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Implementing an Artificial Intelligence Language Model (Midjourney Prompt) to Explore the Objective and Subjective Patterns in Architectural Design Based on the Behavioral Science Data

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Abstract

In recent decades, with the advancement and expansion of knowledge in behavioral sciences and technology, new opportunities have emerged for architects and architectural design. The design of objective and subjective patterns, as one of the most basic physical and mental needs of humans, has long directly impacted the quality of people's lives. In this regard, understanding human behaviors, needs, and interactions in a design, especially with the influence and attention to the characteristics of behavioral sciences, can help create more efficient, human-centered, and harmonious environments with people's daily lives. On the other hand, the emergence of artificial intelligence as a powerful tool in data analysis and providing creative suggestions and solutions has opened new horizons in the architectural design process. Combining data from behavioral sciences with the capabilities of artificial intelligence enables the definition of design patterns in a way that can meet the diverse needs of each individual and, at the same time, improve and enhance sustainability, flexibility, and aesthetics in design thinking and architecture. In this article, The research method in the present article is qualitative, conducted through the examination of documents related to behavioral sciences in order to generate objective and subjective patterns by means of an artificial intelligence language model (Midjourney Prompt) via trial and error by examining objective and subjective approaches not only based on traditional criteria but also using the analysis of behavioral science data and their intelligent processing with the help of artificial intelligence language models, the existing potentials in architectural design have been identified and exploited. The main goal of this research is to improve the architectural design process by promoting a better physical and mental human experience in spaces.

Keywords

Artificial Intelligence, Objective Components, Subjective Patterns, Behavioral Science Data, Midjourney Prompt.

Introduction

In recent decades, with the advancement and expansion of knowledge in behavioral sciences and technology, new opportunities have emerged for architects and architectural design. The design of form and space, as one of the most fundamental human needs, has long directly impacted the quality of people's lives. In this regard, understanding human behaviors, needs, and interactions in a design, especially with the influence and attention to the characteristics of behavioral sciences, can help create more efficient, human-centered, and harmonious environments with people's daily lives. On the other hand, the emergence of artificial intelligence as a powerful tool in data analysis and providing creative suggestions and solutions has opened new horizons in the architectural design process. Combining data from behavioral sciences with the capabilities of artificial intelligence enables the definition of objective and subjective patterns in a way that can meet the diverse needs of each individual and, at the same time, improve and enhance sustainability, flexibility, and aesthetics in design and architecture. Research on the process of architectural development in cities of Iran shows that this process has been accompanied by crises in quality and chaotic conditions. These crises are mainly caused by urban development policies and socio-demographic changes, cultural attitudes, and increasing demands of the design market (Rafieian et al., 2010). On the one hand, the increase in one-dimensional and quantity-oriented approaches in the development of environments as a response to the immediate needs of people for space has limited attention to the basic qualities of designed environments. This lack of attention to environmental qualities over time leads to conscious or unconscious dissatisfaction with architectural spaces. On the other hand, quality has become a relative and multi-dimensional concept, which makes it complex to identify its components for improving architectural environments (Golkar, 2001). Environmental psychology, as an interdisciplinary branch of psychology, analyzes human behavior in interaction with the environment and shows how environmental characteristics affect human perception, cognition, and emotions. As a result, paying attention to the quality of spaces from the perspective of environmental psychology can be the key to resolving the quality crises in these environments (Babazadeh et al., 2019). Alongside these developments, the introduction of new technologies, such as artificial intelligence, into the field of architecture and the design of residential environments has provided new potential for improving the quality of these spaces. Artificial intelligence, as a technology that can learn and solve problems in a human-like manner, can play an effective role in the analysis, design, and optimization of spaces (Xu et al., 2021). By providing the possibility of simulating and analyzing human behavior in different environments, this technology can help design environments with higher quality and meet the psychological needs of users (Lund et al., 2023).

Therefore, it is essential to pay attention to the issue of how artificial intelligence can play a role in improving the quality of residential environments and resolving quality crises. In the digital age, advanced tools and new technologies provide architects with a wide range of approaches, which has led to more complexities in the architectural design process. In this context, we are faced with rich potential that can significantly improve the quality and efficiency of architectural designs. The entry of technology into the architectural design process, while creating new challenges, has also brought hopes that have created new trends in this field (Rahbar et al., 2020). Using artificial intelligence, architects will be able to perform various activities, including analysis and management of scheduling, budget, performance estimation, construction, and parametric architecture, as well as planning smart cities with higher speed, accuracy, and efficiency while significantly reducing project costs and time (Nejati et al., 2021). The application of artificial intelligence in architecture, the expansion of the use of computer-aided design software, the rapid growth of fab labs (architectural laboratories), and the use of construction robots have made it possible to create new and innovative forms in architecture. These developments have not only allowed designers to visualize their ideas more easily but have also led to the creation of new criteria and values in architectural aesthetics (Golpasha, 2020). According to Chaillou (2019), artificial intelligence will soon provide extensive capabilities for architects to carry out their daily tasks, and all these changes will contribute to improving design outcomes. Important findings show that artificial intelligence can identify connections that humans may spend a lot of time finding or may not be able to achieve at all (Krausková & Pifko, 2021).

Given these developments, architects can now personalize their desired algorithms based on their design needs to achieve more accurate and tailored results. Although the potentials of artificial intelligence in architecture are almost guaranteed, the success of this technology depends on the ability of architects to properly train machines and turn them into reliable assistants (Eris et al., 2021). Currently, some architects use computer-processed data to create their architectural designs, but many architects still use old and time-consuming methods (Nejati et al., 2021).

