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Enhancing Architectural Space through AI-Driven Ideation: A Case Study of Future Iranian-Traditional City

Yapay Zeka Odaklı Fikir Yoluyla Mimari Mekanın Geliştirilmesi: Geleceğin İran-Geleneksel Şehri Üzerine Bir Örnek Olay İncelemesi

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Written by:
Shabnam Golkarian[1]
https://orcid.org/0000-0002-1858-0133

Abstract

Artificial intelligence is an evolving technology that has drawn huge economic and social, educational benefits for the future. The revolutionary potential of this technology is boundless, as it can transform how humans live, work, learn, discover, and interact with each other. This research aims to investigate the theoretical foundations of environmental psychology, identify the characteristics of the appropriate architectural space, and then investigate the effect of using artificial intelligence in creating the appropriate architectural space from a formal aspect. The research method is descriptive-analytical and of a qualitative type, which was done by studying library sources and then logically analyzing the data. The research tool is artificial intelligence Midjourny and Dall.e3, which has been introduced for some time in creating artistic images from input words, and prompts. It has been the focus of various artists and architects. It can be said that with architectural conceptual plans, the future will become a reality differently, and they can positively influence the creativity of architects and create futures that most people will not think of today. The use of these images in creating accessible spaces is only one example of the use of artificial intelligence in the architectural design process and it can inspire architectural researchers in various fields.

Keywords: Artificial Intelligence, Architectural Space, Iranian-Traditional City, Future Cities, Midjourny, Dall.e3.

Özet

Yapay zeka, geleceğe yönelik ekonomik, sosyal ve eğitimsel birçok fayda sağlayacak yeni gelişen bir teknolojidir. Bu teknolojinin devrim niteliğindeki potansiyeli sınırsızdır çünkü insanların yaşama, çalışma, öğrenme, keşfetme ve birbirleriyle etkileşim kurma şeklini değiştirebilir. Bu araştırma, çevre psikolojisinin teorik temellerinin araştırılması, uygun bir mimari mekanın özelliklerinin belirlenmesi ve daha sonra uygun bir mimari mekanın oluşturulmasında yapay zeka kullanımının resmi etkisinin araştırılması amacıyla yapılmıştır. Araştırma yöntemi tanımlayıcı-analitik ve nitel türde olup, kütüphane kaynaklarının incelenmesi ve ardından verilerin mantıksal olarak analiz edilmesi yoluyla yapılmıştır. Araştırma aracı, girdi sözcüklerinden ve yönlerden sanatsal görüntüler oluşturmada bir süredir tanıtılan bir yapay zeka olan Midjourny ve Dall.e3'tür. Bu, çeşitli sanatçıların ve mimarların odak noktası olmuştur. Mimarların yaratıcılığını olumlu yönde etkileyebilecek ve çoğu insanın bugün düşünmediği gelecekleri yaratabilecek mimari kavramsal tasarımlarla geleceğin farklı bir şekilde gerçeğe dönüştüğü söylenebilir. Bu görsellerin erişilebilir mekanlar yaratmak için kullanılması, çeşitli alanlardaki mimari araştırmacılara ilham verebilecek, mimari tasarım sürecinde yapay zeka kullanımına dair örneklerden sadece bir tanesidir.

Anahtar Kelimeler: Yapay Zeka, Mimari Mekan, İran-Geleneksel Kenti, Geleceğin Kentleri, Midjourny, Dall.e3.

[1] Assist. Prof. Dr., Department of Architecture, Near East University, Nicosia, Turkey. WoS Researcher ID: GZA-9671-2022

Introduction

In today's era of ubiquitous computing, cities, and countries are gradually losing their unique cultural and lifestyle differences, giving rise to standardized and homogeneous spaces. This trend diminishes the richness of cultural identity and leads to environments where human interactions are often replaced by machine interactions, resulting in spaces that lack sensitivity and fail to meet diverse human needs. The consequences of this homogenization are far-reaching: it weakens community bonds, reduces individual well-being, and creates spaces that are disconnected from the cultural and emotional fabric of their inhabitants. Environmental psychology, a branch of psychology and behavioral science, provides a valuable framework for addressing these issues. This field examines the interplay between humans and their physical environments, emphasizing how spaces can be designed to reflect cultural values, foster a sense of belonging, and promote well-being. By understanding the psychological aspects of human interactions with their environments, designers can create spaces that are not only functional but also emotionally and culturally resonant. The revolutionary potential of artificial intelligence (AI) adds a new dimension to this endeavor. AI tools such as Midjourney and DALL-E 3 can generate creative and innovative architectural concepts from simple prompts, offering designers unprecedented opportunities to explore new forms and ideas. By integrating AI into the design process, architects can enhance their creativity and develop spaces that are both accessible and culturally meaningful. AI can analyze vast amounts of data to identify patterns and preferences that human designers might overlook, ensuring that the resulting spaces cater to diverse needs and promote inclusive, user-friendly environments. This research aims to bridge the gap between the loss of cultural identity in modern architecture and the principles of environmental psychology, leveraging AI to create more accessible and meaningful architectural spaces. The study will begin by examining the theoretical foundations of environmental psychology, identifying the key characteristics of spaces that support human well-being. It will then explore how AI-driven design tools can be used to enhance these spaces, ensuring they are both innovative and responsive to their users' cultural and psychological needs.

