

Article

Integrating an Image-Generative Tool on Creative Design Brainstorming Process of a Safavid Mosque Architecture Conceptual Form

Aref Maksoud , Aya Elshabshiri , Amani Saeed Hilal Humaid Alzaabi and Aseel Hussien 

Department of Architectural Engineering, College of Engineering, University of Sharjah, Sharjah 27272, United Arab Emirates; u23107024@sharjah.ac.ae (A.E.); u21200105@sharjah.ac.ae (A.S.H.H.A.); ahussien@sharjah.ac.ae (A.H.)

* Correspondence: amaksoud@sharjah.ac.ae

Abstract: The study aims to understand to what extent employing A.I. image-generative tools in architectural concept brainstorming demonstrates effectiveness, accuracy, and adherence to text and image inputs, and evaluate the utilization of A.I. image-generative tools in the architectural ideation phase, considering factors such as speed, creativity, and accuracy. Thus, this study will investigate using an A.I. image-generative tool, Midjourney, in the creative brainstorming stage for a Safavid mosque architectural form design process. The study will quantitatively evaluate the form proportions of mosques generated by Midjourney based on certain criteria as they pertain to the Shah Mosque as the inspiration for the design as it encompasses many of the Safavid Mosque's typical elements and characteristics. The most matching form will then be found. The findings are that Midjourney is reliable in terms of its speed and creativity; however, it lacks accuracy and adherence to inputs. This study is essential as limited literature exists on A.I. image-generative tools in the brainstorming process of architectural projects, particularly mosque architecture. It also provides architects and designers with a framework and the pros and cons of the use of A.I. generative tools, such as Midjourney, in the ideation process for an architectural project.

Keywords: mosque architecture; design creativity; architectural brainstorming; visual perception; Shah Mosque; image-generative AI



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1. Introduction

The prevalent adoption of artificial intelligence (A.I.) has triggered a revolutionary wave of technological progress in the modern era. This paradigm shift is visible in society, the economy, and the construction industry [1]. Currently, A.I. is being used by architects to streamline the design process, provide novel forms and structures, and improve building energy efficiency. Developing a concept for the building form is the initial step in building design. It can be performed at a potentially high level and speed using various generative A.I. technologies (summarized in Table 1) that allow them to produce new content in response to an input. Creating creative detailed architectural models using text prompts and specialized BIM CAD tools is the next stage A.I. solves. A.I. may evaluate, forecast, model, compute, and test implemented solutions [1–3].

Table 1. Comparison between three A.I. image-generative models [2].

Model	txt2img	img2img	In-/Out-Paint	Editing	Upscaling	Semantics
Midjourney v4	Yes	Yes	No	No	Yes	No
Stable Diffusion v2.1	Yes	Yes	Yes	No	Yes	No
DALL·E 2	Yes	Yes	Yes	No	No	No

Architects today are more likely to employ A.I. generators like DALL-E 2, Midjourney, and Stable Diffusion for the form conceptual phase. They can produce creative images of very high quality. Thus, Midjourney, for instance, enables the creation of an accurate, detailed image from a straightforward text description and/or image prompts [1,4]. With this technology, designers and architects may effectively conceptualize their ideas in highly detailed ways and visualize their thoughts and concepts. As a result, it is feasible to quickly produce realistic representations of the concept and clear, precise graphics when using A.I. in architectural design during the idea development stage. Currently, however, there is no practical framework to incorporate image-generative A.I., like Midjourney, DALL-E 2, and Stable Diffusion, into actual architectural practice [1–3]. Therefore, this study aims to study the extent of employing Midjourney in architectural form conceptual brainstorming in demonstrating effectiveness, accuracy, and adherence to text and image inputs, and to evaluate its accuracy, creativity, and speed in regenerating a mosque form in the Safavid Islamic Architectural Style.

To achieve this aim, this study investigates using an A.I. image-generative tool, Midjourney, inspired by a specific Islamic architectural style in the architectural form brainstorming stage of the architectural mosque design process. Midjourney is chosen in this study because it stands out as a preferred A.I. image-generative tool among architects and students due to its popularity, cost-effectiveness, and ability to deliver realism, quality, and intricate detail [5]. Furthermore, its proficiency in generating high-quality images from a prompt presents a compelling justification for research in design-oriented fields such as architecture and art. With its capacity to accurately translate inputted prompts and offer customization options, Midjourney emerges as a valuable asset for investigating and conceptualizing design ideas [6]. The Islamic style chosen is the Safavid Architecture style for its simple and elegant form. The research will reference the Shah Mosque as the inspiration for the design as it encompasses many of the typical characteristics and elements of the Safavid Mosque. The study starts by investigating the characteristics of Safavid mosque architecture. This study focuses on two main aspects: (1) the main components that are essential to a Safavid mosque and (2) the proportions of a typical Safavid Mosque. These aspects are then turned into criteria to assess the generations of form carried out by Midjourney. These generations are then narrowed down to the most matching form that scores the highest against the criteria. This study is essential as it addresses a gap in the literature. Based on searching on SCOPUS and Google Scholar, limited literature exists on A.I. image-generative tools in the brainstorming process of architectural projects in general, particularly mosque architecture [7]. Moreover, limited research exists on the use of image prompts besides the usual use of text prompts [7,8]. Thus, this present study supports the use of text prompts with image prompts using reference images of the Shah Mosque. It also adds to the literature more insight into the use of A.I. image-generative tools in the conceptual brainstorming stage of the design process, in particular mosque architecture design process. Hence, the novelty of the study lies in the exploration of A.I. image-generative tools in the conceptual design of a mosque.

The paper is organized as follows: first, the introduction is provided, and then it delves into a literature review on A.I. image-generative tools, Islamic Architecture, Safavid Mosque Architecture, and the Shah Mosque as a representative of Safavid Mosque Architecture; next, it outlines the methodology, followed by the findings, and finally ending with the conclusion.

2. A.I. Image-Generative Tools

As digital technologies progress, the process of turning design concepts into visual representations becomes more diverse. A.I. technologies can serve as collaborators in the design process, including the ideation stage. One aspect of A.I. technology is A.I. image-generative tools [9]. These A.I. art platforms employ generative machine learning models. Examples are Midjourney, Stable Diffusion, and DALL-E. The latest versions of generative models combine natural language processing and diffusion models, Midjourney being

one of them [2]. This type of A.I. image-generative diffusion model creates an extensive range of intricate images [4]. This type of diffusion model design may handle a variety of image-generation tasks. A text-to-image model (txt2img) is used to create an image from a user-written text prompt, whereas image-to-image models (img2img) are used to modify an existing image based on a text prompt [2].

Table 1, compares Midjourney to other A.I. image-generative tools such as Stable Diffusion and DALL-E 2 [2].

Because A.I. generative tools are still in their early phases of development, the generated images may not be accurate or realistic enough to be used in the design process because their quality does not yet match that of professional software. In addition, because spoken English is not always accurate, the computer may misinterpret the architect's explanation and produce an inaccurate image. Despite these barriers, the use of A.I. image-generative platforms in architectural design has substantial potential advantages. These tools could allow architects to create 3D models, photorealistic pictures, and animations rapidly and efficiently, which can have the potential to change the design process in the future [10]. Currently, however, in the context of architectural design, a generated image reflects only the initial stage of the concept; it remains an architect's role to evaluate the feasibility of the building, make the changes that are required, determine the requirements of the building, and design its functional plan [7].

Zhang et al. [11] compared the designs of architect Antoni Gaudí to those produced by an A.I. system using image and text prompts. The researchers assessed the designs using five key metrics: authenticity, attractiveness, creativity, harmony, and overall preference. Gaudí's designs excel in Authenticity and Harmony, demonstrating the distinct aesthetic appeal of human-created designs. AI-generated designs, on the other hand, show great promise, with competitive outcomes in the categories of attractiveness and creativity. Some A.I. designs even outperform Gaudí's in terms of overall preference [11].