This article aims to identify and exploit the existing potentials in architectural objective and subjective patterns by examining approaches that design form and space not only based on traditional criteria but also using the analysis of behavioral science data and their intelligent processing with the help of artificial intelligence language models. The main goal of this research is to improve the architectural design process of objective and subjective patterns and enhance the human experience in spaces. In behavioral sciences and architecture, built environments have a profound impact on human experience and perception. These impacts can be examined from two perspectives: objective and subjective components. Objective components include the measurable and physical characteristics of a space, while subjective components relate to users' perceptions, emotions, and psychological responses to the environment. The interaction between these two categories plays a fundamental role in shaping human behavior and the quality of spatial experience.

The main goal is to define the pattern of objective and subjective components design based on behavioral science data in architecture using an artificial intelligence language model.

- Secondary objectives are:

Identifying and examining different patterns of objective and subjective design in architecture.

Analyzing and interpreting the indicators of behavioral sciences from a qualitative perspective in design thinking.

Developing an artificial intelligence language model concerning subjective and objective components to improve design thinking.

The main question is, *How can objective and subjective design patterns based on behavioral science data in residential architecture be defined by utilizing an artificial intelligence language model?*

- Secondary questions are:

What are the patterns of objective and subjective components?

What are the qualitative indicators of behavioral sciences in residential architecture?

How can an artificial intelligence language model based on objective and subjective components be developed?

Literature Review

Studies show that architectural development and design in Iran have faced crises in the quality of spaces, which are caused by quantity-oriented development policies and demographic changes. In addition, environmental psychology has studied the effects of space on human behavior, and artificial intelligence, with its data processing capabilities, can help improve the design and quality of residential spaces. This technology allows architects to design spaces that meet the psychological needs of users.

Until the last two years, due to the novelty of this technology, not much research has been done on artificial intelligence and its language model and how to connect with it. The present article deals with the analytical branch (including architectural, economic, cultural, etc.). In general, this research deals with the objective and subjective patterns design in architecture, and behavioral sciences, and the introduction and analysis of the new technology of artificial intelligence.

Here is the list of some important research in Iran, Hossein Pour Behnamiri (2023), in his article *Investigating the Impact of the Advancement of Artificial Intelligence in Architectural Design*, states that with the advancement of AI, it is expected that this technology will be increasingly used in architecture and will lead to the creation of more efficient, sustainable, and creative buildings. AI is capable of being used in all stages of architectural design and construction, from data analysis to creative design and automated construction. By accurately and quickly processing data, this technology helps architects to better identify the needs of users and intelligently evaluate the strengths and weaknesses of designs. Ceylan (2024), in his article *Artificial Intelligence in Architecture: An Educational Perspective*, The undeniable connection between artificial intelligence (AI) and architecture proves that this technology has a lot of potential to offer in this field. AI can be used in different stages of the design and construction process to create new opportunities. Although the emergence of this technology is in its early stages, its initial results are promising. Currently, AI is mainly able to understand and process data, allowing architects to use it to optimize designs and create improved spaces.

Table 1: *Studies related to implementing an artificial intelligence language model (Prompt) to explore the objective and subjective patterns in architecture based on the data in behavioural sciences in the last two years.*

Author(s)	Title	Abstract
Almaz et al., 2024	The Future Role of Artificial Intelligence (AI) Design's Integration into Architectural and Interior Design Education	Artificial intelligence (AI) is transforming architectural design through several key integrations. First, AI-powered generative algorithms create adaptable and optimized designs. Second, AI analyzes aesthetics to produce visually appealing structures. Third, AI enhances Building Information Modeling (BIM) for efficient project coordination. Ultimately, AI revolutionizes architecture by enabling creative, cost-effective, and time-efficient design and construction.
Sourek, 2024	Artificial Intelligence in Architecture and Built Environment Development	AI is rapidly transforming architecture, enabling innovative design through generative tools, data analysis, and process optimization. Architects can now create complex forms, designs aligned with user needs, and optimized structures. AI opens new creative avenues, pushing architectural excellence to unprecedented levels.
Hosseinbar, 2023	Analyzing the Capabilities and Limitations of Generative AI Design Algorithms in Architecture	Genetic algorithms (GAs) are used to accelerate design team decision-making by rapidly generating information, not to fully automate the design process. They minimize initial errors and quickly adapt to design changes. Future GA advancements promise automated form-finding for diverse architectural projects through parametric input manipulation.
Mohammadzadeh et al., 2023	Analysis of Factors Affecting the Improvement of Environmental Quality in Residential Complexes (Case Study: Vahdat Beton Complex in Sadra City)	The first observation in examining residential environments in contemporary Iranian architecture is that achieving higher-quality residential environments is a necessity. This is because, today, in the design and construction of residential complexes, more focus has been placed on quantitative issues such as space dimensions and standards, as well as demographic and economic factors, while matters related to quality have been overlooked.

Shahcheraghi and Bandar Abad (2015) argue in the book *Contained in the Environment* that humans, as beings who are placed in the environment, are always in interaction with it. On the one hand, we shape our environment and change it according to our needs and desires. On the other hand, the environment also has a profound impact on our psyche and emotions and directly shapes our behavior and perception. This reciprocal interaction between humans and the environment, especially in the context of architecture and the design of living spaces, can have major effects on the quality of individual and collective living experiences. Ching (2008), in his book *Architecture: Form, Space, and Order*, deals with learning the basic concepts of architectural design by examining and researching how form and space are organized in a building and showing the relationships between the main elements of architecture. Eslami Mojaveri et al. (2021) conclude in their article entitled *Formulating a Theoretical Framework for Utilizing Behavioral Science Studies in the Architectural and Urban Design Process to Achieve Desirable Physical Characteristics in a Specific Society* that it is possible to analyze recurring behavioral patterns at different times by studying and questioning the relationship between body and behavior, and by utilizing cultural, social, economic and other capacities.

In this analysis, criteria such as privacy, defensibility, spatial diversity, legibility, capacity to accept activities, and control views can be helpful. Using examples of built environments and according to the specific needs of the community, these features can be used in environmental design and help to improve the quality of residential and public spaces in the desired scale.

