the chat box plays the role of a signifier as it is

what is wanted to be illustrated in the design to be produced, the resulting image space is the construction process of the system of the sign.

The conversation between humans and robots starts when humans send a text to the robot. The robot then searches its library for images that match the text. It creates a new image by merging parts of the pictures it associates with the text, keeping the standard pixels constant. This process is known as semantic fiction, where words are sent to the robot to describe the space. It also stands for what curation means in this design process. The robot takes these words as signifiers and produces a set of new signifieds by matching them to images in its libraries of words sent to the robot. Thus, the robot takes the texts as a set of signifiers to produce and emerge new signifieds generated from images matching the texts connected to these sequences. For example, to create a visual of a new ancient city that does not exist, the user can ask the *Midjourney* robot to visualise it using the simplest form of the prompt, such as "ancient city" (Figure 3).
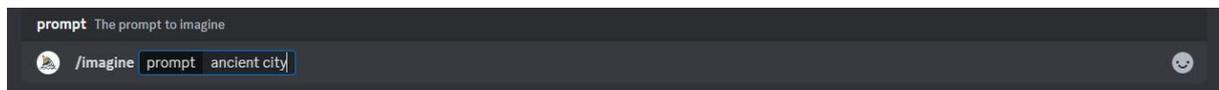

Figure 3. Sending "ancient city" prompt to the robot (created by the author on Midjourney, 2023)

Once they send the prompt, the robot combines all the images associated with those words in its library and presents the resulting visual. However, the visual may differ from the one they envisioned because the written text only covers some of the visual details they have in their mind (Figure 4).
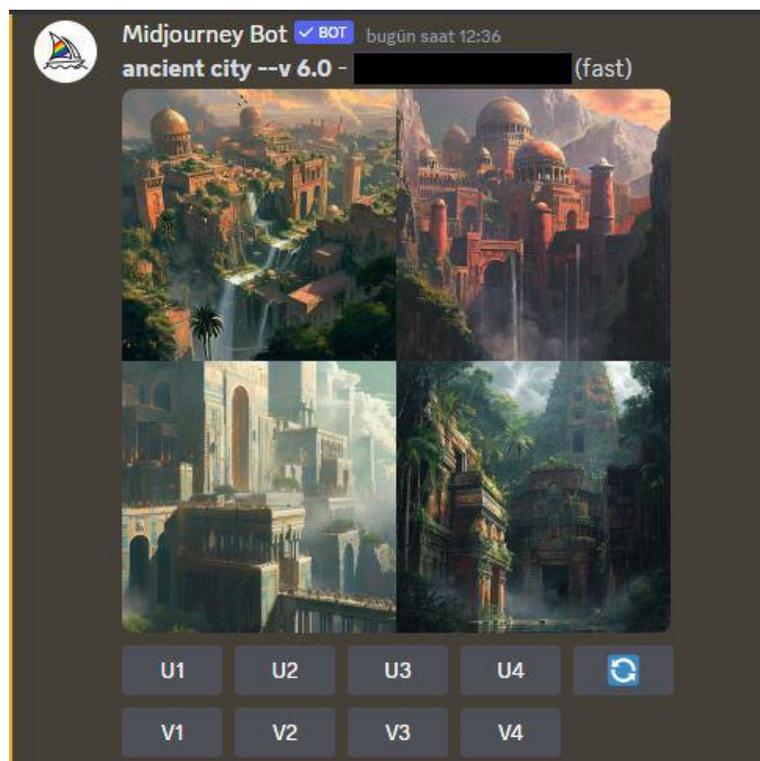
Figure 4. The robot was asked to create an "ancient city" (created by the author on Midjourney, 2023)