Another study by Jaruga-Rozdolska [7] aimed to present Midjourney's potential to be utilized in the process of creating the architectural form using text prompts. The findings showed that the images created with Midjourney depict buildings that are not only aesthetically pleasing and compliant with the input keywords but also correct in aspects not addressed by the keywords inputted, demonstrating an advanced deductive ability that no other tool has achieved. Another apparent advantage is the speed of creation, which is substantially faster than any previously available software. However, artificial intelligence still has a limited potential for independent decision-making [7]. Nevertheless, the study considered text prompts only without considering the use of other types of prompts such as image prompts.

Moreover, Phillips et al. [4] compared the performance of three A.I. image-generative models, namely Dall-E 2, Stable Diffusion, and Midjourney, to generate urban design images from scene descriptions. In total, 240 generated images were assessed by employing an "adapted Sensibleness and Specificity Average (SSA) metric". The findings revealed considerable variances among the three A.I. models as well as differences in scores across urban designs, implying that particular projects and design aspects may be more difficult for A.I. art image generators to visually portray. According to the authors, urban designs generated by A.I. have potential applications in the early stages of design, where rapid ideation and visual brainstorming are essential [12]. However, the study only considered text prompts.

A study by Paananen et al. [8] investigated the use of text-to-image generators in architectural design. The researchers ran a lab with 17 students who designed a culture center concept using three A.I. image generators: Midjourney, Stable Diffusion, and DALL-E. The researchers observed that image generation can be an important component of the design process, assisting in idea discovery and enriching the process. However, participants encountered difficulties when prompting, such as using local buildings as references or removing objects and text. The researchers also discovered that the A.I. image generators were unable to generate floorplan drawings because floorplans are more abstract repre-

sentations. Some participants developed prompts inspired by organic natural materials or structures, often employing literal language which yielded surprising results. While interesting, some of these unconventional possibilities may be difficult to build and unsuitable for the intended objectives. Additionally, several participants regressed to previous versions of their prompts, implying that even with fine-tuning, users may not achieve the results they were looking for [8]. The study by Paananen et al. [8] also only considered text prompts. Therefore, this current research employs not only text prompts but also image prompts to assess how this can make the prompt more accurate.

This study employs Midjourney as an A.I. image-generative tool. Essentially, Midjourney uses human-written text descriptions or image prompts, which can be converted into visually displayed concepts with the same semantic meanings as the prompt [3,4,7,13]. Midjourney has many applications, from helping people with visual impairments understand written material to assisting artists, architects, and even laypeople interested in A.I. and art without experience in these creative sectors. The basic prompt, typically initiated with “/imagine” followed by a textual description (see Figure 1), initiates Midjourney’s image creation process. This user-friendly interface streamlines photo creation, allowing users to input text and select “generate”, prompting Midjourney to employ advanced machine learning to produce relevant images based on the entered text. Alongside this, Midjourney boasts several noteworthy features, including the prompting process itself, the upscale feature, and the variation feature (see Figure 1). Furthermore, users can use the U1, U2, U3, and U4 buttons to upscale specific pictures, producing larger versions with roughly 1024 by 1024 pixels and more details. The buttons labeled V1, V2, V3, and V4 allow variations to be created, resulting in four similar images [3,7,13]. Another feature in Midjourney is the Vary Region option that appears under each upscaled image. This feature allows the user to select a region in the image and alter or regenerate it by modifying the original prompt. Additional advanced prompt features are outlined in Table 2 that have been used to improve image output by employing better prompts.

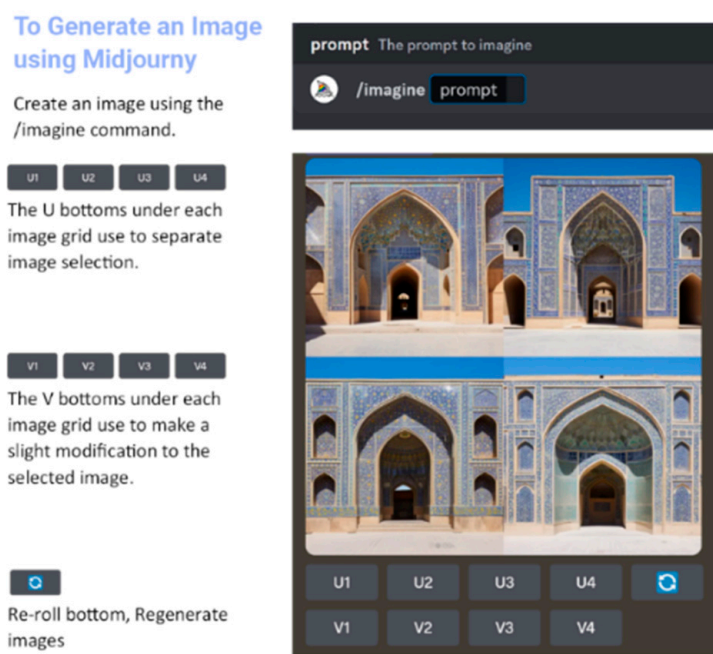


Figure 1. Features of Midjourney.

Table 2. Guide to Midjourney advanced prompts [13].

Feature Name	Why to Use	How to Use
Image prompts (reference image)	To influence the generated image in terms of style and colors. Image prompts can be used with and without text prompts	The prompt structure: /imagine [Image URL, text prompt, parameter]
Multi-Prompt Basics	Using a multi-prompt to control the blending of concepts by assigning relative importance. Separating prompt parts with double colons (::) and adding numbers for specific importance levels.	Adding a double colon:: < with or without value >
Remix	Utilizing Remix Mode for prompt, parameter, model, and aspect ratio adjustments. This ensured continuity by incorporating the initial image's composition into the new job. Dynamically altered settings, lighting, and subjects for creative adaptability.	Activate Remix mode with the /prefer remix OR /settings and toggling the Remix Mode button
Stylize	Control the artistic influence with the s parameter: lower values for prompt fidelity and higher values for enhanced artistry. Style Default is 100, and the Stylize Range ranges from 0 to 1000 for customization.	Add --stylize <value> or --s <value> to the end of the prompt
Style parameter	The --style parameter replaces the default aesthetic of some Midjourney Model Versions. --style raw has less automatic beautification	Add --style <style name> to the end of the prompt.
Image weight	When generating new images from a reference, you can precisely regulate the degree of impact the reference should exert on the entire prompt. Style ratio of 0.5, 1, and 2. Higher values result in greater influence of the image reference on the final output	Add --iw <style ratio> to the end of the prompt.
Aspect ratios	An aspect ratio refers to the relationship between the width and height of an image.	Add --aspect <value>:<value>, or --ar <value>:<value> to the end of the prompt.

3. Mosque Architecture

Mosques' design and construction evolved from a very simple utilitarian shape. However, to create complex structures, the designers combined art, science, and technology to build either a small mosque or a big mosque appropriate for a specific location [14]. A typical mosque will have an enclosed congregational space known as the main prayer hall, generally adorned with geometric ornamentations, colorful tiles, and elegantly written Quranic verses [14]. In most cases throughout the first centuries of Islam, the prayer hall was a space of rows of columns where people gathered to pray, facing the *qibla* wall, a wall perpendicular to a line drawn to Mecca [15].

An important aspect of mosque architecture is the dome. The first domes were modest structures built above the *qibla* wall in front of the *mihrab* to define and illuminate it. Later, the dome relocated from this lateral location to a central one, growing in volume until it filled the entire sanctuary area or the main prayer hall [14–16]. Another element is the Islamic arches that are utilized to support enclosures, veranda ways, and corridors or arcades [14].

In addition, the typical mosque features an entrance courtyard with a well or fountain for ablution or washing one's hands and feet to prepare for prayer. The open courtyard is utilized for the overflow of worshippers [14,15]. The courtyard also provided an architectural display, which the Ottomans, Safavids, and Mughals took advantage of. The fountains in the courtyard could also be considered works of art [16].