Theoretical Foundations

When a person observes something for the first time without having any knowledge of it, a specific mentality is created in their mind. They combine this mentality with their previous experiences to reach a specific feeling about that thing; in other words, we always first go from objectivity to subjectivity and from subjectivity to feeling. When we see a shape, a specific thought is formed in our mind. We analyze this shape in our minds and compare it with the existing basic shapes. This perception creates subjectivity. In general, subjectivity must always be created for the understanding of form to take shape, which this subjectivity gives us a feeling about that shape. The perception that we have of anything is not only the result of receiving and analyzing by the sensory organs; three other important factors also play a fundamental role in this process:

1. The person's mental state at that moment and the atmosphere of the environment at the time of perception.

2. The personal temperament, which is something shaped and formed from all the experiences of the person's past events.

3. Hereditary factors and socio-psychological background, i.e., factors that have arisen neither through learning nor through experience (Shatarian, 2010).

Understanding the meaning of quality is difficult due to its widespread use in various disciplines and its pluralistic and multifaceted nature. Quality is a two-sided concept, meaning it is a *clear and obvious* concept and, at the same time, *ambiguous* and a *comprehensible* concept, yet *elusive* that cannot be easily defined (Golkar, 2001). Quality can be defined in general and specific semantic areas. The semantic commonality of the set of definitions obtained from the general semantic domain shows that quality, on the one hand, relates to the basic characteristics, special attributes, inherent characteristics, and features of anything, whether it is an object, a feeling, or a situation, and on the other hand, it makes something distinguishable from other types and provides relative criteria for evaluating and judging the degree of goodness and superiority of things (Pakzad, 2002; Moeini & Islami, 2012). In the specific semantic domain, three approaches can be sought to the concept of quality: objectivist, subjectivist, and interactionist. In the objectivist approach, value is an attribute that exists in an object or action. In this view, the quality of each phenomenon is considered an inherent attribute and characteristic that is reflected in the phenomena themselves and is not dependent on the feelings or inclinations of individuals (Shariatmadari, 1994). Billings (1993) consider qualities related to the realm of objectivity and believes that this type of quality is measurable.

Considering this issue, the criteria for introducing the quality of the man-made environment in this approach are limited to the formal characteristics of the building members and the spatial relationships existing in it. In the subjectivist approach, the *quality of phenomena* is constructed by the observer and is based on their ideological positions regarding the nature of the universe (Juran, 1989). Considering this issue, the components introducing the quality of the man-made environment in this approach are limited to the mental images of the users based on the meanings received from the environment. In the interactionist approach, the external object and the person, in an interactive relationship with each other, are involved in shaping values. In this view, these two factors interact with each other in a specific context or situation, and it is in this context that the object and the person affect each other. As a result of this influence and mutual relationship, values are formed in an internal relationship with the object and the person. As a result, considering something as valuable by any person depends on two basic conditions: first, that the thing has definite characteristics, and second, that the thing comes into the person's experience (Moeini, 2011; Lynch, 1995).

Humans each have their own psychological, physical, cultural, and personal characteristics, but at the same time, like a container that takes the shape of a vessel, they are influenced by their living environment. It can be said that environmental psychology is the science and study of the mutual effects of humans and the environment on each other. Robert Gifford says: *Environmental psychology is the study of the mutual influences between a person and their physical setting*. Based on this belief, in such a mutual influence, both the individual changes the environment, and their behaviors and experiences are changed by the environment. It should also be added that the use of the concept of physical setting indicates that in environmental psychology studies, the human is considered one of the factors forming the environment. In a more precise definition of environmental psychology, some researchers introduce it as *the study of human behavior about the physical and social environment* (Shahcheraghi & Bandarabad, 2015). The discussion of behavioral sciences is divided into two main parts: human behavior and the fundamental concepts of the environment. The fundamental issue in understanding the role of the built environment in human life is understanding what the meaning of the environment is. The surrounding space is the main criterion for defining the environment (Gibson, 1966).

Therefore, any definition or explanation of the nature of the environment's function must be related to something in the surrounding space. This category includes spatial cognition, which helps us in orienting the environment, and non-spatial cognition, which includes memories and mental models. The extent of influence and influence in the category of behavior and environment is also expressed in the form of specific theories. In the view of environmental determinism, the environment has a decisive role in human behavior, perception, and feelings. In this view, each stimulus creates a specific response. In such a view, the environment mainly means climatic and geographical conditions, although it can be generalized to the artificial environment as well. The view of environmental affordance considers the physical environment as a platform that creates possibilities and limitations for behavior, but the environment does not determine the behavior but merely provides the possibility of the occurrence of some behaviors or creates limitations for the occurrence of some other behaviors. In this view, it is the environment that affects human behavior. In the probabilistic view, while people can have different behaviors in an environment and give importance to individual motivations, it considers the design features and factors of the artificial environment important in the probability of the occurrence of specific behaviors. In environmental psychology studies, the human is considered one of the factors forming the environment because it is assumed that human behavior and experiences cannot be studied without considering the environmental conditions separately. That is, research on behavior, without considering the environment in which the behavior occurs, is incomplete (Mortezavi, 2001).

In the 16th century AD, a new definition of the word environment became common, which meant *a collection of natural and artificial things*. *This definition is close to the current definition of this word in the Oxford Dictionary, in which it includes all living things and explains that the environment means a situation under which any individual or anything grows*; of course, the meaning and content of the concept and nature of the environment vary from the perspective of different researchers. For example, Lewin considers the environment as part of a person's living space and speaks of an environment that has been experienced by the person (personal environment). At the same time, Barker means by environment, an environment that exists objectively (Shahcheraghi & Bandarabad, 2015).

To understand the concept of environment, we will express several theories put forward in this regard.

Gestalt Theory: The physical environment includes terrestrial and geographical locations, the social environment includes institutions made up of individuals and groups, the psychological environment includes people's mental images, and the behavioral environment is a set of factors to which a person reacts.