Theoretical Framework or Literature Review

Environmental Psychology and its Intersections with Architecture

Environmental psychology is a field that has been defined in various ways by researchers. The pioneers of this field are considered to be Egon Brunswick, Kurt Lewin, and Robert Gifford. Brunswick is credited with coining the term "environmental psychology" in 1943, as reported by Ng, (Brunswick, 1943; Ng et al., 2019). Environmental psychology in architecture emerged in the late 19th and early 20th centuries. It gained momentum in the mid-20th century through collaborations between psychologists, architects, and urban planners. The work of Kurt Lewin, Roger Barker, William James (2010), and Hugo Münsterberg (2004) influenced the development of theories and methodologies to study the psychological impacts of architectural design, forming the basis for understanding how environmental factors influence behavior and cognition. In the 1960s and 1970s, the humanistic design movement prioritized human needs and well-being in architectural practice. Architects like Christopher Alexander and Kevin Lynch advocated for user-centered design principles. In 1970, Proshansky, Etelsen, and Rivlin introduced environmental psychology in their book "Environmental Psychology: Humans and the Social-Physical Environment." (Charles & Sommer, 2011). Attention to the study of human behavior and the place and environment in which the behavior is formed was first presented with the term "ecological psychology". Contrary to the traditional psychologists whose research did not pay attention to the relationship between human behavior and his physical environment, in ecological psychology, the concept of human relationship with his environment was considered (Al-Saigh & Mahmoud, 2023). In the 1980s and 1990s, there was a cognitive turn in environmental psychology, with researchers like Donald Norman exploring how cognitive processes influence individuals' interactions with the built environment (Norman, 1980). In recent years, environmental psychology has merged with sustainable design in architecture. Architects and environmental psychologists now collaborate to create buildings and urban areas that enhance environmental sustainability and promote human well-being. Advancements in technology, such as virtual reality and environmental sensors, provide new tools for studying human-environment interactions, (Charehjoo et al., 2018). Innovative tools enable architects and environmental psychologists to evaluate and enhance architectural designs based

on human reactions. This helps create more efficient and user-friendly environments. Environmental psychology in architecture studies how architectural design impacts human behavior and well-being. This connection is exemplified by Christopher Alexander, an influential architect, who emphasizes the importance of psychology in his book "A Pattern Language," highlighting the need to design spaces that align with human desires and actions, (Alexander, 1977). He advocates for the creation of places that are proportionate to human size, usage patterns, and cultural context. Kevin Lynch, a prominent author, contributed to the field of urban design with his book "The Image of the City," which explores how people perceive and navigate metropolitan landscapes. Lynch identified five key elements: pathways, boundaries, districts, nodes, and landmarks, which are essential to individuals' mental maps of cities. His work underscores the importance of coherence and legibility in urban design, which can enhance people's sense of direction and place identification, (Lynch, 1964). Jan Gehl, a Danish architect, and urban designer, is renowned for advocating people-centered design principles. His research emphasizes the significance of designing cities and public spaces prioritizing human experience, social engagement, and pedestrian activity. Gehl's contributions have globally impacted urban planning techniques, promoting walkability, safety, and accessibility in urban contexts, (Gehl, 2011). Donald Norman, a prominent cognitive psychologist and usability specialist, has integrated psychological concepts into the design of everyday objects and environments, including architecture. Norman's insights into human-centered design have broad applications in architectural practice, emphasizing the significance of user-friendly settings that enable intuitive interaction and navigation, (Norman, D.A., 2013). Bill Hillier and Julianne Hanson are renowned for their contributions to space syntax, a theory, and method for analyzing spatial arrangements and their impact on human behavior. Their research examines how spatial configurations influence mobility patterns, social interaction, and accessibility in built environments, (Hillier, 1989). Space syntactic analysis is a valuable tool for architectural design, urban planning, and environmental psychology, informing decisions on building layouts, road networks, and public spaces. Kurt Lewin is widely recognized as the pioneer of environmental psychology, a field that emphasizes the importance of understanding how individuals interact with their surroundings. He coined the term "life space" to refer to an individual's psychological environment, encompassing their perceptions and experiences, (Lewin et al., 2014). Environmental psychology is crucial for understanding how people behave, think, and feel in different settings. This field offers insights into designing spaces that promote health, well-being, and productivity. Roger Barker's work in ecological psychology focused on studying behavior in its natural context. He developed the concept of "behavior settings," the environments in which specific behaviors occur, (Barker, 1989). Barker also highlighted the reciprocal relationship between individuals and their environments. His work on the "urban overload hypothesis" suggested that dense urban environments can lead to stress and sensory overload, ultimately affecting behavior and well-being. Roger Ulrich, a Professor of Architecture at the Center for Healthcare Building Research at Chalmers University of Technology in Sweden, conducted a study titled "View through a window may influence recovery from surgery," which has been cited over 6700 times, (Ulrich, 1984). The study found that patients with a window view of a natural setting had shorter postoperative hospital stays and fewer complications. This research has been cited and replicated numerous times, offering valuable insights into how design decisions shape the human experience of built environments.