One of the most essential mosque features is the minaret. The minaret was included in early mosque designs. They were built near mosques to announce the prayer time or the

adhan. The necessity for height from which to broadcast the call to prayer prompted the construction of the minaret. The minaret is claimed to have been inspired by other religious constructions like Syrian churches during the Umayyad period. However, the minaret was developed into more “slender and graceful” towers as they were not required to account for large loads like church towers did with bells. Aside from its role as a tower for prayer calls, the minaret was included as part of the mosque for embellishment and to convey the building’s grandeur, becoming a symbol of the mosque [14,16,17]. A minaret can be seen in almost every mosque. There are no rules on where they should be placed or how many there should be [15].

As for ornamentation, because other types of art, such as the depiction of people and statuary, are prohibited in the mosque, calligraphy art, frequently showing Quranic passages, was introduced as an artistic addition to the mosque as a source of *dhikr* (remembrance) and raising the spiritual atmosphere. The Quranic writings are frequently carried out in various styles and colors, utilizing various materials. Another form of ornamentation used in mosques is geometric patterns, commonly known as arabesque patterns, based on diverse pattern organizations inspired by mathematical knowledge [14].

In essence, Islamic architecture can be expressed with principles such as unity, balance, and knowledge. For example, the understanding of the use of light is expressed by the play of shade and shadow of the sun rays using architectural elements [14].

Islamic architecture evolved throughout the years, creating various styles corresponding to key specific eras (summarized in Figure 2, below). Some of the essential Islamic architectural styles are Umayyad (7th and 8th centuries), based in Syria; Moorish Architecture (8th to 15th century), which is based in Spain and Northern Africa; Abbasid Architecture (8th to 13th century), majority of which are based in Iraq; Fatimid architecture (10th to 12th century), based in North Africa, Egypt, and Palestine; Mamluk Architecture (13th to 16th century) based in Syria and Egypt; Ottoman Architecture (14th to 20th) based in Turkey; Mughal Architecture (16th to 19th century), based in India and modern-day Pakistan; and Safavid Architecture (16th to 18th century) based in Central Asia [18].

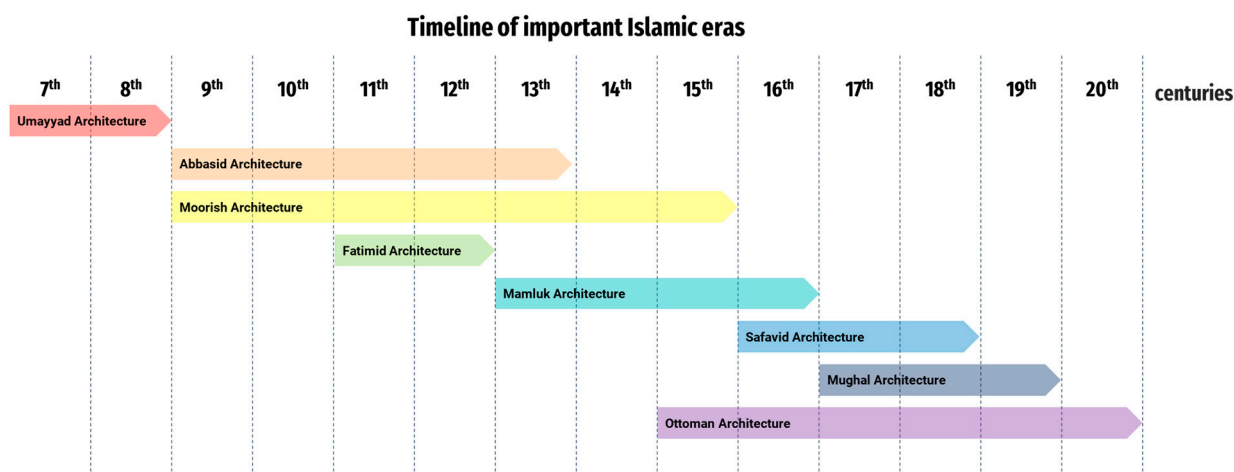


Figure 2. Timeline of important Islamic eras.

3.1. Safavid Mosque Architecture

The first mosque built in Iran was Masjid-i-Fahraj near Yazd in 678 A.D. This simple mosque has a five-span nave with a row of pillars and four porches. Passageways and covered footpaths surround the earthen building. Most mosques in mountainous and cold areas were built with wooden beams and columns and covered with flat roofs. Afterward, the main elements of all mosques have been domed and vaulted spaces. After the seventh century A.D., building a mosque with a large nave or prayer hall with many visible piers or columns inside gradually became popular. Then, in the design of mosques, an Iwan, a covered space with three closed sides and one open side, appeared. The number of Iwans

varied according to the type of mosque. Some two-Iwan mosques, such as the Zuzan and Farumad mosques, were constructed in the seventh century A.D. The Jami Mosque in Zaware was most likely the first mosque built with four Iwans (1151 A.D.). During the later eras, in the Seljuk then the Safavid periods, most of the four Iwan mosques were constructed with a nave, a portion of which was used to construct an Iwan, such as the Masjid-i-Jami and the Shah Mosque in Isfahan. Mosques were typically standalone, and passageways, bazaars, and madrassas surrounded them [17].

The Safavid period (1491–1722 A.D.) is considered the final pinnacle and the epitome of Persian Islamic architecture [17,19]. Printed tiles were introduced, and the richest possible combinations and innovative embellishments were developed on a wide scale while using mosaic and glazed bricks. Isfahan was the most elaborate architectural creation established in the 17th century A.D. The city is located in a valley at 1590 m elevation, latitude 32°8' N, and longitude 51°8' E, with a temperate climate [17]. Under Shah Abbas (1587–1629), Isfahan was made the capital (1598) and the country's artistic focal point. With a population of around half a million, Isfahan quickly grew into a big cosmopolitan city and one of the largest in the world.

Previously, the city's center was located near the old Friday Mosque. Though Abbas restored many of the old buildings in the area, he directed his planners to build a new urban center to the south, which he named Naqsh-e Rostam (meaning "Design of the World") [15,17]. The Naqsh-e Rostam complex and square is one of Asia's most impressive public architectural complexes. It was built between 1590 and 1595. The square represents Isfahan's rise as the Safavid dynasty's new economic, political, and commercial capital [14]. It measures 512 m × 159 m and runs directly north–south, surrounded by two-story arcades. In 1602, the two-story arcaded perimeter was constructed to introduce commercial content into the area. It was admired for its sheer size and architectural consistency and was described as a vast square full of life from the bazaars. A stone channel ran around the square's periphery near the arcade, separating the pedestrian area from the central area [14,17,20]. It was the symbolic center of the Safavid dynasty and its empire [15].

The square is part of a major architectural complex comprising four buildings surrounded by a large, landscaped area. The four principal buildings that face the plaza broke up the square's long, modular façades covered with polychrome glazed tiles. The Shah Mosque, also known as the Imam Mosque (1612–1638 A.D.), is located in the south. This structure was built with 18 million bricks and 472,500 tiles, including a majestic dome, twin minarets, and an impressive entrance Iwan flanked by another pair of minarets. Moreover, to the east is the Sheikh Lotfollah Mosque (1601–1628 A.D.), a smaller building yet a masterpiece with its arabesque-ornamented beige dome. The Ali Qapu Palace, with a high columnar talar (porch), is located on the west façade of the square (1597–1668 A.D.). The massive, tiled enclave portal of the Qaysariyah, a 2 km market that also connects the square to the old city, is located to the north [14,15,17].

Safavid architecture was conservative. The major mosques of this period have the classical four-Iwan plan; each Iwan is located in the middle of each side of the rectangular or square open courtyard [14,21]. The four-Iwan pattern originated in pre-Islamic mansions and Buddhist monasteries. The concept of the soaring gateway, the *pishtaq*, was an innovation of Central Asia. When placed in front of an Iwan entrance to a mausoleum, mosque, or madrasa, the *pishtaq* emphasized the importance of the building [16]. In addition, Persian mosques are distinguished by their onion-shaped domes decorated with usually turquoise-colored decorative tiles. The praying hall's mosque is frequently connected to numerous other buildings, such as a madrasa or religious school, via covered passageways and huge open courtyards. The pointed arches are frequently utilized repetitively across numerous stories or floors [14].

