Revolutionizing Plastic Furniture Design: Harnessing the Power of Artificial Intelligence

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Abstract:

The global furniture industry has experienced a surge in demand for alternative materials like plastic, driven by its versatility, cost, and effectiveness. However, designing plastic furniture poses unique challenges that require innovative approaches to ensure functionality, aesthetics, and durability. Artificial intelligence (AI) emerges as a promising tool to redefine plastic furniture design by augmenting human creativity and expertise. Recent advancements in generative AI have revolutionized the ability to generate detailed and realistic representations of design concepts, enabling quick conceptualization using natural language. AI platforms like MidJourney offer an exciting alternative to traditional design practices, providing avenues for innovative and customizable furniture creations. Despite extensive AI research in domains such as architecture, product design, and fashion, minimal research has focused on AI in furniture design. This paper explores MidJourney as an experimental tool for designing various styles of plastic furniture, highlighting the delicate balance between aesthetics, functionality, and manufacturing technology. The generated results from this experimental study and expert feedback from data gathered by an online questionnaire confirms the effectiveness of AI in plastic furniture design based on and

emphasizes the numerous benefits of AI technology in the furniture design industry.

Keywords:

Interior Design; furniture design; artificial intelligence; design concepts

1. Introduction

In recent years, the global furniture industry has witnessed a significant rise in the demand for alternative materials, such as plastic, due to its versatility, cost, and effectiveness. However, the design process for plastic furniture presents unique challenges that mandates novel approaches to ensure optimal functionality, aesthetics, and durability. Artificial intelligence (AI) has emerged recently as a promising tool in this context for redefining the design of plastic furniture by augmenting human creativity and expertise.

In the field of design, effective ideation is dependent on the ability to represent ideas. Traditionally, drawings, photographs, and other visual media have been used to stimulate ideation and communicate design concepts. Recent advances in generative AI have made it possible to generate detailed and realistic representations of design concepts (Paananen et al, 2023). New AI tools are now capable of handling complex design concepts and being used early in the design process (Hakimshafaei, 2023). During the idea generation process, Text-to-Image generation tools offered by AI can allow for quick conceptualization of ideas using natural language. As a result, these tools have the potential to change the way designers develop and communicate their concepts.

The emergence of AI platforms such as MidJourney offers a promising alternative to traditional design practices and has opened up exciting avenues for innovative and customizable furniture creations. Although AI research has been conducted in Architecture (Hegazy & Mohamed Saleh, 2023), product design (Waheed, 2023), and fashion design (Al-Qatari & Abu Rady, 2023), few researches has been steered toward the use of AI in furniture design. In this paper, we focus on the utilization of the AI as an experimental tool for designing various styles of plastic furniture. By leveraging AI's capabilities, we aim to push the boundaries of creativity, expand design possibilities, and explore novel approaches to crafting plastic furniture that caters to variety of styles, preferences, and user needs while adhering to design concepts and elements of design.

Statement of the Problem

Plastic furniture design mandates a difficult balance of various factors such as material properties, structural integrity, ergonomics, and aesthetic appeal. Achieving this balance manually can be a time-consuming and laborious task that frequently results in suboptimal results. Furthermore, the complexity of plastic material behavior complicates the design process even more. As a result, there is an urgent need to investigate AI-driven solutions that can improve the efficiency and effectiveness of designing plastic furniture, resulting in improved and more creative furniture design.

Objectives of the Study

This research paper aims to address the challenges in designing plastic furniture and present the potential AI as a tool to achieve the following objectives:

1. Investigate the current state-of-the-art AI techniques and methods to support creativity and ideation during the early stages of furniture design.
2. Evaluate the performance and effectiveness of the AI platform Midjourney in the context of furniture design to generate diverse designs and styles, and what future considerations should be considered.
3. Assess the challenges of AI text-to-image generators to provide practical guidelines and recommendations for designers in the design industry to adopt and capitalize on the benefits offered by this technology.

Significance of the Study

By conducting this study, we add to the existing body of knowledge by shedding light on the transformative role of artificial intelligence in the field of plastic furniture design. Using MidJourney to conduct this experimental design study expands AI capabilities to augment human creativity and decision-making processes, allowing designers to unlock new aesthetic potentials and push the boundaries of plastic furniture design. The study's findings have the potential to revolutionize the industry by fostering innovation and improving user experiences while overcoming the challenges associated with traditional design methods.

Terminology

Artificial Intelligence (AI): Refers to any human-like behavior displayed by a machine or system to mimic human behavior using extensive data from past examples of similar behavior (*What Is Artificial Intelligence (AI)? | Glossary*, n.d.).

Midjourney: A text-to-image artificial intelligence service developed by an independent research lab named Midjourney that allows users to generate high-quality, well-structured, and detailed images based on textual descriptions, creating a wide range of art forms, from realistic to abstract styles (What Is Midjourney | Definition, Advantages and How to Use It, 2023).