Kafka's Theory: The geographical environment is called the objective environment, and the realities around human beings, and the behavioral environment is the cognitive image of the objective environment that shapes behavior. According to the framework of these theories, the environment is a series of relationships between objects with objects, objects with humans, and humans with humans.

Based on this, the environment has three basic components: the natural environment, the man-made environment, and the environment of social interactions (Shahcheraghi & Bandarabad, 2015). The way an activity is performed is called behavior.

Human behavior is the result of a person's motivations and needs, the capabilities of the environment, the person's mental images of the outside world that are caused by his perception, and the meaning that this image has for him (Lang, 2009). On the other hand, it should be noted that the major part of human social behavior is the result of the interaction of cultural-environmental and biological factors (Altman, 1975). Behavior is the most objective and observable human reaction to the environment in which he is located; in such a way that a person can only use the behavior he shows in the environment, without using words, from the nature of behavior as a non-verbal tool to send a message or create communication with others (Shahcheraghi & Bandarabad, 2015). Behavior is a function of the characteristics of the living space. In other words, behavior is a function of the interaction of personality and environmental dimensions. In this theory, the intended environment is the one that is affected by psychological factors and not the environment that exists objectively (Mortezavi, 2001). Human behavior has direction and purpose. Behavioral science specialists use concepts such as motivation or need to describe the purposefulness of behavior. The behavior of choosing a goal is influenced by environmental-cultural conditions, and such a process causes diversity in human behavior (Mortezavi, 2001).

The findings that have been obtained so far in this field have introduced the main factors shaping behavior in the form of three areas:
1. Physiological behavior
2. Social behavior
3. Environmental behavior (Shahcheraghi & Bandarabad, 2015).

Objective components consist of tangible and physical features of the environment that influence user behavior and experience. These components include:

- Spatial Dimensions and Scale: The size and proportions of a space affect users' sense of comfort or confinement.
- Lighting: The amount and quality of both natural and artificial light impact visual perception, mood, and cognitive performance.
- Colors and Materials: Colors and textures influence emotional responses and engagement with the space.
- Layout and Spatial Organization: The arrangement of spatial elements affects social interactions, movement, and accessibility.

Subjective components refer to how individuals process environmental information and form emotions and perceptions. These components include:

- Aesthetic Perception: The visual appeal of spaces enhances feelings of satisfaction, relaxation, and even inspiration.
- Sense of Belonging and Spatial Identity: Environments that align with users' needs and values strengthen their sense of attachment to a place.
- Environmental Memory: Spaces are imprinted in people's minds based on past experiences and can influence future decision-making.
- Emotional Responses: Different environments evoke various emotions such as calmness, anxiety, excitement, or depression.

The relationship between objective and subjective components is crucial in spatial design. For example, an open and well-lit space can enhance feelings of freedom and tranquility, while a dark and enclosed environment may induce anxiety. Additionally, users' subjective perceptions can influence their experience of space; for instance, cultural background or personal memories may shape aesthetic appreciation.

Artificial intelligence is the intelligence of machines and also refers to a branch of computer science that aims to create such a level of intelligence for machines (Norving & Russell, 2018).

Sikorova defines artificial intelligence as a field of information technology that deals with the creation or application of machines and devices that have signs of intelligent behavior in them. In his view, the word artificial intelligence is equivalent to intelligent behavior, and a sufficient amount of study has not yet been done on this concept. Related books on this topic consider it as the study and design of intelligent tools, which, in this definition, an intelligent tool is a system that understands its environment and takes actions to maximize the chance of success (Luger & Stubblefield, 2004). McCarthy first used this word in 1956 and called it the science and engineering of building intelligent machines. Machine learning and deep learning are two fundamental elements of artificial intelligence. Some people sometimes use these two concepts interchangeably, but their nature and function are different. Machine learning is a process in which the data of an algorithm are fed into a computer with statistical methods. The goal of this action is to help the algorithm learn and gradually improve its performance. This algorithm is not necessarily programmed to perform a specific task, but through this mechanism, it can gradually learn the process of doing it. However, deep learning is a type of machine learning algorithm that executes its input data inspired by the patterns of the neural network of living organisms. These patterns are copied from biology. In a neural network, there are multiple layers (at least three layers). Each of these layers can be input or output. Their ultimate task is to process data at different levels. This mechanism allows the algorithm to learn the desired pattern more deeply (Esteki, 2023).

Artificial intelligence is a very broad and complex science that includes many branches, including expert systems, robotics, machine learning, neural networks, fuzzy logic, and natural language processing. As it is clear, the adoption of artificial intelligence in creative industries faces challenges. Some designers are concerned that artificial intelligence will replace human labor. Considering that the goal of artificial intelligence is to create machines or programs that are capable of guiding and learning, this concern is logical. However, most experts agree that artificial intelligence has the potential to make architecture easier, more efficient, more creative, and even safer. Computers are excellent at solving problems with clear answers. Crunching data and doing repetitive tasks frees up time for creativity and working on more open-ended problems than humans, and there is no shortage in architectural design. For this purpose, here are five ways that artificial intelligence is changing the field of architecture:

1. Achieving the optimal state of building efficiency

2. Virtual presence of users in the building before construction

3. Updating the construction process

4. Increasing security, optimizing, maintaining, and repairing buildings (Oberste-Ufert, 2020).

The tools available in the digital age provide architects with a wide range of approaches, and in other words, the growth of technology in practice has led to the complexity of the architectural design process. In this field, we see the possibility of rich results which complements our work. The entry of technology into the architectural design process has been challenging on the one hand and promising on the other hand (Rahbar et al., 2020). By using artificial intelligence, on the one hand, activities such as analysis and control of scheduling, budget, and billing, estimation and performance analysis, 3D printing technology, infrastructure construction, parametric architecture, construction and planning, and smart cities can be done with more speed and accuracy and less time and cost, and on the other hand, it is a threat to architecture-related jobs and the possibility of replacing them (Nejati et al., 2021).

