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Original Research Article

Exploring the Perspectives of Iranian Carpet Designers on Their Career Future in the Face of AI-Based Software

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Abstract

Introduction: Artificial Intelligence (AI) has become a significant force in reshaping various aspects of social, economic, and industrial life, making it a hallmark of technological advancement and future-oriented thinking. It appears that the domain of Iranian carpet design is also on the brink of transformation under the influence of this emerging power. While scholars have long debated the tension between artistic creativity and technological innovation, this study explicitly focuses on how carpet designers adapt to the advent of AI-based software capable of modifying and designing carpet patterns. The primary aim is to explore how Iranian carpet designers perceive their career prospects in the face of AI-driven design software. The central question is: How will the future of professionals in this field unfold, given the presence of AI-based design tools?

Research Method: This research employs a mixed-methods approach, combining quantitative and qualitative analysis through descriptive-analytical methods backed by library research and field studies. The researchers used behavioral analysis tools, observation, and surveys to evaluate the capabilities of four AI platforms currently available for carpet design. Subsequently, an electronic questionnaire was distributed to 132 prominent Iranian carpet designers, of whom only 50 participated.

Findings: The results reveal that, at the time of the study, only one AI software could modify existing carpet patterns, yet it lacked the sophistication to serve as a genuinely creative assistant. Despite being positioned as innovative design tools, the other available AI-based software solutions had not undergone sufficient machine learning training to be effective in the intricate field of carpet design. Additionally, the examination of experts in this field reveals that they have either not utilized AI-based software or, if they have, it has only been for resizing and modifying existing patterns. None have encountered a software solution capable of creating carpet designs from start to finish. Furthermore, 57% of the designers view AI as merely a tool to assist their work rather than a potential replacement for their profession.

Conclusion: AI-based software in carpet design can currently be seen as a tool that facilitates the design process. Whether or not AI will eventually replace designers in this field, there is an immediate opportunity to develop AI platforms that can function as design assistants. Such platforms can expedite tasks like design, color selection, pattern adjustment, and resizing—tasks that designers find particularly time-consuming and complex.

Keywords

Artificial Intelligence, AI, Carpets, Carpet Design, Career Future

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Introduction and Problem Definition

Artificial Intelligence (AI) is a complex innovation that performs tasks related to human cognitive functions through data processing. These activities include learning, problem-solving, recognition, processing, and machine vision. AI embodies humanity's pursuit of creating something that can think and act like a human. The interaction between AI and human intelligence has become a pressing issue and a growing concern for contemporary society. A stable, well-paying job is a fundamental human need, and the fear of job displacement due to the advancement and integration of AI is a significant challenge for workers and employers alike. Today, many fields are examining their futures in the face of AI, and most professions, now and increasingly in the near future, will confront this human-made technology head-on. Understanding how carpet designers perceive this issue is particularly crucial for this study. Currently, few software solutions leverage AI capabilities for carpet design, but the number of such tools is steadily growing. The main objective of this research is to explore the perspectives of Iranian carpet designers regarding their career futures in light of AI-based design software. The central question it aims to address is: How will the careers of professionals in this field evolve with the advent of AI-based design tools? This study seeks to analyze the behavior of existing AI tools about various aspects of carpet design alongside the thoughts of both traditional and modern carpet designers. By examining how AI can assist in the design process, it aims to explore potential opportunities for enhancing the status and sustainability of the carpet design profession. The hypothesis suggests that AI can facilitate the carpet design process and alleviate some of the complexities involved in production. Other questions this research seeks to answer include: Which software solutions are capable of AI-driven carpet design? How do these tools generate carpet patterns? Moreover, how can the anxiety of AI replacing human labor be transformed into an opportunity for improving efficiency and simplifying the complex stages of Iranian carpet design?