2. Background

2.1 AI Platform Midjourney

Although the concept of generative art, specifically text-to-image generative capabilities such as DALL-E and Midjourney, has been discussed as a research area for many years, it was only recently that it became aware of it (Ploennigs & Berger, 2022). These artificial intelligence bots compete with each other in terms of skills, abilities, and visual quality. In fact, according to the findings of Al-Qatari & Abu Rady (2023), Midjourney platform was the best for creating various designs in the context of women's clothing design. Midjourney was superior to the other tools in terms of verifying the foundations and elements of design and achieving the innovative and functional values of the new designs. By experimenting with text-to-image AI platforms to generate designs and comparing Midjourney, DALLE-2, and Stable Diffusion AI platforms, Hakimshafaei (2023) discovered that Midjourney could recognize all of the words in the prompt and use them in the generated images. Midjourney can also create unique designs that adhere to the main idea of the prompt in terms of design. Because a direct comparison of AI platforms and their usability is frequently complicated due to style variants, we evaluated the results of different cases in a single platform, Midjourney. By experimenting with text-to-image AI platforms to generate designs and comparing Midjourney, DALLE-2, and Stable Diffusion AI platforms, Hakimshafaei (2023) discovered that Midjourney could recognize all of the words in the prompt and use them in the generated images. Midjourney

can also create unique designs that adhere to the main idea of the prompt in terms of design. Because a direct comparison of AI platforms and their usability is frequently complicated due to style variants, we evaluated the results of different cases in a single platform, Midjourney.

In July 2022, Midjourney was released as an artificial intelligence system that generates from natural language descriptions. The tool is available through the social platform "Discord" where users can input text prompts as messages describing their scene of choice (What Is Midjourney | Definition, Advantages and How to Use It, 2023). It combines the capabilities of natural language processing and computer vision to convert textual descriptions into visually appealing and contextually relevant images. It has distinguished itself as a more "artistic" AI image generator than other alternatives since its inception, creating highly aesthetically pleasing results with a broad understanding of art styles and composition (Hegazy & Mohamed Saleh, 2023).
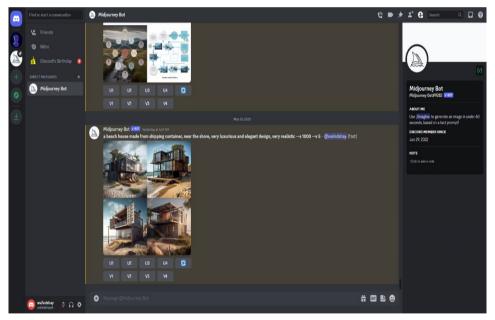

Figure 1. Midjourney channel interface in Discord (Source: Created by the author)

Midjourney has been widely used in exploratory approaches to produce fluid, dreamy forms of architecture, including façade and interior design, due to its artist-oriented nature. However, their aim was no more than to create visually appealing graphics. Furthermore, Midjourney offers several advantages as a text-to-picture AI tool (What Is Midjourney | Definition, Advantages and How to Use It, 2023) including:

- **High-quality images:** Midjourney is known for producing well-structured, defined, and realistic images, making it a strong competitor.
- **High image resolution**: Midjourney can generate images with resolutions of up to 1,792 x 1,024 pixels.
- **Freemium model**: Midjourney offers users a limited number of free image creations to test the service. Paid plans offer faster processing, additional features, and greater imaging capabilities.
- **Easy to use platform:** Midjourney works through Discord, a widely used chat platform using simple commands, making it accessible even to those with no coding experience.
- **Customization**: Midjourney offers greater control by providing a variety of commands and parameters to help users fine-tune their image creations.

A noteworthy advantage of Midjourney is that it offers successive upscaling of resolution and does so with multiple different sizes. Thus, Midjourney's workflows center on generating and comparing image variants from different text to image models and then upsampling the best one, with limited possibilities to edit the original prompt outcome (Ploennigs & Berger, 2022). Another undeniable advantage lies in the speed of the creation, which is significantly more rapid than any previously released AI (Jaruga-Rozdolska, 2022), however, AI still has a limited capacity for decision-making. The process always begins with the user entering relevant data, making it the user's responsibility to evaluate its output and make subsequent decisions that lead to the desired result. The outcomes are dependent on the users' judgment based on their knowledge, awareness, and ability to formulate accurate prompts.

2.2 Applications of AI in Design

The most possible application of text-to-image generation is during the early design phase. AI can facilitate the design process at the first stages of ideation and inspiration (Al-Qatari & Abu Rady, 2023) by accessing and analyzing a vast amount of data and references to generate new ideas and provide designers with creative concepts in minutes. Designers could quickly create a visual representation of any design concept from a written description using text-to-image generation tools. This technology can assist designers in exploring multiple design options and making more informed decisions.