The cylindrical minaret was the most popular in Persia from the beginning until the Safavid Period. The first minarets to be capped with a balcony or a crown were Persian minarets. Each minaret is made up of three parts: the basement, the body, and the cowl or crown. The body can be cylindrical (as in the minaret in Gulpaygan in the twelfth

century A.D.), conical (as in the Sariban and Ali minarets), or prismatic (as in the minarets in Masjid-i-Jami in Nayin (970 A.D.) and Imam Hasan in Amul in the ninth century A.D.). The minaret's body may be tapered, decreasing in width from the base to the crown. The crown on top resembles a nenuphar with a height of up to 2 or 3 m. A minaret can reach heights of up to 50 m [17].

Persian domes are also a major characteristic of Safavid Architecture and are classified as single-shell domes, double-shell domes, or triple-shell domes [17]. Bulbous domes, one of the most popular dome shapes in Persian Architecture, have arisen in Iran since the mid-15th century A.D. [22].

3.2. The Shah Mosque as a Representation of Safavid Mosque Architecture

Beginning in the late sixteenth century, Shah Abbas I's renovation of Isfahan included a new congregational mosque, Shah Mosque, also known as Imam Mosque, as a magnet for drawing the inhabitants to use the neighboring bazaars on Naqsh-e Rostam square in Isfahan, Iran. The mosque incorporates many features of earlier Timurid examples, such as paired minarets, false upper courtyard galleries, and side domed chambers, but it is best known for its sense of scale and proportion, as well as the clever way in which the plan incorporates the 45° angle shift from the entrance to the qibla axis [21].

The Shah Mosque, a UNESCO World Heritage site, is described as a masterpiece of Safavid architecture, with exceptionally strong and complex proportional combinations and a four-Iwan form brought to perfection [16,23,24]. It is the result of a thousand years of Persian mosque architecture and the work of creative and innovative minds in the design [17,25]. In addition, the Mosque was built during the most productive period of Safavid architecture in 1598, with the Shah's decision to redesign Isfahan as an imperial capital, marking a significant advancement in Iranian architectural arts, whereas other mosques built during the Safavid era were, in general, less adventurous in their design. In short words, the Shah Mosque exemplifies the success of "applying typical Persian architecture" [26,27].

3.3. Form Characteristics of the Shah Mosque

The mosque follows the traditional Persian four-Iwan arrangement with an almost square plan. It is encircled by two-story arcades. The entrance portal is parallel to the square in front of it, and the mosque is rotated 45 degrees to face the qibla (see Figure 3). In addition, the mosque has a vast dome and numerous minarets. The mosque's overall plan and form are symmetrical [15,16,20]. According to Goudarzi et al. [23], the Shah mosque's proportions are "precise and harmonious", where the golden ratio was found in their study multiple times in the mosque's plans, sections, and elevations (see Figure 3), which exemplified the Safavid architect's awareness of the application of mathematics in the geometry of the buildings they design [23].

Moreover, a key characteristic of the mosque is the arches found in the Shah Mosque, which are of the four-centered high-rise arch type [17].

The mosque contains one major dome as well as several smaller ones [15]. The primary dome is massive in size. The dome is onion or turnip-shaped, and it is a four-centered arch in a section. The dome is double-shelled, with the external dome 14 m higher than the inner dome. The main prayer hall's bulbous dome is adorned with a spiraling "beige arabesque on a light blue mosaic-tiled background". The dome is supported by a 16-sided drum. The interior of the dome is decorated with levels of arabesque designs that descend to its circular base, which is pierced by eight open arches that are 3.3 m high and 1.7 m wide. The inner shell spans 22.5 m, while the outer shell is 27.60 m wide in span and 45.20 m high from the ground [14,17,28].

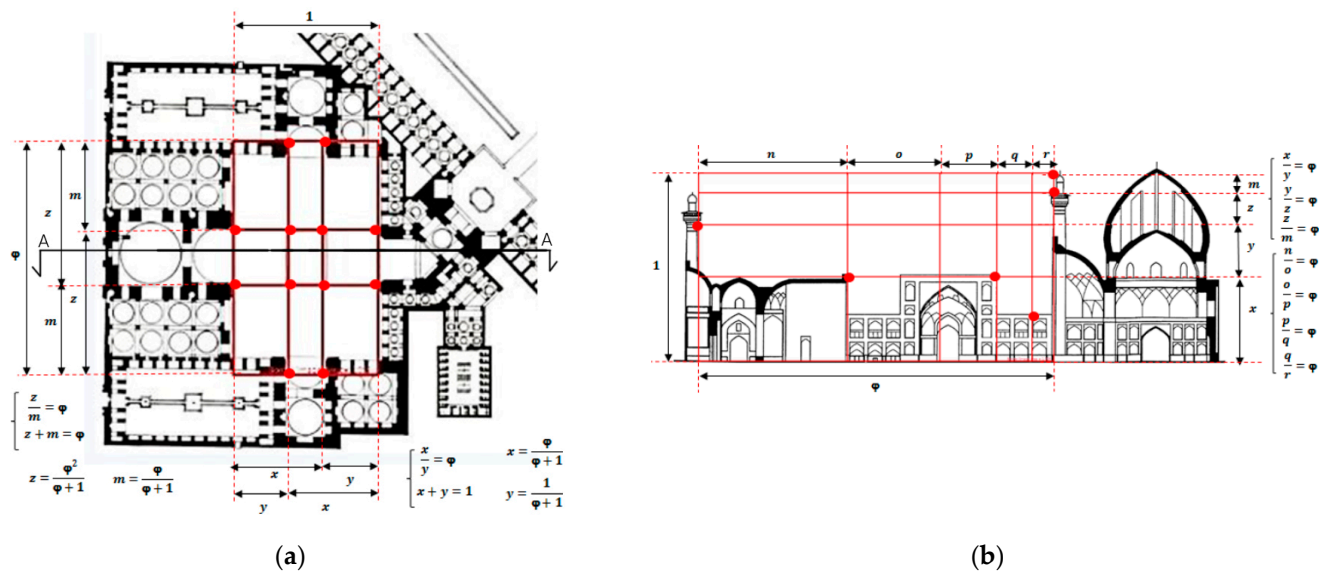


Figure 3. (a) Plan and (b) Section A-A of Shah Mosque [23].

There are four minarets, each two rising at mid-height and flanking two of the mosque's Iwans. They are cylindrical and slightly tapered. The minarets are decorated with "tile and mosaic faience". They consist of the body (34 m) and the crown (2–3 m); the minarets are approximately 48 m high from the ground [14,17]. There is a small band of muqarnas decoration underneath the crown, with a band of calligraphy. Moreover, the circular crown has a mashrabiya screen around it.

The Iwan is an essential aspect of the mosque as it is for the Safavid Mosques in general, the most important of which is the main entrance Iwan [16]. The main portal Iwan is symmetrical and is flanked by two minarets. It is covered with tile mosaic as with the rest of the mosque [16]. The most captivating element of the Iwan is its muqarnas that fill its half dome. In addition, some panels of the Iwan are embellished with scrolling stars and vines, while others depict facing peacocks. Magnificent panels laid out like prayer mats surround the doorway, which is adorned with alabaster panels [14,20]. The Iwan is framed with a band of thuluth calligraphy running on a dark blue background [14,20]. Similarly, the iwans in the courtyard of the mosque are also symmetrical. Bronze panels run the bottom third of the lower story. Additionally, the semi-dome of the arch is decorated with concentric medallions with floral motifs, and a band of thuluth calligraphy runs across the back wall of the Iwan that is aligned to the top of the first story of the arcade. The Iwan is framed with a band of decorations.

Also in the courtyard of the mosque is its arcade, which is two stories tall [15], of nearly the same height. The arches are four-centered arches (high-rise type), inscribed in rectangles, whose width is nearly 0.75 times the height. The center-to-center distance between the arches is equal to its height. Bronze panels run the bottom third of the lower story.

The muqarnas is a modular three-dimensional decoration that is composed of niche-like elements, arranged in tiers to form a tessellation. They are usually covered with glazed tiles, colored glass, stucco, and mirrors. There are eight tiers of modules in total in the muqarnas of the main portal Iwan of the Shah Mosque. The modules of a muqarnas are interconnected on a two-dimensional plane with no overlaps. The entire semi-dome of the main portal Iwan of Shah Mosque, which is filled with the muqarnas, appears to be half of an eight-winged star and is rectangular in plan [29].