Research Method

This study employs a mixed-methods approach, integrating quantitative and qualitative methods simultaneously with a descriptive-analytical framework. The foundational data was gathered and organized through library research, while field studies were conducted using user surveys and behavior analysis. The focus was on user interactions with available AI tools, both in design and non-design contexts, particularly in carpet design. To enhance the research, the authors distributed an electronic questionnaire[1] (Authors, 2024) via link and QR code through social networks or text messages to the target group, which comprised Iranian carpet designers. Out of all recipients, only 50 individuals chose to participate. Most of the questions focused on their perspectives regarding the impact of AI. The primary goal of this research is to explore how Iranian carpet designers perceive their career prospects in the face of AI. A secondary goal is to evaluate the current AI software that has the potential to support design, specifically in the field of carpet design. The study begins with an overview of general information related to AI, followed by an examination of contemporary carpet design practices through observation and user behavior analysis. It then explores the creative potential of four popular software tools in AI and design, aiming to assess their ability to generate ideas for carpet design. Finally, the survey responses were analyzed to gain scientifically grounded insights into how AI may impact the professional futures of

Iranian carpet designers, with a focus on potential risks AI poses to the field of carpet design (Figure 1).

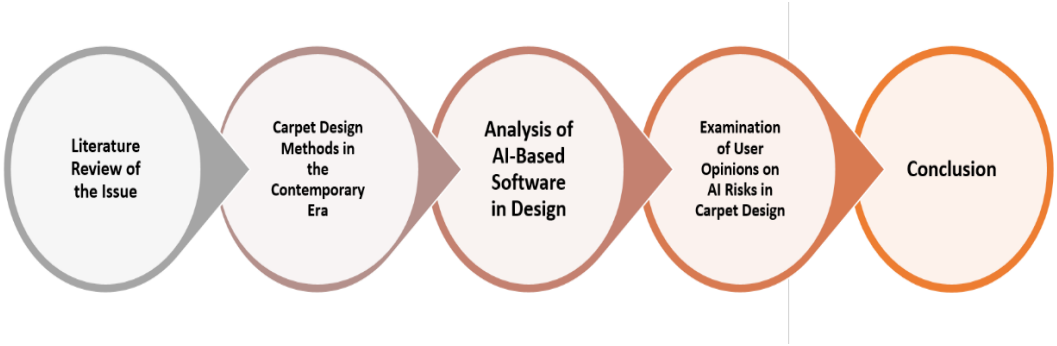

Figure 1. Conceptual Model of the Research. Source: Authors.

Research Background

There is limited information available in the field under study. «Yurman and Reddy» (2022) explored the behavior of artificial intelligence in response to prompts posed to it and the images it generates. Their findings suggest that AI creates images based on prior data—specifically, those it has seen or stored in its database. Without sufficient data, AI is unable to produce genuinely original works. «Unal & Gurbuz» (2022), in their study titled «New Carpet Pattern Design with Deep Learning», examined how AI responds to patterns provided to it. Their results indicate that, to a considerable extent, the machine can generate new designs using the novel information provided. Similarly, «Ziyi et al » (2022), in their article «AI Carpet: Automatic Generation of Aesthetic Carpet Pattern», investigated how AI can create carpet-like designs tailored to a user's living environment. The study emphasizes the role of AI in producing repetitive patterns for architectural settings, aiming to align with residents' aesthetic preferences and well-being. This research evaluated randomly selected modular and repeating carpet patterns using AI's aesthetic logic to incorporate them into residential interior design.

Artificial Intelligence

Artificial Intelligence (AI) will be one of the most fascinating and impactful aspects of technology in the coming era. Understanding its fundamental principles is, therefore, crucial. This section aims to introduce some of these foundational concepts, providing a basis for exploring AI's role in carpet design and the findings of this study. First and foremost, it is essential to define AI. The Turing Test is one of AI's earliest and most well-known definitions. It remains a philosophical topic closely linked to how humans became what they are and how human behavior differs from intelligent machines. The Turing Test, a concept in AI and computer science introduced by Alan Turing in 1950, evaluates the ability of a computer system to be reasonably classified as intelligent. The primary criterion of the Turing Test is whether a human evaluator, by examining the dialogue between a human and an unknown entity (which could potentially be a computer system), can