Figure 2. An example of Midjourney outcome, a beach house design made of shipping containers (Source: Created by the author)

AI art generation tools have advanced to the point where they can assist architects and designers in certain aspects of their daily work (Ploennigs & Berger, 2022) thus gaining attention of several architects and designers across the globe to test out the applicability to their workflows. The study by Paananen et al (2023) has the implication that text-to-image generators could offer ideation tools in the context of creativity in architecture; however, a lot of effort must be put into the prompt language as word choice is essential. According to the findings of Jaruga-(2022) Rozdolska's study, an outline of an architectural concept can be generated by entering a suitable sequence of key words; the generated sketch has the potential to be developed further in the project, and incorporating the MidJourney tool into the practice can significantly speed up the early stages of an architect's work. The potential benefits of AI platforms for creative work are hard to overstate. According to the research (Jaruga-Rozdolska, 2022), artificial intelligence, when used appropriately, can be a valuable tool for the architect and capable of supporting the creative thinking process. Images produced through integration with midjourney depict buildings with a high level of aesthetics, and the digital image itself is visually appealing (Jaruga-Rozdolska, 2022). As a result, the potential for using scripts in architectural practice was rated as high.

With AI's limitless possibilities, designers must collaborate with AI to assist them at the start of the design process and create a design that combines human creativity with analytical capabilities and AI-supported improvement. Furthermore, when investigating the potential application of AI-based techniques in the introduction of design representation during first-year education (Tong et al, 2023), it was discovered that text-to-image AI techniques contribute to improving freshmen's interpretation and composition skills while producing new visual representations by utilizing source images and technical drawings.

These new image generation tools open up a new horizon as an inspirational tool and a fast lane for generating conceptual ideas; however, these tools have limitations, including a lack of technical abilities specific to architecture and a focus on image generation, which limits their efficiency in conceptual and post-conceptual processes (Hegazy & Mohamed Saleh, 2023). According to Paananen et al. (2023), image generators failed to attain conventional floorplan drawings because the generated floorplans are only abstract representations. They also propose

that architecture education focus on teaching students the detailed and broadly applicable expert vocabulary required to effectively describe anticipated design concepts to generative models.

The primary benefit of text-to-image generation in interior architecture is the quick production of high-quality visuals (Yildirim, 2022). Instead of spending hours or even days creating detailed 3D models or intricate computer-generated images, interior designers can simply describe their design in text and the computer will generate a realistic image. This not only saves time and effort, but also allows for greater flexibility and experimentation since designers can quickly generate multiple iterations of their designs to explore various options.

2.3 Plastic Furniture Design and Properties

Designing furniture that reflects different styles and accommodates individual tastes is a complex task that requires a deep understanding of design principles, materials, and user aesthetics. Traditionally, designers have relied on manual processes and iterative iterations to achieve desired outcomes. However, this approach can be time-consuming, limited in scope, and may not fully explore the vast design space. Moreover, when it comes to plastic furniture, which often demands a balance between form, function, and material properties, conventional design methods may fall short in generating innovative and optimized solutions.

According to Bakelite: The Plastic That Made History (2012), Leo Baekeland, a chemist from Belgium who successfully developed the first entirely synthetic plastic in 1909, revolutionized the manufacturing processes of numerous consumer goods. Termed "Bakelite" by Baekeland himself, this plastic possessed characteristics akin to many contemporary plastics, such as its lightweight nature and durability, while also being highly malleable, allowing it to be molded into a vast array of shapes. As a result, its potential was immediately recognized by manufacturers, leading to a rapid increase in its utilization. Notably, consumers were drawn to Bakelite because of its appealing aesthetic qualities, which included a sleek and stylish appearance as well as a sense of substantial luxury. Thus, gaining popularity by consumers in a diverse range of products including jewelry boxes, lamps, desk sets, clocks, radios, telephones, kitchenware, and tableware. This was a turning point, as Bakelite enabled the production of attractive, affordable, and convenient consumer goods that were previously out of reach for a broader segment

of the population. Plastic was available in various colors, including translucent and marbled shades, and featured visually striking patterns such as polka dots and chevrons. Furthermore, its versatility extended to intricate carved designs, showcasing its ability to accommodate complex shapes.

Eero Aarnio's Ball Chair (Figure 3), designed in 1963 and debuted at the Cologne Furniture Fair in 1966, exemplified the creative freedom that designers obtained by liberating themselves from the constraints of traditional carving and joining methods (How furniture design is tackling the plastics paradox, 2022, October 28). Plastics, as a novel material, played a pivotal role in facilitating the realization of audacious and innovative forms. Plastics' inherent ability to seamlessly incorporate continuous curves was particularly notable, allowing designers to experiment with novel shapes and colors that were both aesthetically pleasing and visually striking. Furthermore, the introduction of mass production techniques like compression molding and injection molding transformed the manufacturing process. These techniques not only provided designers with virtually limitless possibilities, but also helped to lower the cost of plastic-based designs, making them more accessible to a wider audience (How furniture design is tackling the plastics paradox, 2022, October 28).