Frank Gehry, as a pioneer in the use of computer technologies, was able to solve difficult geometric problems by using the capabilities of Catia, Cam, and Cad software. He fully uses digital technologies in all stages of building design (from design to construction), and their results after several decades show that new technology not only leads to the creation of innovative buildings with high technology, such as the Guggenheim Museum Bilbao but also leads to the creation of new jobs (Eris et al., 2021).

Artificial intelligence has penetrated most areas of architecture independently and has had some acceptable achievements.

Among the most important sub-branches of architecture in which artificial intelligence has made progress, and more research has been done, the following can be mentioned:

- Ideation
- Designing the plan, facade, form of the building, elements, and furniture
- Morphology and analysis of the plan

Improving Designer Performance with the help of many traditional computer-aided design tools that are used today are not able to meet the needs of contemporary architectural design (Radziszewski & Cudzik, 2018). The use of artificial intelligence in architecture, the expansion of the use of computer-aided design software, the rapid growth of fab-labs or the same architectural laboratories, and finally, the use of builder robots have made it possible to witness the emergence of new forms in architecture, which has led to the creation of new criteria and values in the aesthetics of architecture and allowed designers to draw and present their ideas much easier than in the past (Golpasha, 2020). The basic finding is that artificial intelligence can identify connections that humans search for a longer time or do not find at all (Krausková & Pifko, 2021).

We can code the required algorithm based on our design needs and problem-solve to achieve a personalized design that meets our needs. Although the potentials of artificial intelligence for architecture are almost guaranteed, it is still conditional on the abilities of designers how to teach their intentions to the machine so that it can serve as a reliable assistant for them (Aris et al., 2021). Currently, some architects also use past information and data processed by computers for their architecture, but many architects are still stuck in the past and follow time-consuming and inefficient processes (Nejati et al., 2021). With the entry of artificial intelligence and its use in the science of architecture, a new challenge has been created for architects, especially the veterans of the field of architecture. They have greatly changed the way we think, feel, act, and how we communicate and interact with each other (Nejati et al., 2021). Currently, the use of artificial intelligence in architectural designs is very small and not very efficient, and there is little experience that we can rely on (Krausková & Pifko, 2021). However, we can assume that artificial intelligence will be applicable in some areas and can be mentioned as an influential factor. Many software and algorithms have been introduced to solve complex problems in architecture and urban planning, in the field of evolutionary computation, genetic algorithms are the most widespread type of multi-criteria optimization methods. Therefore, they are becoming a topic of interest for artists, designers, and architects (Radziszewski & Cudzik, 2018).

If we look at it positively, it can be assumed that this profession, in some of the most innovative studies, is becoming closer to computer science, statistics, and science in general than architectural design (Paolillo et al., 2022). The speed of penetration of artificial intelligence into the field of architecture is beyond imagination, and recently, its speed has increased day by day. Artificial intelligence can potentially evolve as a creative designer and creator in the future, perhaps even stronger in the field of creativity, however, advanced automated machines can never create reasonable spaces that communicate with human understanding of a space, and this is what architecture is based on (Nidal, 2019). Currently, many parametric design software and algorithms help designers, but it can certainly be pointed out that, in general, according to their purpose, they improve the efficiency of a design process. However, in many cases, due to the need for evaluation, decision-making, and manual control of the designer at each level of the project, the result is the opposite (Radziszewski & Cudzik, 2018) and the effective presence of the architect and his architectural intelligence is strongly felt. The five stages that make up the architectural design thinking process are feeling, defining, ideation, prototyping, and testing (Vardhan, 2020), with a deeper look at these processes, we conclude that artificial intelligence is not able to provide solutions and control all five stages simultaneously. Artificial intelligence still cannot think creatively or dynamically, at least in architecture, and an architect can question the outputs of the machine at any time (Paolillo et al., 2022).

In addition, the great diversity and artistic content of architecture protect this profession against sudden changes, but another reason for underestimating artificial intelligence is the interest in preserving the existence of architects themselves, which is inherent in all professions (Trabucco, 2021).

Arthur Mamou-Mani announces that even with the use of artificial intelligence, designers retain the right to control the design process at any time, select and question the answers provided by artificial intelligence (Paolillo et al., 2022), which means the dependence of the machine on the human or architecture that controls and reviews it so that it does not make mistakes or is lost. The relationship between artificial intelligence and professional performance is currently known as a pioneering situation (Paolillo et al., 2022). Technological advances have specific criteria called *technological bottlenecks* that evaluate the possibility of replacing specific jobs. This ranking is based on a range of how much that job requires creativity (Nidal, 2019). As Andreas Klok Petersen points out, architecture is certainly one of the most complex professional practices, and every architectural choice involves countless aspects (Paolillo et al., 2022) that designing and programming artificial intelligence for them is very time-consuming and perhaps out of reach. The human brain works in a multi-channel way and collects and analyzes the most information input for the best result, and this is one of the strongest reasons why artificial intelligence cannot be a substitute for an architect in the multiplicity of ways of data entry into the human brain. Unlike computers, brains not only make decisions based on processed data but also include additional decisions depending on the five senses that computers do not have (Nidal, 2019). From the perspective of survival, machines cannot maintain themselves on their own to check the quality and function of their hardware and software. Robots and computers need the help of humans to be updated in some physical aspects, such as upgrading hardware parts to always be up-to-date to be able to fulfill the tasks assigned to them.

Methodology

The research method in this study is based on a qualitative (descriptive-analytical) and experimental (trial and error method) approach. The data collection method is library, documentary, and field. This research is categorized as applied research because it aims to improve housing architecture by explaining the design pattern of form and space based on behavioral science data using artificial intelligence suggestions. In this research, information has been obtained through studying and reviewing relevant books, valid specialized articles in Persian and translated from English, visual documents, and valid and relevant specialized websites and software related to the topic and objectives.