Therefore, it is essential to describe the envisioned ancient city in the correct order, including all details such as materials, scale, and supporting users on an urban and architectural scale. Since the robot produces different visuals, even the same prompt is used each time, giving more details changes the results and makes it richer or closer to the envisioned space. For example, when the prompt is detailed and offered as "ancient city by Greek architects" and "an ancient city in Egyptian and Neoclassical Style", the robot will add more details, and each image will be different (Figure 5).
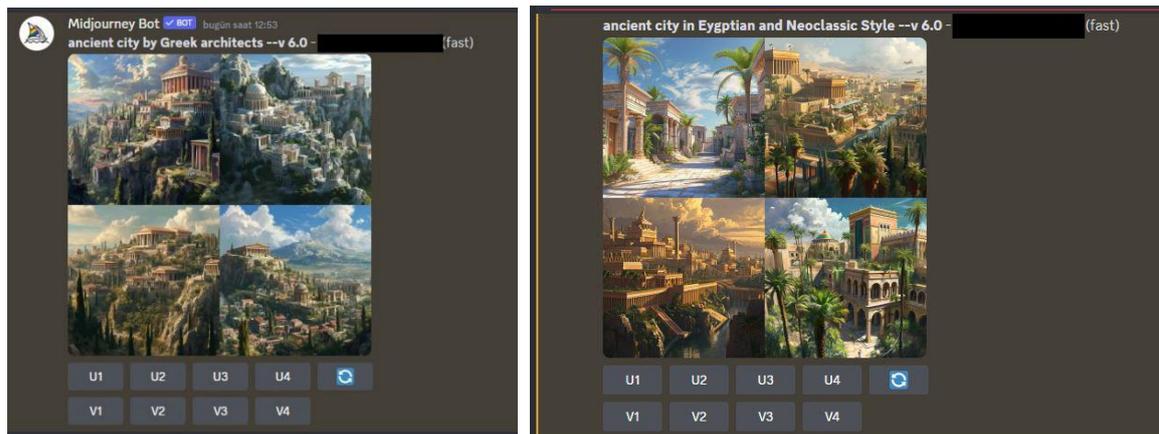
Figure 5. illustrations for "ancient city by Greek architects" (left) and "an ancient city in Egyptian and Neoclassical Style" (created by the author on Midjourney, 2023)

Also, carefully choosing word sequences and terminology when communicating with a robot is essential. The meaning and context of a text can vary greatly depending on the specific words used and their order. If the order of the words does not change the meanings of words or sentences too much or does not make the words unpredictable, like typing "Egyptian" instead of "Egyptian", as in Figure 5, the robot can still predict its correct order. Nonetheless, there is a particular difference between describing a city as "*an ancient city where a group of statues standing next to each other, by Greek architects, neoclassicism, elderly Greek goddess, highly detailed stonework, Egyptian atmosphere, carved marble texture silk cloth, stone walls and pillars, impressive detail, touring, great detail, attractive caryatids, the city was carved in the mountains, the epic river passes among temples"* versus "*an ancient city where Greek architects next to each other, by a group of statues standing, neoclassicism, elderly Greek goddess, highly detailed Egyptian atmosphere, carved stonework, marble texture stone walls and pillars, impressive silk cloth detail, touring, great detail, attractive temples, city was carved in the mountains, epic river passes among caryatids*" (Figure 6). Therefore, the richness of dialogue with robots relies on historical, architectural knowledge, and semantics and can significantly affect how a robot visualises the city when asked to do so. However, the final image may only sometimes match the user's exact imagination due to the limitations of the pixels used by the robot. While the result sets may be meaningful or meaningless depending on the library robot used and the specific pixels it chose to re-develop, this process can be observed through the development of the pixels.
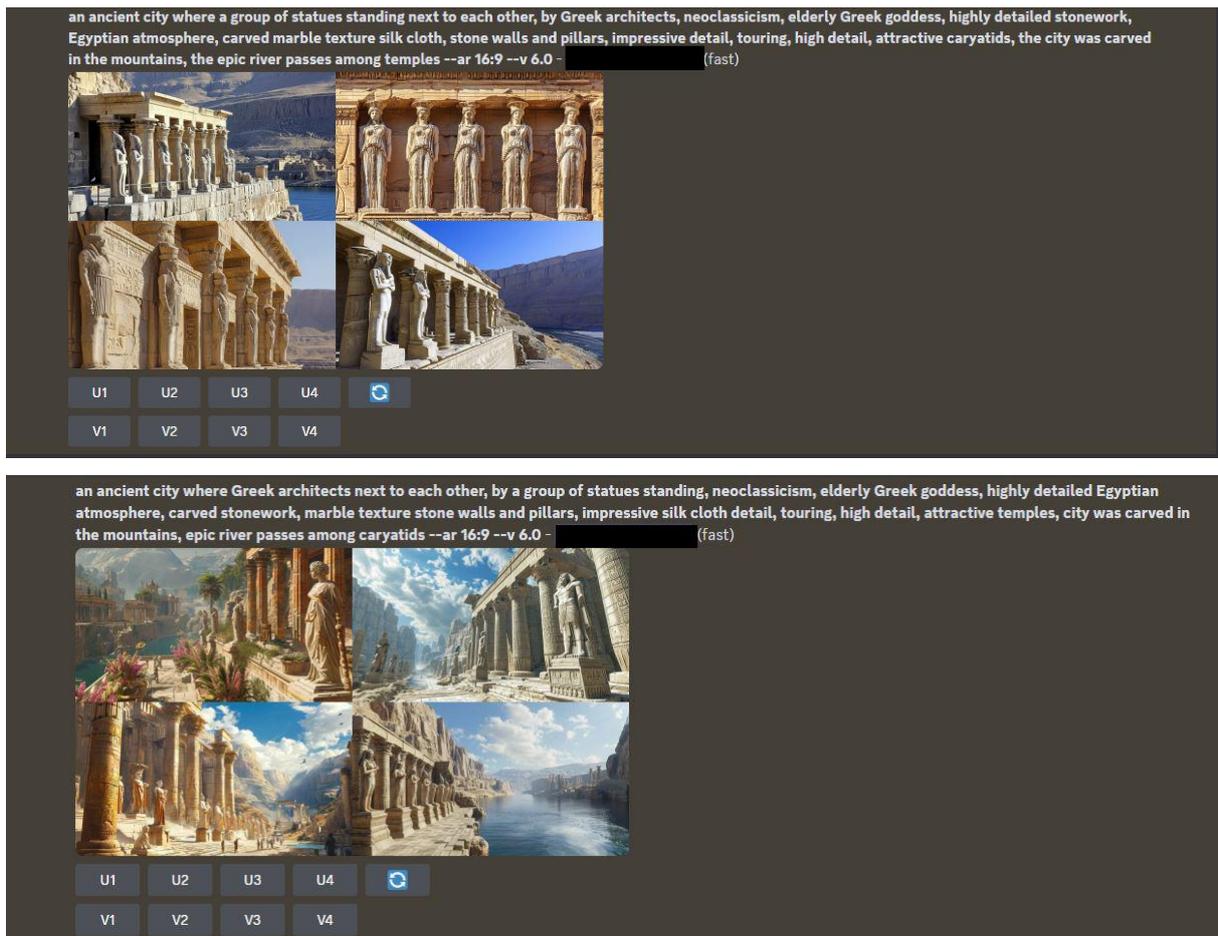
**Figure 6.** Robot responds to semantic order of the words (created by the author on Midjourney, 2023)