A vibrant palette of seven saturated bright colors (dark blue, light blue/turquoise, white, black, yellow/gold/ochre, red, and green) that contrast with the plain brick color of the surrounding buildings and scenery is used. The dark blue color is prominently used for the background. The unlimited artistic potential of ceramic facing is fully displayed in the mosque, with both its inner and exterior walls completely glazed on an almost

inconceivable scale. The colors define the various patterns and components of the building and are flexible and adaptable in both scale and character because the colored domes, wall panels, arches, muqarnas, gateways, and mosaics can all be admired individually up close and from afar. The ornamentation of the tilework includes “trees, lotus flowers, undulating vines, leaf motifs, and many varieties of geometric interlaces of six- and eight-pointed stars”, as well as calligraphy. The calligraphy style used on the tile work is the Thuluth and Kufic scripts [15,20,30,31].

4. Methodology

4.1. Design Framework

After investigating the characteristics of Safavid mosque architecture in the data collection phase, the study determined three main aspects: (1) the main components that are essential to a Safavid mosque, (2) the proportions of a typical Safavid Mosque, and (3) color and ornamentations [32]. These aspects are then turned into criteria to assess the generations of form carried out by Midjourney (Table 3). Afterward, Midjourney is used to generate mosque forms inspired by Safavid mosque architecture, inputting text prompts supported by reference images of the Shah Mosque [33]. These generations are then narrowed down to the most matching form that scores the highest against the criteria in two stages (see Figure 4).

Table 3. Criteria used to assess the generations.

			Criteria
Stage 1	Set 1: Presence of components (yes/no)	If any of the components is absent, the generation will be eliminated	1. Massive onion-shaped dome [14,17]. 2. Main portal Iwan [16,18]. 3. Domed prayer hall [34]. 4. Pointed arches [14,17]. 5. Arcades [34]. 6. The presence of a minaret is not a requirement, but if a minaret is there, it should be cylindrical with a crown [14,17].
		Overall form	1. The height of the dome (highest point) is 4 times the height of the arcade [23].
Stage 2	Set 2: Proportions (quantitative)	Dome	2. The dome width is 1.075 times the height [14,17,28]. 3. The circular drum height is nearly 1/3 of the total height [17]. 4. The 16-sided drum height is 0.16 times the height of the dome [17].
		Minaret	5. The minaret's height is nearly 13.5 times the height of the crown [14,17]. 6. The height of the minaret from the ground is nearly 22 times the width (from the middle). 7. The overall height is nearly 2.4 times the height of the minaret from the portal Iwan to the top.
		Main portal Iwan	8. The height is 1.5 times the width. 9. The width of the Iwan is 1.43 the width of the opening. 10. The height of the Iwan is 1.15 the height of the opening. 11. The height of the opening is nearly 2 times the width of the opening. 12. The height of the rectangular part of the opening is 1.5 times the height of the arched part of the opening.
		Arcade	13. Two stories of nearly the same height [34]. 14. The arches' width is nearly 0.75 times the height [23]. 15. C-C distance between arches = height [23].

Table 3. Cont.

		Criteria	
Stage 2	Set 3: Color and ornamentation (quantitative)	Overall	16. Saturated intense colors [30].
		Dome	17. Yellow and white lotus flowers, vines, and leaf motifs [14,28].
			18. Turquoise background [14,28].
			19. A band of white thuluth calligraphy over a dark blue background [20]
		Minaret at main portal Iwan	20. White, dark blue, and yellow spiraling bands of Kufic calligraphy.
			21. Turquoise and white spiraling vines over a black background.
			22. Turquoise background mainly.
		Main portal Iwan	23. Dark blue muqarnas fill its half dome [14,20].
			24. Panels with yellow, white, and turquoise stars and vines [14,20].
			25. The Iwan is framed with a band of white thuluth calligraphy running on a dark blue background [14,20].
			26. Dark blue background.
			27. Bronze doorway.
		Arcade	28. Yellow, white, and turquoise trees, lotus flowers, vines, and leaf motifs [20].
			29. Bronze panels that run the bottom portion of the arcades.
			30. Framed with a band of decorations.
			31. Dark blue background.

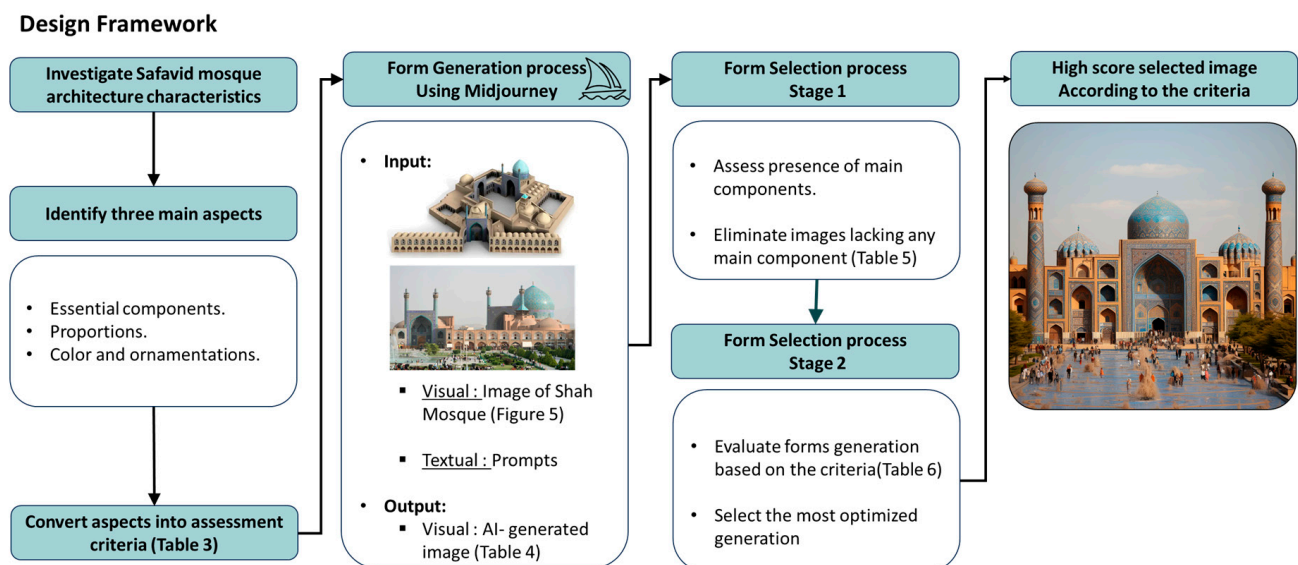


Figure 4. The design framework of the study.

4.2. Reference Images

The main reference images inputted in Midjourney for the form generation is a 3D model of the mosque (Figure 5). Following an analysis of the generated forms against the criteria listed in Table 3, the form that best aligns with Safavid mosque architecture is selected.

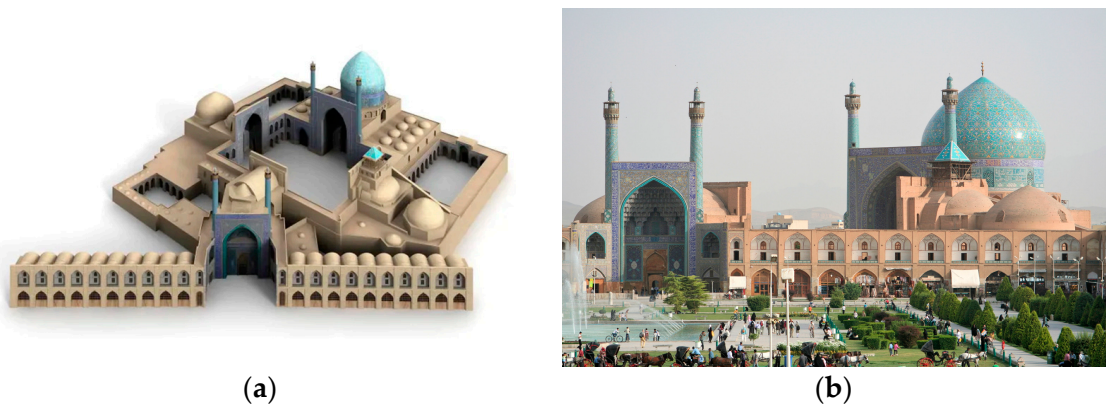


Figure 5. (a) The reference image of a model of the Shah Mosque by Clora Torrence. Public Domain [35]. (b) A view of the Shah Mosque by Patrick Ringgenberg under the Creative Commons Attribution-Share Alike 4.0 International license [36].