accurately determine, without error, whether this unknown entity is intelligent or not. Specifically, if the evaluator cannot distinguish between a human and a computer system reliably, the system is considered AI (Qaeminia, 2006). Computers possess a far greater capacity for analysis and calculation than humans. However, discussions about AI focus more on aspects of thinking, autonomy, decision-making, and human-like innovation rather than mere computational power. Today, AI is seen as a data analyst that uses information previously provided by humans to extract insights for decision-making. While this form of AI can analyze data, it still falls short of human capacity regarding thought, emotion, and autonomy (Haugeland, 1985, 287-353). The first significant research into what we now consider AI—a creative, innovative data analyst rather than just a calculator—took place at MIT in 1959, led by John McCarthy and Marvin Lee Minsky (Yazdani & Akbarian, 2023). One primary concern among those studying human resources and job risks is the employment risk posed by AI. AI has proven highly effective in the design field. According to official statistics from 2023, design-related fields face the second-highest level of job risks due to AI, highlighting a significant challenge for the industry (Cawley, 2024). Carpet design, too, is unlikely to remain unaffected by this AI wave. Thus, becoming more familiar with how AI functions in design processes is crucial. As illustrated in Figure 2, designers provide initial input to the AI, which can be written or graphic. The data is processed by AI systems trained through machine learning techniques developed by programmers and AI developers (Qin et al, 2022). The AI then uses this input to produce various designs—typically in sets of four—presented as square or three-dimensional renderings. The more precise and detailed the input data provided by the designer, and the more specialized the training of the AI in that specific field, the more accurate, clear, and realistic the resulting designs will be.

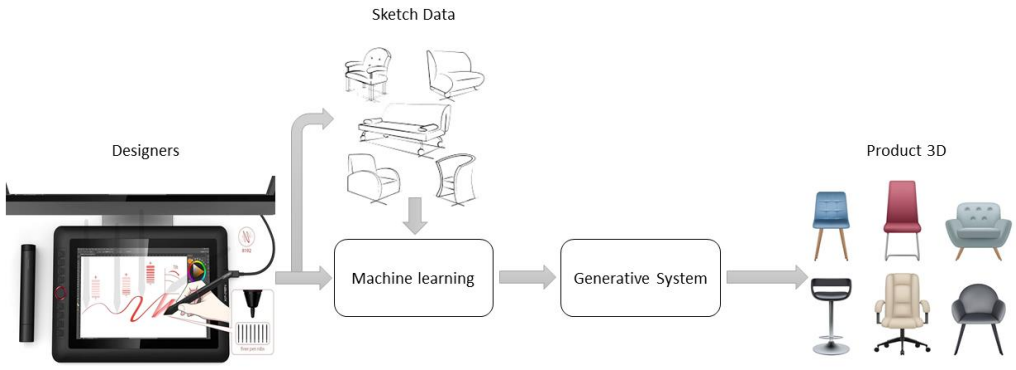

Figure 2. AI Operation in Design. Source: Authors.

Different levels of AI are considered, including Assisted Intelligence, Automated Intelligence, Augmented Intelligence, and Autonomous Intelligence, with the latter being the most advanced (Pordel & Zia Bakhsh, 2023).