Figure 3. Ball Chair (Source: Wikipedia, https://en.wikipedia.org/wiki/Ball_Chair)

Plastics are significantly less environmentally friendly than wood due to their energy-intensive manufacturing process, reliance on nonrenewable oil for most plastic furniture manufacturing, and inherent recycling challenges (Properties of Thermoplastics for Furniture SMEs and Designers, n.d.), however, wood fails to provide the translucency characteristic of plastic materials. In contrast to plastic, steel possesses a lower cost but exhibits increased weight and susceptibility to oxidation. Aluminum, on the other hand, demonstrates reduced weight but higher cost and greater energy consumption, while lacking the transparency inherent to plastics (Properties of Thermoplastics for Furniture SMEs and Designers, n.d.). The remarkable lightweight and high strength properties of plastics make it possible to build objects with significantly reduced material requirements.

3. Methodology

In this paper, we used the exploratory research method in conjunction with the Midjourney AI platform version 5 to generate unique designs in a variety of scenarios. This version can produce an adequate level of realism, also known as hyperrealism. To constrict the scope of our investigation, we needed to focus on one particular experimental subject within the domain of furniture design. To meet this requirement, a dining chair, which is considered a widely used and popular piece of furniture encountered in our daily lives that is significant in both form and function, was selected as the focal point of our experimentation.

Our intention was to create a plastic chair design solely based on relevant key words. The process of creation will be presented in the following chapter, beginning with the selection of key words and ending with the selection of the best results, which were later analyzed in terms of their usefulness in the result of created plastic furniture.

3.1 Design Keywords

To generate furniture design prompts based on keywords, we must first determine and select a variety of factors appropriate for furniture design based on the basic elements of design. Elements of design include space, line, form, color, and texture (5 Elements of Interior Design, 2021). Color and style are two elements that have previously been used in

furniture design research (Yoon & Cho, 2009). We use color to provide connection between objects and furniture in a room (The 7 Elements of Great Interior Design, 2017). Form, identified as the outline of any three-dimensional object, can be either natural or manmade (The 7 Elements of Great Interior Design, 2017). Lines and shapes that join together produce the form (5 Elements of Interior Design, 2021) which in turn impacts the contours or overall feeling of a furniture piece. Texture is an important role in interior design. Visual texture is a material's apparent smoothness or roughness (5 Elements of Interior Design, 2021). It is a tangible property of a surface that determines how a surface looks and feels. Furniture pieces with texture often add more depth to the space and interest to the eye (The 7 Elements of Great Interior Design, 2017).

Other potential factors were also included to test the platform's ability to generate creative designs. The property of translucency, which as discussed earlier is inherent to plastic materials, poses a distinct challenge when attempting to accurately simulate it within three-dimensional rendering software. Consequently, it was included as a factor to evaluate the platform's capability to effectively replicate translucent materials.

Furniture is classified according to its style or appearance, such as American style, Gothic style, Rococo style, and so on (Hu et al, 2017). Nowadays, the market offers an unimaginable variety of furniture in a wide range of styles, with numerous potential applications ranging from minimalist and modernist, to ornate and decorative styles like Baroque or Art Nouveau. For that reason, style was included as a factor.

Renowned architects' styles are always attractive for the general public (Hakimshafaei, 2023). It is advantageous if Midjourney can distinguish between different design approaches and generate original designs inspired by an architects' respective style. In fact, we sought to extend the boundaries of AI creativity by presenting a task to design plastic chair inspired by prominent artists with distinctive artistic styles. Which lead us to include inspirations another factor. Therefore, the chosen design keywords are:

- Translucency
- Color

- Texture
- Form
- Style
- Texture
- Inspirations

3.2 Image Generation Process

Using Midjourney is straightforward. First, Midjourney is accessed via the online communication software Discord. In Discord, users can provide a simple description or text prompt describing the image they have in mind. It can be as detailed or as brief as desired. The platform then processes the text input, employing sophisticated image generation model to generate a visually coherent and plausible image that aligns with the given text prompt. The model considers various factors like objects, scenes, colors, and styles to create a compelling visual representation. The command system of Midjourney (figure 2) works as follows:

1. The command: Where the user type a command for Midjourney to process. In this context, the command */imagine* was the primary used command to visualize an image.
2. The text prompt: Where a user types a description for the desired outcome.
3. Additional parameters: Modifiers that manipulate the outcome. Advanced parameters can be added such as aspect ratio to control the dimensions of the image.