Belonging to the Place and Symbolism in Architecture

The concept of belonging to a place is a deep emotional connection that individuals establish with a specific location where they feel comfortable and safe. The process of developing knowledge and respect for a particular location can transform it from a meaningless space to one that holds deep and enduring significance. This process of belonging pertains to an individual's or group's profound emotional attachment to their surroundings, an attachment that transcends the sum of its components. Place belonging, therefore, represents a unique connection between an individual or a group and a location, one that varies based on the geographical level, degree of specificity, and social or physical aspects of the area. This connection manifests itself in different psychological processes, emotions, and cognition, and is an integral part of our existence that contributes to our sense of identity and purpose (Allen et al., 2021), (Figure 1).

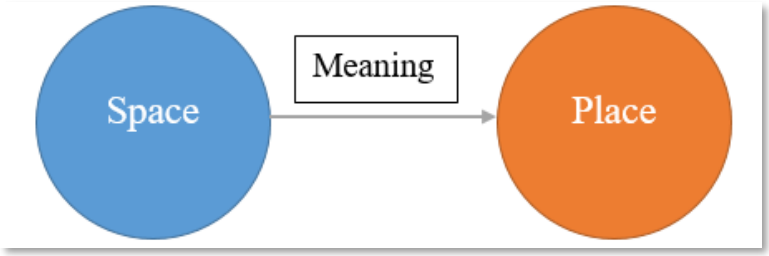


Figure 1. The relationship between space and place in environmental psychology. Source: (By author).

The physical presence is essential for community membership, as it involves spending time in a specific place and interacting with others connected to the environment. The cultural significance of a location also influences individuals' identities and sense of heritage. Places can embody cultural, historical, and social significance, contributing to individuals' sense of identity. A sense of place is a deep emotional connection to a location, based on personal experiences and memories. These attachments can influence behaviors and perceptions, shaping a sense of belonging and well-being. Symbolism in the built environment uses architectural elements to convey cultural significance. Buildings, monuments, and public spaces often represent the identity of a society or community. Architectural styles, motifs, and ornamentation can convey cultural meanings and heritage. Expressive forms in architecture and urban design can express symbolic meanings through their form, scale, and visual aesthetics. Buildings may evoke certain emotions or convey messages through their design features, such as symmetry, proportion, and materiality. Symbols in the built environment can be interpreted differently by individuals based on their personal experiences, backgrounds, and cultural contexts. People may attribute unique meanings to places or architectural elements, influencing their perceptions and behaviors. Symbolism in architecture and urban design plays a significant role in shaping the identity, character, and meaning of places. It contributes to the creation of environments that resonate with people on an emotional and symbolic level, fostering a sense of connection and belonging.

Human-Centered Design in Architectural Practice

Human-centered design, also known as user-centered design, prioritizes the needs and experiences of users throughout the design process. It involves understanding user behaviors, motivations, and goals, and integrating their feedback into the design of products, services, or environments. Designers engage with users through observation, interviews, and participatory methods to gain insights. The goal is to create intuitive, accessible solutions that enhance users' quality of life. Environmental psychology intersects with architecture and influences our approach to design. However, some key ideas, concepts, and approaches that stem from, or are related to environmental psychology, have been assimilated into the way architecture is taught and practiced. These include but are not limited to, an evidence-based design that was adapted from evidence-based practice in healthcare and psychology, aspects related to mental mapping, way-finding, and navigation in cities, biophilic design, and the effects of natural environments on wellbeing (Ulrich, 1984; Wilson, & Kellert, 1993), effects of different textures, materials, and shapes on human comfort (Sommer, 1969), pinch points and opportunities for enabling or inhibiting behavior through design, aspects related to levels of privacy and crowding, and more. In summary, the field of environmental psychology offers profound insights and practical tools that architects and urban planners can utilize to create built environments that are not only functional and aesthetically pleasing but also promote psychological well-being and a sense of belonging among their inhabitants. By understanding and applying the principles of environmental psychology, we can design spaces that enhance the human experience and contribute to healthier, more sustainable communities.

Artificial Intelligence in Architectural Design

Artificial intelligence (AI) is a rapidly expanding field of computer science that encompasses the development of intelligent robots capable of performing activities that would typically require human intelligence. These activities include, but are not limited to, problem-solving, decision-making, perception, reasoning, and learning. AI systems comprise various technologies and applications, each with its own set of algorithms,

methodologies, and frameworks. Artificial intelligence is a kind of simulation of human intelligence for computers, and artificial intelligence is a machine that is programmed in such a way that it thinks like a human and can imitate human behavior and even human emotions. Artificial intelligence can be classified according to cognitive, emotional, and social types, into artificial intelligence, general, and super, (Kaplan and Hanaline, 2019). But when the use of artificial intelligence becomes a normal thing, often the sensitivities about it are reduced and it becomes a tool. As Arthur Clarke, a science fiction writer, said: Any sufficiently advanced technology is indistinguishable from magic, but when we understand technology, the magic disappears, (Carleton et al., 2020).