Risks of Using Artificial Intelligence

«Deepfake Learning» is one of the advanced technologies in the field of machine learning, typically generated through Generative Adversarial Networks or GANs. These networks, designed by researcher Ian Goodfellow in 2014, are capable of creating fake images and other types of synthetic data. Meta, a company owned by Mark Zuckerberg, considers GANs to be one of the most intriguing concepts in the field of AI. The technology based on Conditional Generative Adversarial Networks (cGANs) focuses on producing specific images based on given conditions, as opposed to relying on random numbers used in earlier versions, to generate simulated images. Deepfake, now a prominent topic in AI, has become a mainstream issue in the field of AI technologies, especially since 2020. Deepfake learning is capable of manipulating both static and dynamic images to face off characters, transform faces with precise details, and artificially recreate speech and emotional expressions, seamlessly converting them into other faces in a fake and unrealistic manner. A significant concern with deepfakes is their potential for misuse, especially in political contexts. For example, deepfake videos could be used to create misleading representations of public figures, such as politicians, celebrities, or influencers. One notable case involved a deepfake video of Russian President Vladimir Putin. In this video, two versions of «Putin» appear in conversation, with one being a digital fabrication (AI generated Putin asks Putin about his rumored body doubles video, 2024). The challenge for viewers was to identify the real Putin from the fake one—an increasingly difficult task given the sophistication of modern deepfake technology. Given the high capability of this technology to produce fake images and videos, there is a pressing need for solutions that can differentiate between authentic and manipulated visuals. Programs designed to evaluate people's ability to distinguish real faces from fake ones can play a crucial role in refining and enhancing detection methods. For instance, Facebook, in collaboration with Microsoft, Amazon, and leading universities around the world, has launched the Deepfake Detection Challenge, aimed at developing methods to identify fabricated videos. Additionally, projects like MediFort, developed by the Defense Advanced Research Projects Agency (DARPA) in partnership with SRI International, focus on developing detection methods for altered photos and videos using GANs. The website This Person Does Not Exist[2] (This person does not exist, 2025) uses AI to rapidly generate a fake face based on data available from the internet. When you access this site, you encounter a human face with no indication that it was generated by AI. Another program[3] (Does this person exist Heroku app, 2024) prompts users with the question: Can you differentiate between a real person's face and a fake one? The site uses a million fake facial data points to create images using GANs and leverages the UTKFace Kaggle dataset to enhance its accuracy and performance. One of the most constructive uses of GANs has been in architecture. In this field, AI is widely used for the design and optimization of buildings and various spaces, showcasing one of the most notable applications of this technology. While current software can easily generate simple house layouts using previous data and outperform humans on a larger scale, this outperformance is currently limited to speed and efficiency. As we know, AI still lacks the ability to think creatively and dynamically, especially in architecture. However, in the near future, it is estimated that 90% of architects and those responsible for teaching architecture will see their jobs as dependent on AI (Nejati et al 2021).

Risks of Artificial Intelligence for Employees in the Carpet Design Industry

One of the greatest risks posed by AI to workers in the carpet industry is job reduction. As production processes become automated and intelligent machines are used, the need for human labor in specific production stages decreases. This shift may lead to unemployment or fewer job opportunities for both skilled and unskilled workers. Additionally, the introduction of AI in the carpet industry creates a demand for new skill sets. Workers may need to acquire skills related to new technologies, such as advanced software and intelligent machinery, which can be difficult for those unfamiliar with these tools. Continuous training and retraining are often required to stay competitive. A key aspect of traditional carpets is the value and beauty of handcrafted work. With the adoption of AI and automated machines, the appreciation for handmade and artisanal work by skilled craftsmen may diminish. This change could reduce the income and morale of artists and workers. Not all companies and workers in the carpet industry have access to advanced technologies, leading to a potential gap between larger and smaller companies, as well as between workers with varying skill levels. Larger companies with more resources may be able to utilize advanced technologies to enhance productivity and production quality, while smaller companies and independent workers may struggle to keep up. Relying heavily on technology and AI carries its own risks. Technical issues or disruptions in AI systems can interrupt production and design processes, leading to financial losses and delays. Such setbacks can threaten the stability of companies in the industry.

Steps of Carpet Design Preparation in the Contemporary Era

To better understand the job-related risks posed by AI for designers, it is helpful to first provide a general overview of carpet design methods before exploring AI-based design software. After determining the dimensions of a handwoven carpet, the producer either uses pre-existing designs or creates a new pattern through a meticulous process that showcases the designer's creativity and skills. In the past, designs were drawn to actual scale, requiring each carpet, with its unique dimensions, colors, and knot count, to be designed and executed separately. This process was time-consuming and intricate. Afterward, the designs were cut into various dimensions, numbered, and mounted onto wooden frames for the weaver's use. With technological advancements, the carpet design process has transformed completely. The speed and accuracy of the work have increased significantly, and correcting errors is now much easier. Today, the process of producing a carpet design digitally is carried out in two methods: semi-traditional and modern, as outlined below:

1. Traditional Design Process: In this method, all stages of carpet design are done by hand, without using digital software. First, the dimensions of the carpet design are determined. Then, a gridded design paper is prepared, using either the Azeri style (graph paper with red lines) or the Farsi style (graph paper with white lines), according to the planned dimensions. The design is drawn on paper, with colors and detailed dot-by-dot shading directly applied to match the final carpet's color scheme. The design is then cut into sections of 60 by 30 centimeters, adhered to wooden frames, numbered, and handed over to the weaver.