4.3. Criteria to Assess the Generations

The generations are assessed through two stages. The first stage entails one set of criteria as follows: (1) the presence of all the main components of Safavid mosque architecture; any image that does not include any of the main components is eliminated. Stage 2 examines two sets of criteria as follows: (2) how close the form generated is to the reference in terms of various proportions between the different elements of the form and (3) the ornamentation and the colors present in the generations. The Stage 2 criteria are measured quantitatively to a score out of 100. All criteria are formed based on studying the literature as well as images of the mosques.

4.4. Form Generation by Midjourney

Table 4 contains the generations carried out by Midjourney using the images in Figure 5 as references along with text descriptions. Based on the prompt, Midjourney was able to generate each image in under 60 s by using Fast Mode time. Fast Mode time seeks to provide instant Graphics Processing Unit (GPU) access, where Midjourney employs robust GPUs to interpret and process each prompt effectively [13].

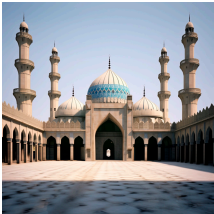
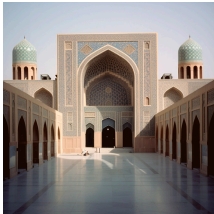
Table 4. All Midjourney generations.

Conceptual form Generation		
Generation	Generation	Generation
1	2	3
4	5	6

Table 4. Cont.

Conceptual form Generation		
Generation	Generation	Generation
7	8	9
10	11	12
13	14	15
16	17	18
19	20	21
22	23	24
25	26	27

Table 4. Cont.

Conceptional form Generation		
Generation	Generation	Generation
28	29	30
		

4.5. Form-Selection Stage 1: Presence of Components

In this stage, images are evaluated based on the presence or absence of certain components that are important in the Safavid Mosque Architecture (see Table 3, the first set of criteria). Any image that is missing any of the criteria in this stage is eliminated, except for the last criterion (no. 6) which says, “The presence of a minaret is not a requirement but if a minaret is there it should be cylindrical with a crown”. Because a minaret is not always present in Safavid architecture, but they are distinct in style compared to other Islamic styles, the criterion stipulates that a minaret presence in the generation is not a requirement; however, if they do exist, they must match the style of the typical Safavid minaret described in the literature (see Sections 3.1 and 3.3). Table 5, below, shows all the images that passed Stage 1 in green, and the images that are eliminated in red.

Table 5. All images after going through Stage 1.

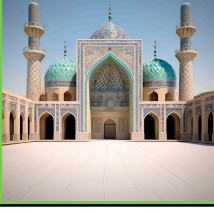
Conceptional form Generation		
Generation	Generation	Generation
1	2	3
4	5	6
7	8	9
		
		
		

Table 5. Cont.

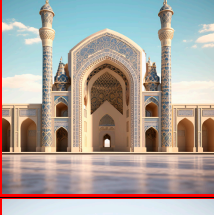
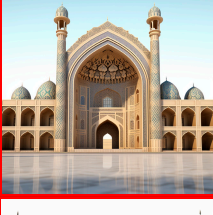
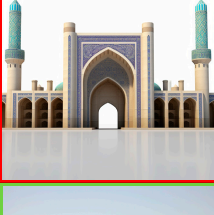
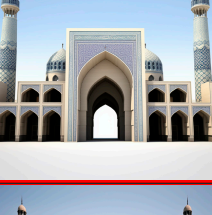
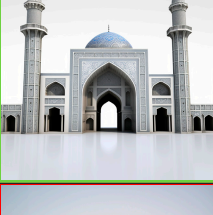
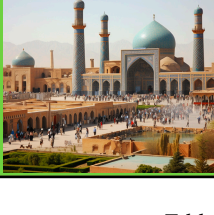
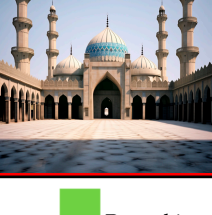
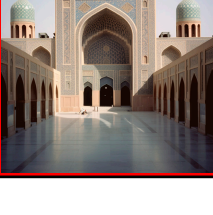
Conceptional form Generation					
Generation		Generation		Generation	
10		11		12	
13		14		15	
16		17		18	
19		20		21	
22		23		24	
25		26		27	
28		29		30	

Table Legend:  Eliminated image,  Passed images.

4.6. Form-Selection Stage 2: Proportions and Color Criteria

This stage entails quantitatively evaluating each of the nine images that passed Stage 1 against the criteria that pertain to proportions, color, and ornamentation (see Table 6). For the criteria set that relates to the proportions, each part of the generated mosque's proportion is compared to the proportions mentioned in the criteria. The proportions that are within the $\pm 10\%$ range of the proportions in the criteria gain a point, and the results that are not within the range do not. The last column of the table evaluates Midjourney's ability to adhere to the reference images.

Table 6. Decision matrix of the optimal generation for Stage 2.

Decision Matrix of the Optimal Generation (✓ and X)													
		Criteria	Generations that Passed Stage 1									Midjourney's Evaluation Score	
			1	3	6	9	11	14	18	27	28		
Proportions	Overall form	Dome Height (4 × Arcade Height)	X	X	X	X	X	✓	✓	X	✓	33.33%	33.33%
	Dome	Dome Width (1.075 × Height)	X	✓	X	X	✓	✓	✓	X	X	44.44%	18.52%
		Circular Drum Height (Approx. 1/3 Total Height)	X	X	X	X	X	✓	X	X	X	11.11%	
		16-Sided Drum Height (0.16 × Dome Height)	X	X	X	X	X	X	X	X	X	0%	
		Minaret Height (13.5 × Crown Height)	X	X	X	X	X	X	X	X	X	0%	
	Minaret	Minaret Height from Ground (22 × Mid-Width)	X	X	X	X	X	X	X	X	X	0%	11.11%
		Overall Height (2.4 × Minaret Height from Portal Iwan to Top)	X	X	X	X	✓	✓	X	X	✓	33.33%	
		Main Portal Iwan Height (1.5 × Width)	X	✓	X	✓	X	X	X	X	✓	33.33%	
	Main portal Iwan	Main Portal Iwan Width (1.43 × Opening Width)	X	✓	X	✓	✓	X	X	✓	✓	55.56%	46.67%
		Main Portal Iwan Height (1.15 × Opening Height)	X	✓	X	✓	✓	✓	X	✓	✓	66.67%	
		Opening Height (Nearly 2 times the width)	X	✓	X	✓	X	✓	X	X	X	33.33%	
		Rectangular Part of Arch Height (1.5 × Arched Part Height)	X	✓	✓	✓	X	✓	X	X	X	44.44%	
	Arcade	Arcade Height (Two stories of nearly the same height)	X	X	X	X	X	X	X	X	X	0%	14.81%
		Arches Width (0.75 × Height)	X	X	X	✓	✓	X	X	X	X	22.22%	
		C-C Distance between Arches = width of one arch	X	X	✓	X	X	X	✓	X	X	22.22%	
Color and ornamentation	Overall	Overall Color (Saturated intense colors)	X	✓	✓	✓	✓	✓	✓	✓	✓	88.88%	88.88%
	Dome	Ornamentation (lotus, vines and leaf) and color (yellow and white)	X	✓	X	X	X	✓	✓	X	✓	44.44%	44.44%
		Background color (Turquoise)	X	✓	X	✓	✓	✓	✓	X	✓	66.66%	
		A band of white thuluth calligraphy over a dark blue background	X	X	X	✓	X	✓	X	X	X	22.22%	
	Minaret	White, dark blue, and yellow spiraling bands of Kufic calligraphy	X	X	X	X	X	X	X	X	X	0%	22.22%
		Turquoise and white spiraling vines over a black background	X	X	X	X	X	X	X	X	X	0%	
		Turquoise background mainly	✓	✓	✓	X	X	✓	✓	X	✓	66.66%	
	Main portal Iwan	Dark blue muqarnas fill its half dome	X	X	X	✓	X	X	X	X	X	11.11%	24.44%
		Panels with yellow, white, and turquoise stars and vines.	X	X	✓	X	✓	X	✓	✓	X	44.44%	
		White thuluth calligraphy on a dark blue background framing the portal.	X	X	X	X	✓	X	X	X	X	11.11%	
		Dark blue background	X	✓	✓	✓	X	X	X	✓	✓	55.55%	
		Bronze doorway	X	X	X	X	X	X	X	X	X	0%	
	Arcade	Yellow, white, and turquoise trees, lotus flowers, vines, and leaf motifs	X	✓	X	X	X	✓	✓	X	✓	44.44%	50.00%
		Bronze panels that run the bottom portion of the arcades	X	✓	X	X	X	X	X	X	X	11.11%	
		Framed with a band of decorations	X	✓	X	✓	✓	✓	✓	✓	✓	77.77%	
		Dark blue background	X	✓	X	✓	✓	X	✓	✓	✓	66.66%	
Generation score in percentage			0%	48%	19%	42%	35%	45%	35%	23%	42%		