Components and Applications of AI in Architecture

Natural language processing (NLP) is a crucial component of AI, enabling computers to perceive, interpret, and synthesize human language. NLP algorithms analyze and comprehend human language using statistical models, rule-based methods, and machine-learning techniques. Another critical aspect of AI is computer vision, which enables robots to understand and evaluate visual input from the physical environment. Computer vision algorithms can identify objects, faces, gestures, and scenes in photos or videos, allowing for applications such as image categorization, object identification, and facial recognition. AI has revolutionized various industries, including architecture. AI tools like Midjourney and DALL-E 3 generate innovative design concepts from simple prompts, offering new ways to explore architectural ideas. The integration of AI into the design process offers significant benefits for architects. AI, through generative design, can produce a wide array of design variations, thereby exploring diverse possibilities and identifying optimal solutions. AI's data analysis capabilities enable the examination of extensive data sets to unveil patterns and user preferences, facilitating a deeper understanding of user needs and preferences for designers. AI tools can foster creativity by presenting unconventional design ideas and solutions, expanding the realm of what is achievable. Ultimately, the incorporation of AI into the design process empowers architects to augment their creative capabilities and craft spaces that are not only innovative but also user-friendly.

Ethical Considerations and Future Directions

The integration of AI into architectural design raises vital considerations regarding cultural and social impact. While generative AI can offer design solutions that respond to cultural and societal nuances, ethical concerns surrounding biases in training data and the potential displacement of human creativity must be carefully addressed. Striking a balance between AI assistance and preserving the human touch in design is crucial for responsible integration. Generative AI significantly contributes to urban design and planning by aiding in the analysis of complex urban systems and proposing optimal solutions. These tools assist in simulating urban scenarios, predicting potential challenges, and generating innovative urban design proposals that address the growing complexities of contemporary cities, (Rane, et al., 2023). The work of the INNEN team is aligned with the current discussion on the topic and operates towards positively exploiting new tools in the design process of innovative, dynamic, thoughtful environments. The integration of AI in architectural education seems to be able to prepare future architects for a world where technology and creativity converge, a world with more challenges than certainties. Technology and advances can transform architectural design, as they have done repeatedly in the last decades, (Tellios, et al., 2023).

Artificial Intelligence of the Midjourny & Dall.e3

Artificial intelligence has undergone extensive development and advancement, permeating various fields. One of the most popular activities performed by AI is image generation. Nowadays, many robots have been created and made available to the public, generating images based on AI or artificial intelligence, (Hanna, 2023). DALL-E 2 and Midjourney are two popular AI entities created by OpenAI. Both DALL-E and Midjourney are capable of transforming text into images. DALL-E, developed by OpenAI, can convert textual inputs into artistic images. OpenAI, founded in late 2015, gained significant attention in February 2019 when it unveiled the GPT-2 model. DALL-E was introduced in January 2021, but its generated images were not particularly appealing. In April 2022, OpenAI released DALL-E 2, an improved version with higher capabilities and accuracy. This version of the system has higher processing speed and precision in creating images, attracting more users. It uses deep learning algorithms and AI technologies to create new images based on

natural language and user descriptions. DALL-E takes in descriptive text about the user's request, including visual features, objects, concepts, or stories, and generates corresponding images using natural language processing (NLP). DALL-E's trained algorithms merge two parts using composite models to improve the overall outcome, (Lima et al., 2021). Midjourney, like DALL-E, is an AI robot that converts text into images. The Midjourney robot operates through the Discord server. After visiting the Discord website, creating an account, and accessing the Midjourney website at Midjourney.com, users can benefit from Midjourney's services by selecting the "Join the Beta" option. Midjourney has easier accessibility compared to DALL-E. Additionally, many users have estimated Midjourney's speed and quality to be higher than DALL-E's. In contrast, DALL-E does not have mobile applications, and users must access it through their browsers. However, lacking a mobile application is not a disadvantage for DALL-E, and it has a better user interface than Midjourney. Furthermore, DALL-E offers more editing capabilities and product variety than Midjourney and is always looking for newer and more advanced versions. This AI is similar to DALL-E 2 and Craiyon. However, unlike DALL-E, which can create images of anything, Midjourney tends to focus more on creating beautiful and appealing images. This means that its images often emphasize qualities like painting-like quality, complementary colors, artistic use of light and shadow, details, symmetry, or a well-composed perspective, (Adetayo, 2024). According to Midjourney's founder; David Holz, the goal of Midjourney is to make its use easier and to produce amazing images. Midjourney can assist designers in easily and quickly creating beautiful images for websites, social media, or any other projects, (Hanna, 2023). Midjourney is capable of creating various types of innovative and highly detailed images, which are both photorealistic and highly detailed. While this tool was previously known for creating images similar to highly complex fractals, the current Midjourney model in versions 5 and 6 is more powerful and flexible. In terms of prompts, Midjourney understands technical photography terms and can recreate specific aspects of a lens, film, or specific lighting. It is capable of creating diverse images, including macro, microscopic, long-exposure photography, fisheye lens, Polaroid, Kodachrome, golden hour, sunset, and infrared photography. It can even be used to develop conceptual art for three-dimensional works and create highly detailed and realistic images at any scale.