2. Semi-Traditional Carpet Design Process: The design process begins with an initial pencil sketch on paper, with any flaws corrected using an eraser. Once refined, the sketch is traced with a permanent tool, such as a pen or marker, to preserve the design, or it's

transferred to a new sheet using a light table for enhanced clarity. The finalized design is then either scanned or photographed in high resolution to create a digital file, which is transferred to a computer for further adjustments in size and scale. Next, the design is manually pixelated by marking each pixel, often with vibrant colors like fluorescent hues to improve clarity. The pixelated design is then shaded and colored according to the client's or designer's preferences, using either accent colors or the primary palette. Once completed, the finalized design can be printed as a paper pattern for handwoven carpets or formatted as a digital file compatible with automated weaving systems for machine-made carpets (Figure 3). In the final step, any necessary resizing or modifications are made to the file, aligning it with the new colors and dimensions.

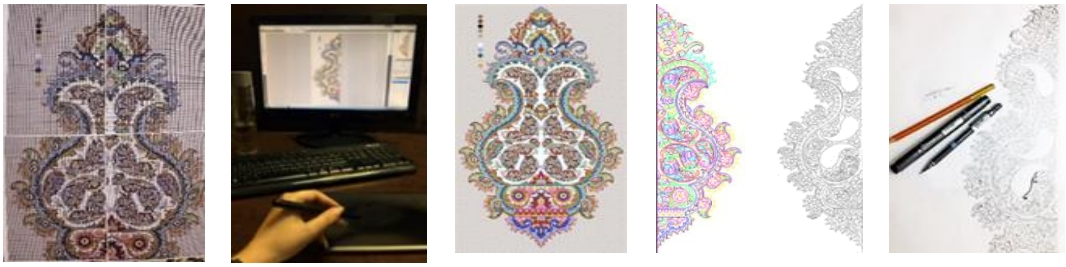

Figure 3. Modern Approach in Handwoven Carpet Design (Naghash chirehdast & Hojati Emami, 2023).

3. The Digital Carpet Design Process: In this approach, traditional tools like paper, pencils, and erasers are replaced with digital drawing tools and software. The designer completes each stage of the design process with a stylus on a digital screen. Various hardware options support digital pens and pads in this field, including iPads, Wacom tablets, and other brands recognized for their quality and reliability. The modern design process, or digital design workflow, involves the following steps: the designer first creates an initial sketch with a stylus on the digital screen in a light, draft form (Figure 4). The design can be adjusted multiple times until the desired outcome is achieved. The final file is then resized to match the intended carpet dimensions. Additional steps, such as dotting and coloring, follow this adjustment. The subsequent steps align with those of the semi-traditional design process (Figure 3).

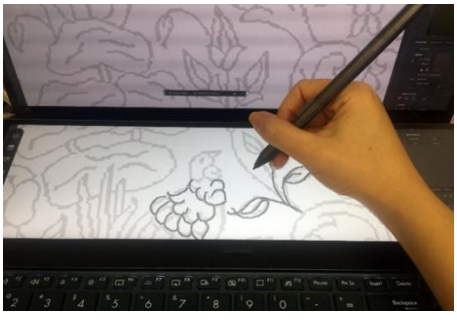

Figure 4. Carpet design on a digital screen. Source: Authors.

Another essential element of carpet design is color. In every culture, the psychological significance of color is closely tied to the customs and way of life of that culture. In carpet

design, the use of color is crucial and foundational. Manufacturers typically provide a defined color palette with a specific range of colors, which varies according to the weaving style of the region and the production process. Designers use these palettes when selecting colors for the carpet pattern. Similarly, in architecture, various digital tools are used throughout the design process and in the professional practices of contemporary architects. These digital tools significantly enhance the design process, from the ideation phase to presenting architectural projects. The choice of these tools should be based on a balanced and unbiased assessment of their strengths and weaknesses, fostering a rational decision-making process (Asgari & Fathi, 2022).