5. Findings and Discussion

The workflow presented in Figure 6 shows how the study was conducted. After investigating the literature on the characteristics of Safavid Mosque Architecture form, three main aspects were determined and converted into criteria (Table 3) to assess the generated images by Midjourney. Reference images of the Shah Mosque were used for the generation process (Figure 5) along with text prompts. The form selection process was followed and was conducted in two stages. The first stage entailed evaluating the images for the presence of the main components of Safavid mosque architecture; any image that did not include any of the main components was eliminated. Nine images resulted from this stage. Stage 2 examined two sets of criteria: proportionality and color/ornamentation. The Stage 2 criteria were measured quantitatively to a score out of 100. The best matching image resulted from this stage. Moreover, Midjourney was evaluated in this stage in terms of accuracy on how closely it adhered to the reference images inputted.

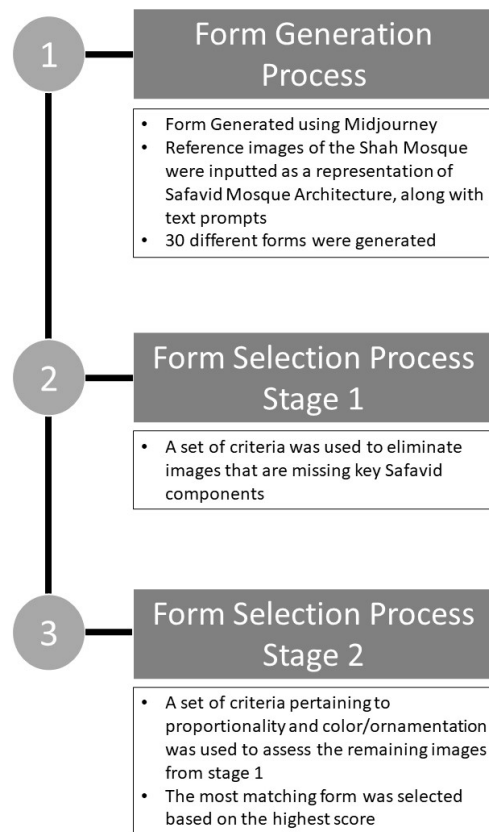


Figure 6. Form selection framework.

The outcome of Stage 1 of the form selection process shows that Midjourney is not reliable when it comes to generating mosques in the Safavid style that have the necessary components of the Safavid Mosque architecture. Only 9 out of 30 (30%) images generated passed Stage 1 of the assessment. The presence of a vast onion-shaped dome was the most missed component in the generations that were eliminated (56.67% of the generations). Some generations had domes, but they were small secondary ones with an absence of a main vast dome, while some had a main dome but were not onion shaped. On the other hand, the arcade was always present. Moreover, all the generations fulfilled the criteria of containing pointed arches as well as a main portal Iwan. Additionally, some of the generations had minarets that resembled that of other Islamic styles. Consequently, Stage 1 of the form selection process showed that Midjourney still cannot differentiate between the different Islamic architectural styles.

Stage 2 resulted in the highest-scoring form which scored 48% (Figure 7). The highest-scoring image showed the most success in terms of proportionality of the main portal Iwan, while in terms of color and ornamentation, it had the most success in the dome and arcade criteria. However, almost all other criteria of proportions are not met. Stage 2 also evaluated Midjourney's reliability in generating Safavid aspects in terms of proportionality and ornamentation. In terms of proportionality, the results showed that Midjourney is not reliable in generating minarets that are proportional to typical Safavid Mosque minarets, resulting in 11.11% success. On the other hand, Midjourney was successful in the proportions of the main portal Iwan with a 46.67% success. In terms of color and ornamentation, 88.88% of the nine generations contained an intense saturated color palette reminiscent of that of the Safavid Mosque Architecture. Midjourney scored better in terms of color and ornamentation compared to proportionality, with the lowest being 22.22% for minaret ornamentation and the highest being 50.00% for arcade ornamentation. This shows that Midjourney is better suited for generating artistic and aesthetic aspects.



Figure 7. Highest-scoring generation.

6. Conclusions

This study addressed a research gap wherein it added more insight into the use of A.I. image-generative tools in the conceptual brainstorming stage of the design process, in particular mosque architecture design process. Hence, the novelty of the study lies in the exploration of A.I. image-generative tools in the conceptual design of a mosque. It also explored the support of the typical use of text prompts in Midjourney to generate ideas with image prompts. The study analyzed the Safavid Mosque Architecture form using Midjourney, focusing on three main aspects. The process involved two stages: evaluating images for the presence of main components and assessing proportionality and color/ornamentation. The highest-scored image scored 48%, with the most success in proportionality of the main portal Iwan, and color/ornamentation of the arcade. However, most other proportional criteria were not met. Midjourney was not reliable in generating minarets proportional to typical Safavid Mosque minarets. However, it was somewhat successful in the proportions of the main portal Iwan. In terms of color and ornamentation, most of the nine generations contained an intense saturated color palette reminiscent of Safavid Mosque Architecture. Midjourney scored better in color and ornamentation compared to proportionality criteria, demonstrating that Midjourney is better suited for artistic and aesthetic aspects. In conclusion, even though Midjourney is effective in terms

of speed in generating different forms that pertain to Safavid Mosque architecture, it does not show a high level of accuracy.

Limitation and Future Work

One limitation encountered is that the study did not encompass some main elements characteristic of mosque architecture, such as the mihrab, the courtyard, and the interior of the mosque. Only the exterior form was evaluated. Another limitation is that the performance of the generated forms was not studied in terms of not just aesthetics but also the form's practicality and functionality.

A future study can encompass more of the main aspects that are characteristic of mosque architecture, such as the mihrab, the courtyard, and the interior of the mosque. Moreover, some other aspects can be further studied as individual elements, such as the ornamentation on the tile work and the arches. The results obtained for that can be used as reference images for another aspect, such as the dome or the minaret, to obtain better results for them in terms of details. Therefore, a future study can focus on individual elements to provide more understanding of A.I. image-generative tools in the role of the brainstorming process of Safavid Mosque architecture. Future research can also be conducted where typical ideation and brainstorming processes can be compared side by side against using an AI-generative tool process through field studies, observations, and surveys regarding factors such as speed, accuracy, and creativity. Another future study can focus on generating plans, sections, and other technical drawings for a form generated using A.I. image-generative tools. The performance of the generated form can be further evaluated scientifically based on aspects such as environmental performance and economic feasibility. This would give a better understanding of A.I. image generators, such as Midjourney, on their ability to not just produce creative designs but also practical ones.