Figure 4. Midjourney Command System (Source: Created by the author)

We started our inquiry with the command */Imagine a dining chair made entirely from plastic*. We've added the parameters " *realistic, in a living room, perspective view* " to each command to ensure the realism of the representation, control the scene setting, and maintain viewing angle. After entering the command, Midjourney provides the user with the four suggested images to review and provide feedback. If the generated images meet the requirements, we can choose to upscale and download any of the four images provided. In case the user is not completely satisfied, they can adjust the prompt to achieve a more accurate image representation.

Based on our explanation, the steps of Midjourney text-to-image process can be summarized as follows:

1. User provides a description or text prompt.
2. The text prompt is processed and used as input for an image generation model.
3. The system creates a corresponding image through post-processing steps.
4. The user is presented with four generated images for evaluation and feedback. If the user is not satisfied with the image, they can modify the text prompt and refine the image further.
5. A selected image is upscaled once the user is satisfied with the generated image.
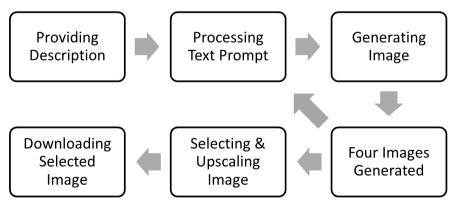6. The user download the image or view it within the platform's interface.

Figure 5. Midjourney Steps (Source: Created by the author)

3.3 Online Survey

We conducted an online survey among interior and furniture design faculty members. Using Google Forms, a questionnaire was created and distributed. In the questionnaire, a collection of images generated in Midjourney by the authors were presented to be examined first, followed by a series of questions in the form of Statements. All statements were answered on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The higher the score was, the higher the respondent agree to the statement. It was necessary to obtain critical evaluations and gather feedback from experts within the discipline in order to assess the generated designs, aesthetic appeal, and compliance to design principles, and also evaluate the benefits of using AI in designing furniture. The online survey is an effective tool for facilitating a thorough evaluation of the generated designs and deepening our understanding of AI's potential contributions to the field of furniture design.

4. Research Results

This section showcases the results of each case study, displaying the generated images that correspond to the factors under consideration. In addition, the results of survey results were included with valuable insights and feedback gathered from the panel of experts. By presenting these findings, we aim to present a comprehensive and informative overview of both the visual outputs produced and the perceptions and opinions gathered through the survey.

4.1 Generated Images

1. **Translucency**

The property of translucency, which is inherent to plastic materials, poses a distinct challenge when attempting to accurately simulate it within three-dimensional rendering software. Consequently, our initial objective was to evaluate the platform's capability to effectively replicate translucent materials. Based on our provided prompt, the script generated four variants of digital images.

Figure 6. Translucent plastic chairs generated using the prompt *"a dining chair made entirely from plastic, translucent"*

Figure 7. Translucent plastic chairs generated using the prompt *"a dining chair made entirely from plastic, translucent"*

2. Color

Then, we tested how the platform perform purely on their own with specific color selection, including the color yellow and blue. Additional designs were generated by entering blue color in the prompt. Furthermore, we conducted an examination of the platform's capability in generating a plastic dining chair featuring a combination of colors, specifically exploring the combination of yellow and red, as well as blue and green hues. The following results, presented below, display the images produced by the platform.

| **Figure 8. Plastic chairs generated in yellow using the prompt *"a dining chair made entirely from plastic, in yellow color"*** | **Figure 9. Plastic chairs generated in color blue using the prompt *"a dining chair made entirely from plastic, in blue color"*** |

Figure 10. Plastic chairs generated in a mixture of the colors using the prompt "a dining chair made entirely from plastic, a mixture between red and yellow color"

Figure 11. Plastic chairs generated in a mixture of the colors using the prompt "a dining chair made entirely from plastic, a mixture between blue and green color"

3. Texture

To test the AI's capabilities of simulating different textures, we have asked Midjourney to generate plastic chair designs with surface textured in stone, rock, and denim. The results are presented below.

| **Figure 12. Plastic chairs generated with rock texture using the prompt *"a dining chair made entirely from plastic, with rock texture"*** | **Figure 13. Plastic chairs generated with stone texture using the prompt *"a dining chair made entirely from plastic, with stone texture"*** |

Figure 14. Plastic chairs generated with denim texture using the prompt *"a dining chair made entirely from plastic, with denim texture"*

Figure 15. Plastic chairs generated with leather texture using the prompt *"a dining chair made entirely from plastic, with leather texture"*

4. Form

To create furniture pieces with different forms, we have asked Midjourney to imagine a dining chair in various objects, both manmade and natural, to achieve diverse contours. The results are presented below.

Figure 16. Plastic chairs generated with an an organic form using the prompt *"a dining chair made entirely from plastic, formed in an organic shape"*	**Figure 17. Plastic chairs generated with a form of a sculpture using the prompt** *"a dining chair made entirely from plastic, formed like a sculpture"*

Figure 18. Plastic chairs generated with a form like an origami using the prompt *"a dining chair made entirely from plastic, formed like an origami"*	**Figure 19. Plastic chairs generated with a form like a beehive using the prompt *"a dining chair made entirely from plastic, formed like a beehive"***

5. Style

Each design style carries its own unique visual language, principles, and historical context. For this reason, we have selected distinctive design styles to generate in Midjourney, including Rococo, Art deco, Renaissance, and Baroque styles.