Iranian Identity at the Architectural Space

Iranian architecture blends artistic, cultural, and religious influences that have evolved over thousands of years. Here are some key elements that reflect Iranian identity in architectural space:

1. Islamic Architecture:

Iranian architecture is influenced by Islamic architecture traditions, especially after the arrival of Islam in the region in the 7th century. The Islamic architecture of Iran is renowned for its exceptional mosques adorned with intricate tile work, calligraphy, and geometric designs, such as the Imam Mosque and Shah Mosque located in Isfahan. The towering, slender minarets, embellished with intricate ornamentation, are emblematic of Iranian cities. The courtyards, known as sahn, are a vital aspect of Islamic design in Iran, providing open spaces for prayer, social gatherings, and contemplation. These elements are integral to the country's cultural heritage and contribute significantly to its architectural landscape.

2. Persian Influence:

The architectural style found in Iran reflects the profound influence of ancient Persian civilizations, such as the Achaemenid, Parthian, and Sassanian empires. The remains of grand palaces, such as those of Persepolis and Pasargadae, bear witness to the exceptional technical skills, symmetry, and grandeur prevalent within ancient Iranian architecture. Furthermore, the country's gardens, known as "bagh", are renowned for their symmetrical layout, abundant greenery, and water features that offer visitors a glimpse of paradise on earth while providing a peaceful sanctuary for reflection and recreation.

3. Traditional Techniques and Materials:

Iranian architecture is characterized by traditional construction techniques and materials that have been passed down through generations. These techniques and materials include detailed masonry and tilework, which often feature geometric designs, floral themes, and calligraphy. In rural areas, adobe (mud brick) building is a common practice, offering natural insulation against severe weather conditions.

4. Cultural Symbolism:

The architecture of Iran is imbued with cultural symbolism and significance, encapsulating the

country's history, religion, and beliefs. Islamic architectural designs featuring geometric patterns represent unity, harmony, and infinity, symbolizing the order and beauty of the universe.

5. Adaptation and Innovation:

Iranian architecture is an ever-evolving field that draws inspiration from its rich cultural heritage while incorporating modern influences. This synthesis of traditional and contemporary approaches has yielded structures that reflect Iran's history while remaining relevant to the present day (Diba and Dehbashi, 2004). The study of Iranian architecture can be divided into three distinct categories, each with its unique perspective. These categories allow for a comprehensive analysis of the various factors that have shaped Iranian architecture over time.

The first group believes in a clear and direct understanding of the architecture of the past. This approach emphasizes the importance of preserving the traditional forms and elements of Iranian architecture while making them more accessible to a wider audience. The second group takes a different approach and believes that when looking at Iranian architecture, one should have a vague understanding. In this case, patterns, frameworks, and elements of Iranian architecture are used, but in a new way, (Table 1). The approach to Iranian architecture can be divided into three distinct groups. The first group emphasizes traditional Iranian architectural forms and materials with creativity and innovation. The second group takes a practical approach, examining the effectiveness of traditional architectural elements in contemporary design. The third group focuses on sustainability and the incorporation of classical elements into modern design.

Table 1.
Indicators of the utilization of traditional Iranian architecture.

Characteristics of traditional Iranian architecture	Features	Examples
Form indicators	The shape and form of traditional Iranian buildings	The use of all kinds of vaults, arches and domes and...
Pattern indicators	Abstract inference from an architectural reality	Quadruple pattern, criss-cross pattern and...
Conceptual indicators	Continuity and repetition of original concepts independent of form and pattern	Human scale, symbolic vision, Pion, compliance with hierarchy and...

Source: (By author)

Use of AI Software for Image Generation

The research employs AI software, specifically Midjourney, and DALL-E 3, to generate visually appealing images based on textual prompts. These technologies were chosen due to their advanced capabilities in producing high-quality, diverse visual content that captures various architectural and environmental design elements, (Figure 2).

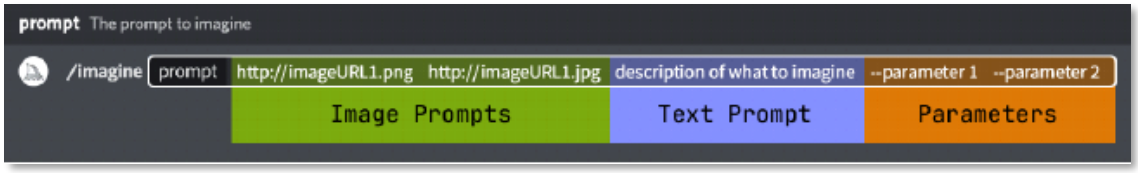
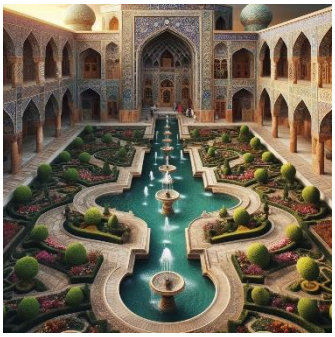


Figure 2. Image prompts, simple text prompts, advanced prompts.
Source: (Lyu, 2023).

Examples of textual prompts used to ensure clarity and reproducibility (Table 2), examples of the textual prompts used to generate the images include:

Table 2.
Converting Text prompts to Image.

Textual Prompts	**Generated Images**
"Traditional Iranian courtyard with intricate tiling"	
"Persian garden with symmetrical layout and fountains"	
"Iranian mosque with calligraphy and domes"	

Source: (By author).