The word "pixel" is an abbreviation of "picture element" (picture x element = pi x el), which is a term used to refer to the smallest unit of an image (Negroponte, 1995, pp. 92-93). Creating a new image by manipulating pixels is not new and can be traced back to the 5th century BC when the Greek painter Zeuxis wanted to make the most beautiful woman in the world. He has collected physical fragments from each woman he considers beautiful and combined them to create a new woman who embodies the features of all the models. This new woman is a unique blend of all the aspects he finds attractive, making it difficult to describe her precisely (Mansfield, 2007, pp. 19-20). This is similar to what GAN technologies do with pixels today, where they can create familiar and strange images. The only difference is that AI can produce these images much faster than Zeuxis ever could, thanks to neural networks. AI can rapidly reproduce variations of images, increase the number of pixels, focus on different points, or change the scale of a specific area. Architects conduct thorough research during the architectural design process, depending on the function, program, and land of the building they will design. They study examples related to this type of building, take inspiration from previous examples and history, and finally combine them with their own experience and design approach. This approach may result in a design that looks like earlier examples in certain respects. However, it takes significant time to finalise a project compared to using artificial intelligence. Using robots to produce space takes only seconds, and it offers features to change the quality and quantity, remake, and upscale within a short period, as space can be mass-produced. As the