Figure 20. Plastic chairs generated with Baroque design style using the prompt *"a dining chair made entirely from plastic, in Baroque style"*	**Figure 21. Plastic chairs generated with Rococo design style using the prompt *"a dining chair made entirely from plastic, in Rococo style"***

Figure 22. Plastic chairs generated with Art deco design style using the prompt *"a dining chair made entirely from plastic, in Art deco style"*

Figure 23. Plastic chairs generated with Renaissance design style using the prompt *"a dining chair made entirely from plastic, in Renaissance style"*

6. Inspirations

We have asked Midjourney to produce a plastic dining chair design in the style of famous architects whose style became famously recognizable and continue to influence contemporary designers. Our selected designers were Zaha Hadid, Antoni Gaudi, and Frank Gehry. The following images are the first four options generated by Midjourney.

Figure 24. Plastic chairs generated with Zaha Hadid design style using the prompt *"a dining chair made entirely from plastic, inspired from Zaha Hadid design style"*

Figure 25. Plastic chairs generated with Antonio Gaudi design style using the prompt *"a dining chair made entirely from plastic, inspired from Anotnio Gaudi design style"*

Figure 26. Plastic chairs generated with Frank Gehry design style using the prompt *"a dining chair made entirely from plastic, inspired from Frank Gehry design style"*

Figure 27. Plastic chairs generated with Frank Lloyd Wright style using the prompt *"a dining chair made entirely from plastic, inspired from Frank Lloyd Wright design style"*

We wanted to investigate AI's ability to generate designs by engaging with famous artists' artistic sensibilities and innovative approaches that capture the essence of their art forms, such as Andy Warhol, Piet Mandrian, and Pablo Picasso. The results are displayed in the following images.

Figure 28. Plastic chairs generated with Andy Warhol style using the prompt *"a dining chair made entirely from plastic, inspired by Andy Warhol style"*	**Figure 29. Plastic chairs generated with Piet Mandrian style using the prompt** *"a dining chair made entirely from plastic, inspired by Piet Mondrian style"*

Figure 30. Plastic chairs generated with Pablo Picasso style using the prompt *"a dining chair made entirely from plastic, inspired by Pablo Picasso style"*	**Figure 31. Plastic chairs generated with Salvador Dali style using the prompt *"a dining chair made entirely from plastic, inspired by Salvador Dali style"***

4.2 Survey Results

This study examined the responses of 30 interior design faculty members from government universities in Kuwait, Egypt, Saudi Arabia, Jordan, and Bahrain. Results obtained from the distributed questionnaire indicated a generally positive response regarding the effectiveness of AI to generate plastic furniture design (Table 1). Based on a 5-point Likert scale questionnaire, a majority of the participants strongly agreed with the following statements: the material used in the generated chair designs represents plastic (56.7%), AI is capable of presenting furniture designs in a realistic and attractive manner (53.3%), AI effectively replicated the translucency of plastic material (63.3%), AI was able to simulate famous art styles in some chair designs (66.7%), AI effectively implemented colors in the chair designs (43.3%), AI showcased texture effectively in the chair designs (36.7%), and AI was capable of creating designs in different forms (46.7%). The participants also expressed agreement that

the generated designs could be manufactured in reality (36.7%) and that the designs would be accepted by people (33.3%)."

Table 1. Questionnaire Results: Effectiveness of AI Generated Designs

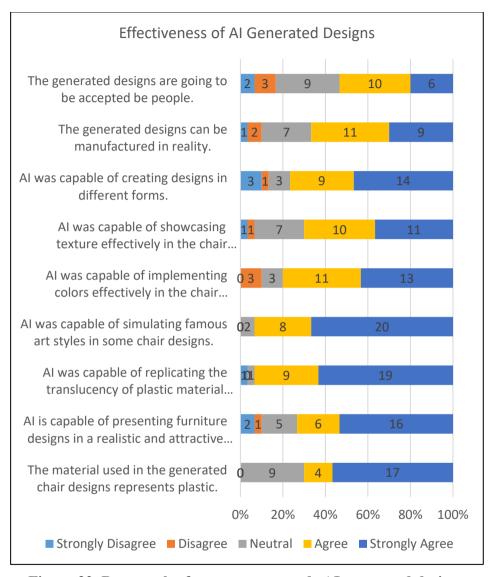| No	Statement	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	The material used in the generated chair designs represents plastic.	0.0%	0.0%	30.0%	13.3%	**56.7%**
2	AI is capable of presenting furniture designs in a realistic and attractive manner.	6.7%	3.3%	16.7%	20.0%	**53.3%**
3	AI was capable of replicating the translucency of plastic material effectively.	3.3%	0.0%	3.3%	30.0%	**63.3%**
4	AI was capable of simulating famous art styles in some chair designs.	0.0%	0.0%	6.7%	26.7%	**66.7%**
5	AI was capable of implementing colors effectively in the chair designs.	0.0%	10.0%	10.0%	36.7%	**43.3%**
6	AI was capable of showcasing texture effectively in the chair designs.	3.3%	3.3%	23.3%	33.3%	**36.7%**
7	AI was capable of creating designs in different forms.	10.0%	3.3%	10.0%	30.0%	**46.7%**
8	The generated designs can be manufactured in reality.	3.3%	6.7%	23.3%	**36.7%**	30.0%
9	The generated designs are going to be accepted be people.	6.7%	10.0%	30.0%	**33.3%**	20.0%