Study Area

With the emergence of technology and its advancement, especially artificial intelligence technology in recent years, the art world has also undergone extensive changes. One of these arts is architecture, in which, through artificial intelligence, the direct conversion of ideas and imagination into digital images has become possible. The most important step in this direction has been taken by Midjourney AI. This technology receives the description of what is to be drawn in the form of text and turns it into an image. Technically, Midjourney is a type of generative artificial intelligence that can convert elements of natural or human language into images. Different examples of this technology have been produced; however, Midjourney is almost the most famous and complete of them. Midjourney AI can be used without the need for special hardware and software and only through the Discord chat program. Among the advantages of this technology are high quality, ease of use, high speed, accuracy, and no need for additional and lengthy explanations, only with formulas that have been obtained through trial and error. To use it, you need to purchase one of the subscription plans because this artificial intelligence does not have a free version. The basic functioning of Midjourney, like any other artificial intelligence technology, is based on machine learning algorithms. The goal of these algorithms is to train machines in such a way that they have human-like answers when faced with situations and questions. These algorithms are fed with initial information, and their answers are monitored and corrected, processes that can be done with or without human intervention.

Midjourney AI also uses diffusion models. The goal of these models is to discover and learn the hidden structures in a set of data. A diffusion model is a type of machine learning that advances its learning process through modeling.

These models also help to produce high-quality images without blurring, noise, and burn. Midjourney, like ChatGPT, uses a large language model to understand what the user has written. This machine then converts the text into a vector or a numerical version of the written text and, after the complex diffusion process, turns it into an image.

From the user's point of view, the process of converting text to image in Midjourney is as follows:

1. Entering the image description in the form of the Midjourney language model (prompt).

2. A field display of four results in the form of unclear noises on the screen.

An important point to consider when working with Midjourney AI is the accuracy and clarity of the words used in the prompt. In general, the clearer you speak with the artificial intelligence user interface and the descriptions are short and conceptual, the better results and closer to the user's mental image are obtained. In this regard, after much research, learning, and trial and error, prompt writing formulas have been obtained to communicate with Midjourney, which, with the easiest possible writing, depict the closest result to the user's mental image.

Also, to facilitate communication with Midjourney and the use of these formulas, all the parameters of the Midjourney user interface, as well as the architectural data according to the formula writing components that Midjourney supports up to version 6.1, have been collected and explained in tables for image creation with the highest possible quality and reaching the closest possible result to the user's request. One of the most important features of Midjourney AI is the high quality of its images. These images are as realistic and structured as possible and seem logical in terms of the relationship between elements. Their resolution is also a maximum of 1024 by 1792 pixels. To achieve this degree of quality, purchasing more expensive plans is necessary. Using Midjourney AI does not require coding knowledge. The user interface of this program is very simple and only requires mastering how to describe the idea and imagination and execute text commands in the form of its language model. One of the most important advantages of Midjourney is its numerous editing possibilities. After receiving the image, you will be able to edit it in various ways, such as rotation, cropping, color changes, etc. This possibility reduces the need for other software, such as Photoshop, to an optimal level.

Currently, it can be said that the most important weakness of Midjourney is the issue of copyright in it. Images produced by the user can also be used by others. Of course, to use them, they have to make changes to the images or, in the terminology of the Midjourney user interface, remix them, especially if users intend to use their images commercially, such as selling them as NFT works or using them as their brand logo, this issue can be challenging. Therefore, it seems that until this problem is resolved, Midjourney cannot be used directly for commercial purposes. To communicate with Midjourney AI, it is necessary to first learn its environment and user interface. As mentioned, clarity in describing the request leads to better and closer results to the user's mental idea. Considering the knowledge of the parameters used and how they affect reaching the output and achieving the appropriate result from Midjourney, some of which are constant and some are variable depending on the user's request, the following formulas, which have been reached after trial and error, are effective in prompt writing and communication with Midjourney.

The point that is important in using these formulas is the prioritization in the order of placement and application of Midjourney parameters, which causes changes in the output. Also, depending on the user's request, adding, deleting, changing, or moving parts of the formula in the text will be effective in reaching the desired output.

1. Basic Prompt:

- [Image Prompt] + Text Prompt + Parameters

2. Advance Prompt:

- Text Prompt + Parameters
- Camera Angle/Shot Type + Subject + Architectural Style + Architect/Designer/Artist Name + Architectural Form/Component + Material/Texture + Facade Style + Artistic Medium + Photographer Name + Photography Rule + Historical Eras + Perspective/Architectural View + Environment + Atmosphere/Weather + Lighting Mood + Color Palette/Color Code + Resolution View

3. Interior Design Prompt: Subject + Interior Design Style + Furniture Name/Design Style + Material/Texture + Color Palette/Color Code + Environment + Lighting Mood + Lamp Type + Designer Name + Atmosphere/Lighting Mood + Artistic Medium + Resolution View

Another point to consider when using the above formulas is to write the defined parameters of the Midjourney user interface at the end of a prompt after placing a period. The use of these prompts is optional and variable, and there is no need to use all of them in one prompt.