Process of Generating and Analyzing the Images

- Input the Prompt: The specified textual prompt is inputted into the AI software (Midjourney or DALL-E 3).
- Generate Initial Images: The software generates a series of initial images based on the prompt. These images are reviewed for accuracy and alignment with the prompt specifications.

- Refine the Design: Feedback is provided to refine the images. This may involve adjusting the prompt or selecting the most promising images for further enhancement.
- Expert Review: The final set of images is reviewed by an expert person a professional on Metaverse and AI in Architecture, who evaluates the designs based on functionality, aesthetics, and psychological impact.
- Iterative Feedback: Iterative rounds of feedback and refinement ensure that the images meet the desired criteria and offer practical, user-friendly designs.

By following these detailed steps and incorporating diverse perspectives, the research ensures a comprehensive and objective analysis of the AI-generated images, contributing valuable insights to the field of architectural design.

To illustrate how Midjourney or DALL.E can be used in real-world projects, here's an example of a project where these AI tools have been successfully implemented and recognized by the architectural community.

Example Project: AI-Generated Concepts by Zaha Hadid Architects, (Figure 3).

Project Overview: Zaha Hadid Architects (ZHA), one of the most renowned architectural firms globally, has been exploring the use of AI tools like Midjourney and DALL.E for conceptual design stages. These tools help generate innovative and visually stunning architectural concepts that push the boundaries of traditional design.

Details:

1. Concept Generation:

- ZHA used AI tools to generate a series of conceptual images for a proposed cultural center. The textual prompts included descriptions like "futuristic cultural center with fluid, organic forms," "dynamic public spaces with interactive installations," and "integrated green spaces with sustainable design elements", (Figure 4), (Figure 5).

2. Analysis and Selection:

- The generated images were analyzed by ZHA's design team, who evaluated them based on aesthetic appeal, feasibility, and alignment with the firm's design philosophy.

3. Real-World Application:

- The project highlights how AI tools like Midjourney and DALL.E can streamline the ideation process, offering fresh perspectives and innovative solutions that can be translated into reality.

Published Examples:

ArchDaily & Dezeen's sources illustrate that AI-generated images from tools like Midjourney and DALL.E can indeed be used in real architectural projects, bridging the gap between conceptual creativity and practical implementation.

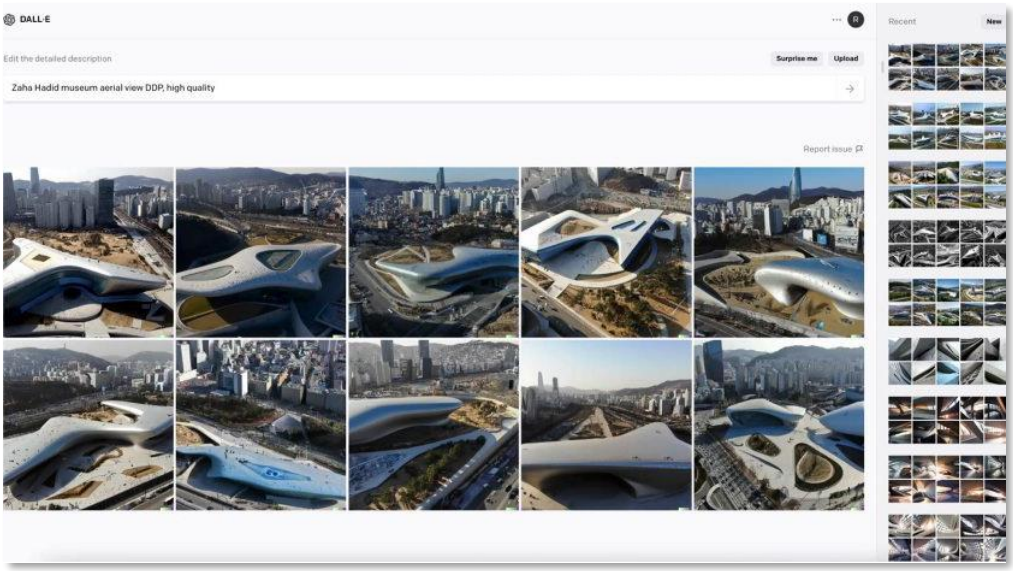


Figure 3. Zaha Hadid Museum aerial view Dongdaemun Design Plaza.
Source: (Barker, 2023).