Figure 32. Bar graph of responses towards AI generated designs effectiveness

Regarding the subject's perception toward the benefits and advantages of using AI technology in the furniture design industry (table 2), the majority of the participants strongly agreed with the following statements: AI will save time for designers by providing creative design concepts quickly

(56.7%), and AI is capable of providing design concepts inspired by various designers and art styles (53.3%). The participants expressed agreement that they will recommend designers to use AI in designing furniture (40.0%), advise designers to use AI at thew beginning stages of a design process (26.7%), AI will assist us by producing more creative design concepts (40.0%), and facilitate the design process by producing countless design concepts (36.7%).

Table 2. Questionnaire results: Responses Towards AI Advantages

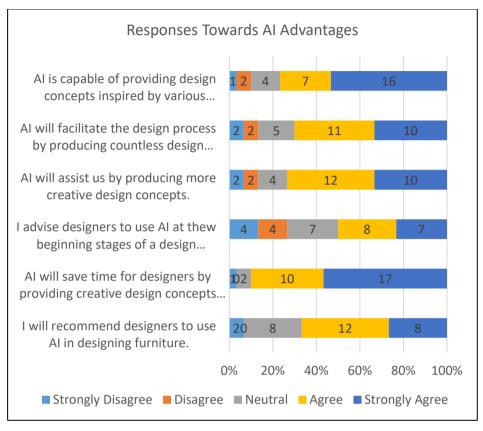| No	Statements	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	I will recommend designers to use AI in designing furniture.	6.7%	0.0%	26.7%	**40.0%**	26.7%
2	AI will save time for designers by providing creative design concepts quickly.	3.3%	0.0%	6.7%	33.3%	**56.7%**
3	I advise designers to use AI at the beginning stages of a design process.	13.3%	13.3%	23.3%	**26.7%**	23.3%
4	AI will assist us by producing more creative design concepts.	6.7%	6.7%	13.3%	**40.0%**	33.3%
5	AI will facilitate the design process by producing countless design concepts.	6.7%	6.7%	16.7%	**36.7%**	33.3%
6	AI is capable of providing design concepts inspired by various designers and art styles.	3.3%	6.7%	13.3%	23.3%	**53.3%**

Figure 33. Bar graph of responses towards AI advantages

5. Conclusion

In this paper, we examined the AI generation platform MidJourney as an experimental tool designing various styles of plastic furniture in order to present an insight of the AI image generation trend and discuss its applicability in the design domain. We highlighted the delicate balance between aesthetics, functionality, and manufacturing technology to assist designers in realizing and visualizing their creative imagination into feasible design forms. Based on our questionnaire, the panel of experts confirmed the effectiveness of AI in the context of furniture design using plastic material, and that using AI technology in the furniture design industry has several benefits, which includes:

1. Midjourney can present furniture designs realistically and attractively.
2. Translucency of plastic material can be realistically simulated in Midjourney effectively.
3. AI was successful in simulating famous styles in art and design.
4. Colors and textures were implemented efficiently in the generated designs.
5. AI is able to produce chair designs in various forms.
6. It is possible to manufacture generated AI designs in reality.
7. Future clients would accept designs generated by AI.
8. AI could provide design concepts based on inspiration from various designers and art styles.
9. AI could help designers and streamline the design process and save time by quickly producing a large number of creative design options.
10. Designers are advised to use AI early in the design process.

The cases and results shown in this paper illustrate a strong potential for AI models in furniture design specifically. Although the prompts we used were simple and generic, the AI platform Midjourney was capable of producing diverse, creative choices. The connection between AI and the design industry is not new. The emergence of AI image-based design has presented designers with a new approach to machine-aided design. While there has always been debate about AI technology, with some avid supporters and others skeptical, the argument about how we should handle the integration of AI into the design realm has not been widely covered. At this point in history, understanding this new technology and evolving our skills to incorporate AI capabilities into design workflows is more important than resisting it.