production is done online, all images can be stored, and each image has a URL (Uniform Resource Locator) link. These links define each image, and each visual library created can be stored. Pasting links into the text box can recall, change, improve, or use these images in a new production (Figure 7).
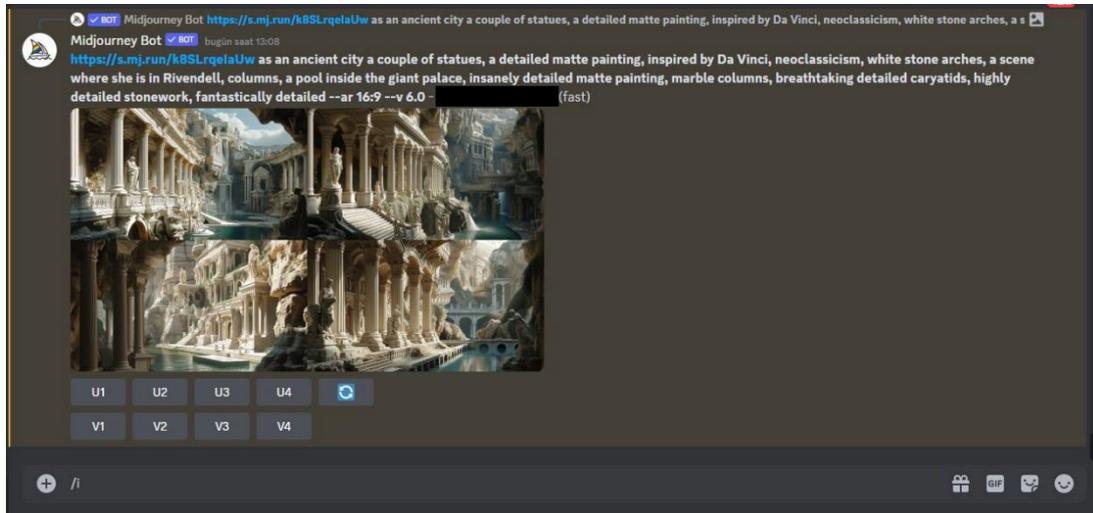
Figure 7. Remaking and developing images by using the URL of the previous prompt (created by the author on Midjourney, 2023)

Moreover, these textual links are paired with images on the internet. Many links sent to the robot can be mixed (remixed) to obtain endless visual variations and surprises that humans cannot imagine. The final output of a robot varies depending on the library quality, the text-visual match's accuracy, the language's richness, and the definition's completeness. The robot can combine images that match the written words, including synonyms and metaphors, which can result in unexpected, thought-provoking, inspiring, or even frightening outputs. When these combinations are viewed together, they can reveal similar, incomprehensible, and foreign images that may correspond to the definition, much like Zeuxis's painting of Helen. However, it can be challenging to determine what is imitation and what is original in the robot's output since it is unclear which data sets are used and how the interpretation is made (Figure 8).
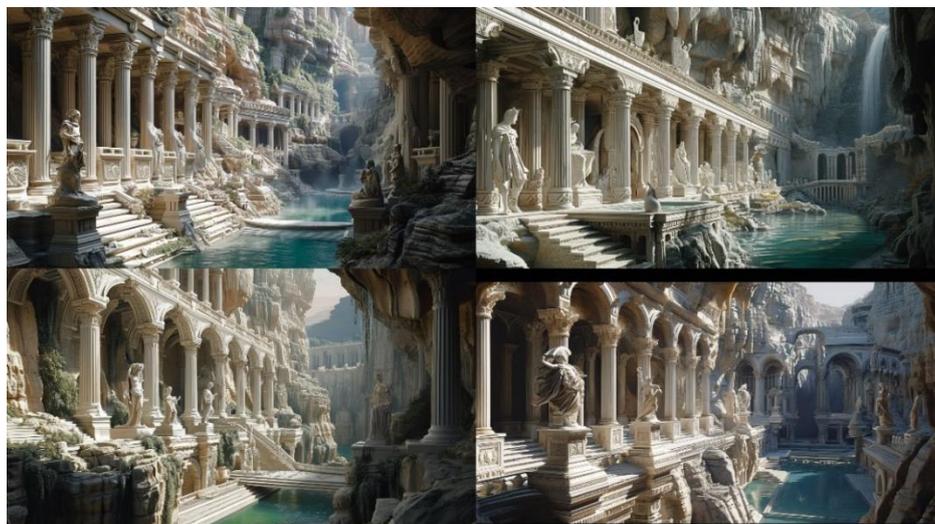
Figure 8. Images can be developed, remade, upscaled, and detailed by changing the words and their semantic order (created by the author on Midjourney, 2023)

CONCLUSION and DISCUSSION

Even though the history of architecture does not represent numerous styles in one body unless it is the neoclassical style, where eclectic style is mixed and reformed in one body, robots can dream different historical fragments in one unique body. It is important to emphasise here that AI successfully designs with anachronistic approaches in which various buildings, bodies, and objects can be resettled in a new time and space. These hybrid designs are both suspicious since AI brings original bodies that do not seem to fit into each other and inspiring because they are artistically merged and melted into each other. Considering this debatable aspect of AI, it does not appear realistic even though it reflects the piece of reality. Nonetheless, all AI programs use libraries which store examples that are already built and imagined; whatever robots are asked to design will always draw similarities to the past or current examples in the world, as in Zeuxis's painting.