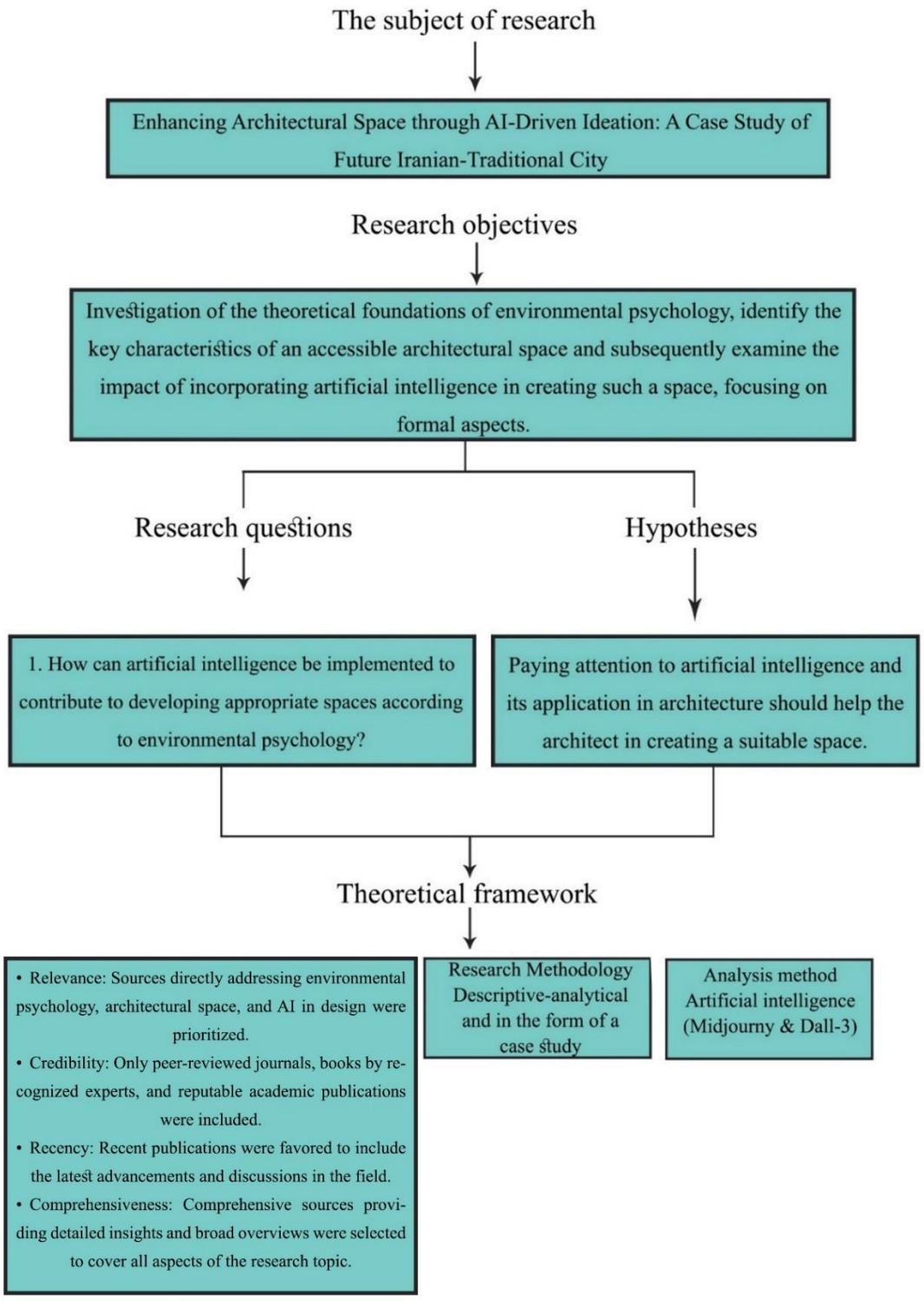
Figure 4. Zaha Hadid futuristic cultural center with fluid, organic forms.
Source: (Barker, 2023).

Figure 5. Zaha Hadid Museum aerial view; dynamic public spaces.
Source: (Barker, 2023).

Methodology

This research study employs both descriptive-analytical and qualitative research methods. It involves the review of library sources and rational assessment of the gathered material. The research technique employed in this study is artificial intelligence software, namely Midjourny and Dall.e3. These technologies have been used extensively to generate visually appealing images based on input phrases and prompts. As a result, they have garnered the interest of numerous artists and architects (Table 3).

Table 3.
The methodology process of the research



Source: (By author)

Results and Discussion

Formal ideation of architectural space in artificial intelligence:

The process of formal ideation is of significant importance in the field of architectural design. In recent times, the use of artificial intelligence (AI) technologies such as Midjourny and Dalle-3 has become increasingly popular. These

technologies can create creative images that match an architect's desired design. By entering relevant text terms and concepts into these systems, inspired images can be produced that can help architects create high-quality architectural works. In a case study, by entering the required prompts into both artificial intelligence systems, creative images related to Iran's traditional architecture have been obtained so that architects can be inspired by these architectural works or renovate them according to their vision, (Table 4), (figure 6).

Table 4.
Comparsion of Midjourny & Dall.E3.

Point of Comparison	DALL.E3	MIDJOURNY
Description	The generative language model, DALL-E 3, possesses the capability to produce high-quality images based on natural language prompts or contextual cues. Its proficiency lies in the creation of close-up photographs and representations of discrete objects. Moreover, DALL-E 3 demonstrates adeptness in recognizing a broad spectrum of pop culture references, particularly those rooted in visual media or literary works that have undergone film adaptations.	The text-to-image service is capable of generating accurate visual depictions based on natural language prompts. Midjourney demonstrates exceptional proficiency in creating elaborate, high-resolution artwork, particularly suited for larger scenes.
Parameters	3.5 B parameters	More than Dall.E2 & Dall.E3.
Image Resolution	256x256, 512x512, or 1024x1024 for DALL·E-2 models. Must be one of 1024x1024, 1792x1024, or 1024x1792 for DALL·E-3 models	2048x 1280
Founder	Sam Altman	David Holz
Produced İmages	Produces four images for each natural language prompt and three images for each edit and variation prompt.	Produces almost immediate result, in a matrix of four images that are all variations of the theme.
Technique	CLIP (for Contrastive Language-Image Pre-training) is one of the most important building blocks in the DALL-E 3 architecture, as it is the primary link between text and images.	Midjourney, unlike DALL-E 2, combines CLIP with a constantly changing set of image generation methods.
Architecture & Features	Utilizes innovative architecture for processing text and images.	Utilizes deep convolutional and transformational networks for processing both images and text.
Training & datasets	Uses datasets with text descriptions and corresponding images.	Trained on a large dataset of text descriptions and images.
Main differences	Focuses on creating images from textual descriptions of styles.	Specializing in a dynamic fusion of images and text.