5.1 Limitations

The new image generation tools open up a new horizon as an inspirational tool and a fast lane for conceptual idea generation. However, these tools have limitations, such as lack of technical abilities and inconsistency of outcomes. To further improve on a design project, it is critical to have a consistent and unified conceptual design. Re-entering the exact same key words will never produce the same results, thus,

making it unreliable to repeat the process to achieve results with similar qualities and characteristics. While using AI image generators to generate design variations is possible, the resulting variations are not always consistent with the input designs. As a result, using AI image generators to create a unified set of visualizations for a single project can be difficult.

We need to point out that the yielded outcomes are only a visual representation of a plastic piece of furniture with no information or specifications pertaining to the dimensions or functional aspects; this is the responsibility of the designer. Also, working with current AI models requires trial and error. They infrequently produce the desired results on the first attempt and provide multiple variants for each query. The user is expected to choose the best one or refine their wording until they reach an acceptable result.

Despite the numerous potential benefits of text-to-image generation, there are also a number of obstacles and restrictions that must be considered. Text-to-image generation algorithms require training data in order to produce accurate and realistic images. The use of natural language is not always precise, and there is a risk that the system will misinterpret the users' description and generate an incorrect image (Yildirim, 2022). These limitations may be overcome in the future as AI technology continues to improve exponentially.

5.2 Recommendations

Based on the findings of this research, AI image generators have a high potential in furniture design. Several key recommendations can be made for designers and researches interested in the effective utilization of AI technology in the field of furniture design:

- Investigate and expand applications of Text-to-Image generation: Text-to-image generation tools' applications in the context of furniture design should be investigated further and expanded to include various materials and types of furniture with the interior design of the space considered as well.
- Utilize AI platforms for time-efficient concept development: Designers are advised to leverage AI platforms to expedite concept

development in furniture design. However, it is crucial to acknowledge that the digital image generated through AI is just a conceptual representation, not a final design.

- Designers must train to employ effective prompts: The results of text-to-image generation currently hinges on the skill of its users. To achieve more targeted and satisfactory results in text-to-image generation tools, designers must receive appropriate training in formulating accurate prompts using proper keywords.

- Leverage AI for simulating different Styles: The successful simulation of famous art and design styles using AI algorithms opens up exciting opportunities for designers. By integrating AI in the design process, designers can draw inspiration from diverse art movements and renowned designers, or a combination of them, to create unique and compelling designs.

- Anticipate acceptance of AI generated designs: Based on the results, it is expected that future clients will be receptive to designs generated by AI. Designers and design firms can confidently incorporate AI technology into their workflow, assuring potential clients of the quality and innovation that can be achieved through AI-driven design processes. In addition, further research should be conducted investigating clients' acceptance of AI-generated outcomes.

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ثورة في تصميم الأثاث البلاستيكي: تسخير قوة الذكاء الاصطناعي

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المستخلص:

شهدت صناعة الأثاث العالمية طفرة في الاقبال على مواد بديلة مثل البلاستيك نتيجة لمرونتها وتكلفتها وفعاليتها، و بالرغم من الطلب المتزايد يواجه تصميم الأثاث البلاستيكي تحديات فريدة تتطلب تصاميم مبتكرة لضمان الوظائف والجمالية والمتانة، يظهر لنا الذكاء الاصطناعي (AI) كأداة واعدة لإعادة تعريف تصميم الأثاث البلاستيكي من خلال تعزيز الإبداع والخبرة البشرية حيث حققت التطورات الأخيرة في الذكاء الاصطناعي تقدمًا في القدرة على إنشاء تصاميم مفصلة وواقعية، مما يمكّن من التصور السريع باستخدام لغة التخاطب الطبيعية، تقدم لنا منصات الذكاء الاصطناعي مثل MidJourney بديلًا مثيرًا لممارسات التصميم التقليدية وتوفر فرصًا لإبداع وإنشاء أثاث مبتكر، على الرغم من البحوث الواسعة في مجالات الذكاء الاصطناعي مثل الهندسة المعمارية وتصميم المنتجات والأزياء إلا أن البحوث المتعلق بتصميم الأثاث باستخدام الذكاء الاصطناعي محدودة، يستكشف هذا البحث MidJourney كأداة تجريبية لتصميم أنماط مختلفة من الأثاث البلاستيكي مسلطًا الضوء على التوازن الدقيق بين الجمالية والوظائف وتكنولوجيا التصنيع، تؤكد النتائج التي توصلت لها هذه الدراسة و البيانات المستندة من افادات الخبراء التي تم جمعها من خلال استبيان عبر الإنترنت فعالية الذكاء الاصطناعي في

تصميم الأثاث البلاستيكي وتسليط الضوء على الفوائد العديدة لتقنية الذكاء الاصطناعي في صناعة تصميم الأثاث.

الكلمات المفتاحية:

التصميم داخلي؛ تصميم الأثاث؛ الذكاء الاصطناعي؛ أفكار تصميمية