It has been observed that artificial intelligence still faces ethical and cultural challenges due to the limitations of the library source and language used. As it primarily relies on English, it only partially recognises other languages. However, this limitation can help the robot develop its creative style. Semper defines style as a continuation of the genetic lineage in which it exists (Semper, 2004). According to Schumacher, genetics refers to the production process that selectively reflects the current socio-cultural situation in every social system (Schumacher, 2011, pp. 243-244). In our current age, we treat stored data as raw materials that can be processed. Artificial intelligence is constantly evolving and is developing a unique style. The word "style" originates from "styleus," which means a writing tool, instrument, or stick (Lund, 2017, p. 27). The stick used to make drawings and sketches on paper or soil is also called a style in architecture. The most crucial factor that determines the style of a scraping stick is what it is used for. Artificial intelligence uses text and grammar as a one-to-one drawing tool, making it possible to sketch architecture by writing instead of drawing. Therefore, artificial intelligence is an architectural style that allows us to visualise various spaces, buildings, and designs through writing.

Since the richness of the text depends on the language, the user who is historically and terminologically rich has an advantage. Accordingly, architectural history and terminology cease to be theoretical knowledge and become a writing tool like raw material that artificial intelligence can use. However, since a human is a robot in this textual dialogue, it is yet to be known precisely who the creator of the resulting design is and how much each person contributes to this production in percentage terms. Therefore, there is no border between the human and the robot's creativity, and the leading subject of the design begins to blur in the process (Franhci & Güzeldere, 2005, p. 457). In addition, the robot's creativity does not depend on an architect. Everyone can now design spaces with robots that can produce spaces described by a subject with no design training, with high quality and originality, without the need for an architect. However, since robots are currently limited to learning only the imagination and hallucination processes of the human brain, the language chosen is very important and can lead to speculative designs (Campo, 2023, p. 25).

Knowledge of the combination of words (semantics) used in written scripts, grammar, architectural terminology, architectural history, and architectural style plays a crucial role in designing, describing, assessing, and discussing

architecture. With a deep understanding of linguistic signs, the production of that language will be expanded. While robots can now help visualise space, the quality of the visuals depends on the depth of the textual indicators written by someone with architectural education. As Wittgenstein once said, "The limits of my language are the limits of my world" (Schroeder, 2006, s. 95); our vocabulary shapes our cognitive understanding of the world, which is not limited by the physical but rather by what we can perceive, access, and experience. Hence, this paper suggests that those who want to be involved in production with artificial intelligence and sketch architecture by writing should improve their grammar, knowledge of architectural history, semiotics, and terminology to create a production closest to their dream. Although images and text can feed robots, this paper only focuses on the text and curation. The text and image curation together will be re-evaluated for further research.

RECOMMENDATIONS

This article explored the use of artificial intelligence in the production of architecture at the intersection of language, history, and semiotics. The importance of the language used in this production and its connection with the outcome are examined. This leads to the question of whether it is possible to use artificial intelligence to produce and illustrate architectural spaces that do not exist but have disappeared, have not survived from the past to the present, but that we can access through texts. The aim is to test how close these productions can be to the original. Since these places, which cannot be seen visually in historical sources but are described textually, have a unique textual raw material potential for artificial intelligence due to the words that define them, this question is left for future studies and recommendations for those interested in the field.

ETHICAL TEXT

"In this article, the journal writing rules, publication principles, research and publication ethics, and journal ethical rules were followed. The responsibility belongs to the author (s) for any violations that may arise regarding the article. "Throughout this research, all the banned words of Midjourney robots will be checked, and no words have been used that contained violation or harassment (Midjourney Community Guidelines, 2024).

This study did not need ethics committee approval since all the dialogue between robots and the author (human) is shared as pictures.

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