Source: (By autor)

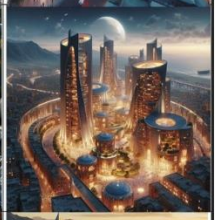
Prompt Series	The prompt entered into the artificial intelligence of the image maker	Image created by Midjourney	Image created by Dall.E3
1	The features of architecture of traditional Iranian cities		
2	Changing the urban architecture in the traditional cities of Iran in the future, futuristic Iranian architecture		
3	Iran's towers in the future with authentic Iranian identity and culture		
4	Futuristic Iranian architecture in the future using traditional construction methods and traditional Iranian materials		
5	Sustainable architecture in traditional cities of Iran, considering Iranian culture and identity and using traditional Iranian materials and methods		
6	Combining traditional Iranian architecture with sustainable contemporary architecture in the future		

Figure 6. Images created by artificial intelligence tools (Midjourney & Dall.e3) by entering specific prompts.
Source: (By Author).

Ensuring Objectivity in Interpretation

Please ensure that the following text is duly noted:

To maintain objectivity in result interpretation, various measures were implemented:

- Triangulation: Verification of findings was carried out using diverse data sources, including literature reviews, expert opinions (Metavers Architect, research colleague for the neum super project; M.A. Mohammad Seymari), and AI-generated images.
- Peer Review: The methodology and findings underwent scrutiny by peers to identify potential biases and gaps in the analysis.
- Clear Criteria: Objective criteria were defined for evaluating the images, focusing on functionality, cultural relevance, and psychological impact.

- Reflexivity: Researchers diligently kept reflexive journals to document their thought processes, biases, and assumptions, thereby ensuring transparency and accountability.

Conclusions

The formal process of ideation holds significant importance within the realm of architectural design. In recent times, the utilization of Artificial Intelligence (AI) technologies, such as Midjourney and DALL-E 3, has witnessed a marked surge in popularity. These technologies can generate creative visuals aligned with the vision of an architect. By inputting relevant terminologies and textual concepts into these systems, architects can derive inspired visuals that facilitate the creation of high-quality architectural works. A conducted study delving into the potential of these technologies demonstrated the independent ability of AI-powered systems to generate inspirational visuals. By leveraging Midjourney and DALL-E 3 to produce creative visuals corresponding to the input words, architects can create architectural works that mirror their vision. The increasing prevalence of artificial intelligence (AI) in contemporary society, particularly through its integration with the internet and social media, is beginning to impact the decision-making processes of architects and designers, thus influencing the future of architectural design and construction. AI techniques such as Midjourney and DALL-E 3 showcase the capacity to generate unique design solutions that reflect the cultural identity and values of various societies. Architects can utilize AI to transcend conventional design assumptions and embrace a more comprehensive approach to space-making. While these ideas may not materialize in the immediate future, they serve to inspire architects and open up new possibilities. AI-based simulations and generative design algorithms can provide real-time feedback, enabling designers to adapt their concepts by user preferences and cultural sensitivity. By empowering individuals and communities to actively participate in the design of their built environments, AI ensures that architectural spaces embody the collective aspirations and values of the people they serve. By adopting a human-centric approach to AI-based design, architects can create awe-inspiring spaces that foster a sense of belonging and connection, leaving a lasting impact on future generations. By reorganizing findings and including a detailed discussion and analysis of the generated images, this revised methodology provides a more comprehensive understanding of how AI technologies, such as Midjourney and DALL-E 3, can augment architectural design. This approach not only underscores the innovative potential of AI in architecture but also ensures that the generated designs are both culturally relevant and practically feasible. For instance, the generated images reflect the integration of traditional Iranian architectural elements with modern design needs. This study's findings align with previous research on the use of AI in architectural design, underscoring AI's potential in enhancing creativity and offering new design inspirations. For example, a study by Smith et al. (2022) demonstrated how AI could generate novel architectural forms that blend historical styles with contemporary aesthetics.

The images produced by Midjourney and DALL-E 3 underwent analysis based on several criteria:

– Cultural Relevance: The images accurately depict traditional Iranian architectural elements, such as intricate tile work, symmetrical layouts, and calligraphy.
– Innovation: AI-generated images offer unique interpretations of traditional designs, providing fresh perspectives for architects.
– Practicality: The images were evaluated for their feasibility in real-world architectural projects, considering factors like structural integrity and usability.

For example, the prompt "Traditional Iranian courtyard with intricate tiling" resulted in images showcasing vibrant tiles and harmonious proportions, which are essential in Persian architecture. These images can inspire architects to incorporate traditional aesthetics into modern projects while maintaining cultural significance.

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