Table 2: *Introducing and recognizing the indicators that can be used in Midjourney AI to define and compile prompt-Part 1.*

Midjourney Prompts Experts (Part 1.)												
Introducing and recognizing the indicators that can be used in Midjourney artificial intelligence to define and compile Prompt (Part 1.)												
Perspective View	Architectural View	Camera Angle	Shot Type	Artistic Medium	Camera Lens	Subject	Zoning	Architectural Style	Interior Design Style	Furniture Design Style	Architect Name	Designer / Artist Name
Description												
The desired viewing angle of the desired subject	The angle of the camera	Terms in the photography profession	Creating artistic images	Photography lenses from brands	Specified subject to describe	definition of subject in prompts	Architecture and design style for the subject	Names of architects and designers for the subject				
Examples												
One-Point Perspective	Eye Level Angle	Extreme Close-up Shot	Block Print	Sony Alpha A1	Cottage	Residential	Folding architecture	Antoni Gaudi				
Two-Point Perspective	Side Angle	Close-up Shot	Folk Art	AFGA Vista 200	Duplex house	Commercial	Modernism architecture	Louis Sullivan				
Three-Point Perspective	Low Camera Angle	Medium Close-up Shot	Cyanotype	AFGA Vista 400	Duplex villa	Industrial	Post-Modernism architecture	Eero Saarinen				
Isometric Perspective	High Camera Angle	Medium Shot	Graffiti	Fujifilm Pro 400H	Apartment building	Agricultural	Brutalism architecture	Louis Kahn				
Forced Perspective	High Angle	Medium Long Shot	Painted-by	Canon EOS R5	High-rise apartment	Recreational	Deconstructivism architecture	Frank Gehry				
Reverse Perspective	Low Angle	Long Shot	Risograph	Nikon 27 II	Town house	Educational	International architecture	Zaha Hadid				
Curvilinear Perspective	Bird Eye Angle / Drone Shot	Extreme Long Shot	Ukiyo-e	Leica M10-P	Row house	Healthcare	Gothic architecture	Norman Foster				
Oblique Perspective	Back Angle	Wide Shot	Pencil Sketch	Tri-X	Terraced house	Government	Renaissance architecture	Renzo Piano				
Cylindrical Perspective	Fish Eye Angle	Establishing Shot	Watercolor	Daguerreotype	Bungalow	Historical	Baroque architecture	Tadao Ando				
Arial Perspective		Two-Shot	Block Print		Castle	Cultural	Neoclassical architecture	Santiago Calatrava				
Plan View		Low Angle Shot			Palace	Religious	Art Nouveau architecture	Le Corbusier				
Axonometric View		Point of View Shot			Villa		Bauhaus architecture	Frank Lloyd Wright				

Table 3: *Introducing and recognizing the indicators that can be used in Midjourney AI to define and compile prompt-Part 2.*

Midjourney Prompts Experts (Part 2.)												
Introducing and recognizing the indicators that can be used in Midjourney artificial intelligence to define and compile Prompt (Part 2.)												
Architecture Form	Architectural Component	Structural System	Material / Texture	Lighting Mood Description	Lamp Type	Color Palette	Color Code	Environment Description	Weather	Atmosphere	Landscape Description	Historical Eras
Description												
Forms and elements in architectural design		Structural systems in architectural forms	Materials and textures	Lighting and light modes of space	Form of lights	Color palettes in design	Definition of color modes	Location of the subject	Weather and space atmosphere	Defining the landscape		Definition of historical decade
Examples												
Organic Form		Lattice framework	Concrete	Natural Lighting	Incandescent Lamps	Earth Tone	Vibrant Colors	In the alleys of...	Bright Sunny day	Urban Park		1700s
Flowing Form		Curtain wall system	Glass	Studio Lighting	LED Lamps	Pastel Paradise	Pop-Up Colors	In the street of...	Cloudy and Cool	Botanical Garden		1800s
Multi-Layered Form		Steel frame structure	Brick	Window Lighting	Fluorescent Lamps	Rose Gold	Muted Tones	In the center of...	Rainy and Windy	Waterfront Promenade		1980s
Striated Form		Shell structure	Timber / Wood	High Key Lighting	Halogen Lamps	Serene Seas	Warm Tones	Over a …	Hazy and Humid	Rooftop Garden		2000s
Geometric Form		Truss system	Stone	Low Key Lighting	Neon Lamps	Vibrant Fiesta	Soft Pastels	Next to the…	Stormy and Thunderous	Civic Plaza		2020s
Rectilinear Form		Green roof system	Steel	Split Lighting	Table Lamps	Cozy Cabin	Earthy Hues	Near the…	Sunny and Breezy	Courtyard		A.D
Curvilinear Form		Steel frame structure	Metal	Broad Lighting	Desk Lamps	Autumn	Monochromatic Shades	Adjacent to…	Foggy and Chilly	Sport Complex		B.C
Minimalist Form		Space frame structure	Stucco	Backlight	Floor Lamps	Desert Dreams	Cool Blues	Grassy Landscape	Snowy and Freezing	Playground		Before Islam

Table 4: *Introducing and recognizing the indicators that can be used in Midjourney AI to define and compile prompt-Part 3.*

Midjourney Prompts Experts (Part 3.)								
Introducing and recognizing the indicators that can be used in Midjourney artificial intelligence to define and compile Prompt (Part 3.)								
Resolution View	Photographer Name	Photography Rule	Facade Style	Facade Form	Model Material	Logo Type	Logo Designer	Art Movement
Description								
Output quality control	The names of famous photographers	The rules of photography in improving the display	Facade styles in architecture	Design forms in urban view	Material in making the replica	Types of logos	Famous logo designers	Artistic movements In decades
Examples								
32K UHD	Hiroshi Sugimoto	Rule of Third	Rectilinear Composition	Pixelated Facade Form	Acrylic Sheet	Word mark Logo	Rob Janoff	Abstract Expressionism
16K UHD	Ezra Stoller	Rule of Odds	Vertical Emphasis	Geometric Facade Form	Plexiglass	Letter mark Logo	Ruth Kedar	Art Deco
12K UHD	Helene Binet	Leading Lines	Horizontal Emphasis	Curved Facade Form	Translucent Plastic Sheet	Brand mark Logo	Turner Duckworth	Art Nouveau
10K UHD	Candida Hofer	Symmetry	Symmetry	Slatted Facade Form	Vellum Paper	Combination mark Logo	Scott Baker	Arts and Crafts Movement
8K UHD	Iwan Baan	Framing	Asymmetry	Folded Facade Form	Translucent Fabric	Emblem Logo	Frank Mason Robinson	Bauhaus
6K UHD	Julius Shulman	Fill the Frame	Grid-based Composition	Glass Curtain Facade Form	Frosted Glass	Abstract Logo	Carolyn Davidson	Cubism
4K UHD	Andreas Gursky	Depth of Field	Triangular Composition	Transparent Facade Form	Card Board	Mascot Logo	Walt Disney	Dadaism
Full HD	Thomas Struth	Golden Hour	Curvilinear Form	Organic Facade Form	Foam Board	Monogram Logo	Jim Schindler	De Stijl
HD	Richard Barnes	Blue Hour	Spiral Form	Parametric Facade Form	Balsa Wood	Flat Logo	Paul Rand	Expressionism