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References

1. Tatomyr, I.; Kvasnii, L. (Eds.) *Artificial Intelligence: An Era of New Threats or Opportunities?* Oktan Print: Prague, Czechia, 2023.
2. Ploennigs, J.; Berger, M. AI Art in Architecture. *AI Civ. Eng.* **2023**, *2*, 8. [\[CrossRef\]](#)
3. Hanafy, N.O. Artificial Intelligence's effects on design process creativity: A study on used A.I. Text-to-image in architecture. *J. Build. Eng.* **2023**, *80*, 107999. [\[CrossRef\]](#)
4. Phillips, C.; Jiao, J.; Clubb, E. Testing the capability of AI Art Tools for Urban Design. *IEEE Comput. Graph. Appl.* **2024**, 1–8. [\[CrossRef\]](#) [\[PubMed\]](#)
5. Maksoud, A.; Al-Beer, H.B.; Mushtaha, E.; Yahia, M.W. Self-learning Buildings: Integrating Artificial Intelligence to create a building that can adapt to future challenges. *IOP Conf. Ser. Earth Environ. Sci.* **2022**, *1019*, 012047. [\[CrossRef\]](#)
6. Müezzinoğlu, M.K.; Akan, S.; Dilek, H.Y.; Güçlü, Y. An analysis of spatial designs produced through mid-journey in relation to creativity standards. *J. Des. Resil. Archit. Plan.* **2023**, *4*, 286–299. [\[CrossRef\]](#)
7. Jaruga-Rozdolska, A. Artificial intelligence as part of future practices in the architect's work: MidJourney generative tool as part of a process of creating an architectural form. *Architectus* **2023**, *3*, 95–104. [\[CrossRef\]](#)
8. Paananen, V.; Oppenlaender, J.; Visuri, A. Using text-to-image generation for architectural design ideation. *Int. J. Archit. Comput.* **2023**, 1–17. [\[CrossRef\]](#)
9. Tong, H.; Türel, A.; Şenkal, H.; Yagci Ergun, S.F.; Güzelci, O.Z.; Alaçam, S. Can AI function as a new mode of sketching. *Int. J. Emerg. Technol. Learn.* **2023**, *18*, 234–248. [\[CrossRef\]](#)

10. Maksoud, A.; Hussien, A.; Mushtaha, E.; Alawneh, S. Computational Design and Virtual Reality Tools as an Effective Approach for Designing Optimization, Enhancement, and Validation of Islamic Parametric Elevation. *Buildings* **2023**, *13*, 1204. [CrossRef]
11. Zhang, Z.; Fort, J.M.; Giménez Mateu, L. Exploring the potential of artificial intelligence as a tool for architectural design: A perception study using gaudí's works. *Buildings* **2023**, *13*, 1863. [CrossRef]
12. Maksoud, A.; Sahall, H.; Massarweh, M.; Taher, D.; Al Nahlawi, M.; Maher, L.; Al Khaled, S.; Auday, A. Parametric—Nature Obsession. *Int. J. Adv. Sci. Technol.* **2020**, *29*, 2091–2095.
13. Midjourney Quick Start Guide. Available online: <https://docs.midjourney.com/docs> (accessed on 27 November 2023).
14. Aziz, A.A. *Masjid: Selected Mosques from the Islamic World*; ATSA Architects Sdn Bhd: Kuala Lumpur, Malaysia, 2016.
15. Ching, F.D.; Jarzombek, M.; Prakash, V. *A Global History of Architecture*, 2nd ed.; Wiley: Hoboken, NJ, USA, 2011.
16. Michell, G. (Ed.) *Architecture of the Islamic World*; Thames and Hudson: London, UK, 1996.
17. Hejazi, M.M.; Saradj, F.M. *Persian Architectural Heritage*; WIT Press: Southampton, UK, 2015.
18. Petersen, A. *Dictionary of Islamic Architecture*; Routledge: London, UK, 2002.
19. Utaberta, N.; Surat, M.; Che-Ani, A.I.; Abdullah, N.A.G. The Study on the Development of Ornamentation in the Architecture of Safavid Dynasty. *Int. J. Archit. Environ. Eng.* **2012**, *6*, 465–469.
20. Hattstein, M.; Delius, P.; Ansell, G. *Islam: Art and Architecture*; H.F. Ullmann: Rheinbreitbach, Germany, 2015.
21. Frishman, M.; Khan, H.-U. *The Mosque: History, Architectural Development and Regional Diversity*; Thames & Hudson: London, UK, 2002.
22. Akbari, Z.; Neyestani, J.; Nasiri, M. An Analysis of Structural Reasons for the Use of Bulbous Domes and their Prevalence in Iran: A Case Study of Shah Mosque in Mashhad. *J. Archeol. Stud.* **2020**, *12*, 23–39. [CrossRef]
23. Goudarzi, M.; Bemanian, M.; Leylian, M. Geometrical analysis of architectural drawings in the Shah-Mosque Isfahan. *Curved Layer. Struct.* **2020**, *7*, 68–79. [CrossRef]
24. UNESCO. Meidan Emam, Esfahan. Available online: <https://whc.unesco.org/en/list/115/> (accessed on 27 January 2023).
25. Tavassoli, M. The concept of space. In *The Urban Book Series*; Springer Nature: Cham, Switzerland, 2019; pp. 57–80.
26. Khajegir, A.R.; Afroogh, M.R.; Fahim, A.R. The Art of Islamic Architecture during the Safavid Period and the Introduction of the Teachings of Islam. *J. Fine Arts* **2018**, *1*, 37–42. [CrossRef]
27. Gholam, D.; Fekry, M. Urbanism of the Neighborhood Mosque. In *Mosque Architecture: A Transdisciplinary Debate*; Pisello, A., Hawkes, D., Eds.; Springer International Publishing: Cham, Switzerland, 2023; pp. 157–166.
28. Valibeig, N.; Rahravi Poodeh, S.; Rahimi Ariaei, A. Structural and geometric analysis of discontinuous double-shell Persian domes in Isfahan and Nain Dome-Building Schools. *Int. J. Archit. Herit.* **2017**, *1*, 1101–1120. [CrossRef]
29. Gherardini, F.; Leali, F. A framework for 3D pattern analysis and reconstruction of Persian architectural elements. *Nexus Netw. J.* **2016**, *18*, 133–167. [CrossRef]
30. Duckworth, C.N.; Sassin, A.E. *Colour and Light in Ancient and Medieval Art*, 3rd ed.; Routledge: London, UK, 2018.
31. Abdullahi, Y.; Rashid Embi, M. Evolution of abstract vegetal ornaments in Islamic architecture. *Int. J. Archit. Res. ArchNet-IJAR* **2015**, *9*, 31. [CrossRef]
32. Maksoud, A.; Mushtaha, E.; Chouman, L.; Al Jawad, E.; Samra, S.A.; Sukkar, A.; Yahia, M.W. Study on Daylighting Performance in the CFAD Studios at the University of Sharjah. *Civ. Eng. Archit.* **2022**, *10*, 2134–2143. [CrossRef]
33. Maksoud, A.; Al-Beer, B.; Hussien, A.; Dirar, S.; Mushtaha, E.; Yahia, M. Computational Design for Futuristic Environmentally Adaptive Building Forms and Structures. *Archit. Eng.* **2023**, *8*, 13–24. [CrossRef]
34. Hillenbrand, R. Safavid Architecture. In *The Cambridge History of Iran*; Cambridge University Press: Cambridge, UK, 1986; pp. 759–842.
35. Torrence, C. King Mosque Isfahan Iran Façade. Photograph. Available online: <https://pixy.org/4720288/> (accessed on 8 February 2024).
36. Patrick Ringgenberg. Wikimedia Commons. Photograph. Available online: [https://en.wikipedia.org/wiki/File:Isfahan_Royal_Mosque_general_\(retouched\).jpg](https://en.wikipedia.org/wiki/File:Isfahan_Royal_Mosque_general_(retouched).jpg) (accessed on 8 February 2024).

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