Table 5: *Introduction and how to used and function parameters used by Midjourney AI.*

Midjourney Parameters							
Introduction and how to use and function parameters used by Midjourney artificial intelligence in Prompt and their impact on the output							
The Parameters	**Instruction**	**Function**	**Defined Value**				
Midjourney Version	--v	Determining the version used by Midjourney	--v 5	--v 5.1	--v 5.2	--v 6	--v 6.1
Aspect Ratio	--ar	Determine the output size of the image	--ar 16:9 --ar 9:16	--ar 5:4 --ar 4:5	--ar 4:3 --ar 3:4	--ar 3:2 --ar 2:3	--ar 1:1
Quality	--q	Determining the image output quality (default value = 1)	--q 0.25		--q 0.5		--q 1
Seed	--seed	Starting points for processing and outputting an image	--seed (0~4294967295)				
No	--no	Delete the desired object by entering its name after the command	--no (Object name)				
Image Weight	--iw	Specifying the effect intensity of photos in a prompt (default value = 1)	--iw 0	--iw 0.5	--iw 1	--iw 1.5	--iw 2
RAW Style	--style raw	Create raw output by removing artistic elements					
Stylize	--s	Determining the artistic level of the output	--s 50	--s 150	--s 250	--s 750	--s 1000
Weird	--weird / --w	Determining the amount of fantasy and unconventionality of the output	--weird (0~3000)				
Chaos	--chaos / --c	Determining the difference intensity of 4 outputs of a prompt	--chaos (0~100)				
Style Reference	--sref (http://URL)	Use one or more images as references in the prompt	Intensity change parameter: --sw (0~1000)				
Character Reference	--cref (http://URL)	Using the portrait image of a character as a reference in Prompt	Intensity change parameter: --cw (0~100)				
Tile	--tile	Create borderless and repetitive patterns as materials					
Video	--video	Create a clip using the 4 outputs of a prompt					
Permutation	{}	Making changes to a prompt using a single imagine command	Write a list of desired options and separate them with commas "," inside braces "{}" in Prompt				
Multi Prompt / Prompt Weight	::	Separation of two or more Prompt concepts by making parts important	::1 = ::	::2	::3	::4	::5= --no
Repeat	--repeat / --r	Repetition of a Job	This parameter can be used only in Fast and Turbo modes.				
			--repeat (2~4) Basic Subscribers		--repeat (2~10) Standard Subscribers		--repeat (2~40) Pro and Mega Subscribers

Table 6: *Showing Sample of Behavioral Science Indicator with Data parameters of table1-5 in Midjourney AI and their displayed elements (Source: Authors).*

Behavioral Science Indicator	Midjourney Output (Objective Component)	Midjourney Output (Subjective Component)	Displayed Elements
Territory			-Defining clear boundaries by creating differences in elevation on surfaces -The presence of markers indicating ownership -A sense of security and control
Personal Space			-The existence of a physical place or boundary -Marking specific elements within a space

Privacy			-Choosing solitude within a space -Avoiding stimuli -Managing crowding -Protecting personal space
Environmental Aesthetics			-Presence of natural elements such as trees, water, and rocks -Harmony between form and nature -Appropriate landscape views of nature -Use of warm lighting
Skeptical Aesthetics			-The definition of formal beauty through curved lines -Presenting a proposed design in the modern architectural style -Use of modern elements and furniture -Use of warm lighting
Sensory Aesthetics			-Presenting a combination of warm and cold lights and colors to evoke a sense of beauty -Combining curved surfaces -Using natural elements such as water and trees -Dynamic lighting
Symbolic Aesthetics			-Presenting simple and symbolic forms (single structure) -Designing long pathways to evoke a sense of movement (towards the future) -Spaces away from crowds -Minimalist design

Discussion and Conclusion

Understanding objective and subjective components in architecture and behavioral sciences is essential for designing environments that meet both the physical and psychological needs of users. Aligning these two aspects can lead to the creation of spaces that are not only functional and efficient but also enriching and capable of improving user experience and overall quality of life. Artificial intelligence (AI) can analyze complex behavioral data and provide solutions based on advanced modeling, which can lead to the design of more optimal objective and subjective patterns by considering reduced energy consumption, increased economic efficiency, and improved architectural quality of housing and residential spaces. Furthermore, by referring to the definition of form, space, and their relationship with the observer and the environment, and the importance of behavioral sciences in identifying human needs in housing design, the integration of behavioral sciences with architecture can provide targeted and human-centered solutions. On the other hand, important challenges such as the need to pay attention to cultural and social aspects in design, emphasis on the principles of behavioral sciences, and recognizing and overcoming the existing limitations in the full understanding of AI from the aesthetic and spiritual aspects of architecture have also been raised. These challenges indicate the necessity of multidisciplinary approaches that employ a combination of humanities, engineering, and art in the design process. In this paper, the research outcomes highlight the development of precise and practical approaches to prompt engineering and effective interaction with the Midjourney artificial intelligence. These findings enable practical applications for generating ideas across different areas of design and architecture, including form, space, and interior design. Also, the introduction and function of Midjourney parameters and the indicators used in formulas, are written in tables to make an easy use of Midjourney AI for users.

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