Types of AI-Assisted Carpet Design Software

To effectively leverage artificial intelligence in carpet design, all essential design parameters require thorough examination. This foundation enables the development of AI-based or AI-assisted software tailored specifically to carpet design. Currently, only a few applications utilize AI for image generation in this field, with just one rudimentary example available. In response, we have undertaken a study to examine how AI, particularly in image generation and design software, interacts with carpet design—focusing on the creation of traditional Iranian carpet patterns. We tested four AI-based image-generation tools capable of producing designs for handmade carpets, evaluating their effectiveness through a question-and-answer approach. These tools have limitations, especially in image creation, as output quality heavily depends on the detail and specificity of user input. When unable to fulfill a request, the AI typically responds, «I'm sorry, but I cannot assist further. If you have another question, please ask!»

1. Microsoft Copilot on Windows: Our experiments with Microsoft Copilot for carpet design yielded several insights. We structured the interaction as a Q&A session with Copilot, which is accessible for free across all Windows-based systems. Copilot, known for its image-generation capabilities, uses DALL-E 3 integration to produce improved results with more advanced prompts. However, for research consistency, we limited testing to four similar prompts. Three prompts involved direct requests for image generation (Table 1), and the final prompt involved uploading a segment of a carpet design to assess Copilot's ability to modify it.

Table 1. Images generated by Copilot AI in response to prompts posed by the end-user. Source: Authors.

Prompt	Draw a carpet pattern with an Isfahan design.	Provide with me a carpet with a high-pile weave and an Isfahan design.
Image		
Number	Figure 5	Figure 6
Prompt	Provide a rug loom with a weaver at work.	Modify the uploaded carpet pattern.
Image		Unfortunately, Copilot AI could not recognize the uploaded carpet pattern for modification.
Number	Figure 7	

As shown in Figure 5, Copilot AI can distinguish a carpet, rug, or pattern from other inanimate objects. Additionally, in most cases, it attempts to present the carpet in a physical or architectural setting (Figure 6) or in an outdoor environment. The use of architectural elements in drawing carpet patterns is evident. The AI demonstrates a partial understanding of carpet pile and fringe. The fringe is rendered correctly in the cross-section but incorrectly in the horizontal section of the carpet using cotton-like materials. However, the depiction of the pile resembles felt more than the typical vertical fiber piles of wool or silk found in carpets, as seen clearly in Figure 6. The AI lacks an understanding of the standard rules and processes in traditional and modern carpet design and production. For instance, in Figure 7, the loom is depicted horizontally with several people seemingly weaving from all directions, reminiscent of fabric weaving rather than carpet weaving. This illustrates the AI's perception of the weaving process based on its dataset. Ultimately, it becomes clear that this AI does not have a precise understanding of concepts such as designing shapes and patterns in carpets, along with related areas. The consistency and accuracy of the above results may change from today (03/27/1403, Persian calendar) to tomorrow, as one of the core features of AI is its ability to learn and adapt through continuous interaction and question-answering, constantly evolving its knowledge base.

2. Midjourney AI: Midjourney is a sophisticated AI system that generates unique, high-quality artwork based on written prompts. This platform can produce visually detailed, high-resolution art by interpreting text inputs. Midjourney's algorithms quickly access and process a large database of images to identify visual patterns that align with user requests. It serves as a creative tool in fields like design and architecture, inspiring innovative ideas that might not naturally occur to human designers (Pordel & Zia Bakhsh, 2023). This AI

tool is not freely available, and generating images with it requires a foundational knowledge of programming commands and English, making it challenging for general public use. Both basic and advanced training may be necessary for those unfamiliar with these requirements, as Midjourney is not particularly user-friendly and has accessibility limitations. Here, as in previous studies, a conversation between an end-user and Midjourney AI was conducted. The same prompts posed to Copilot AI were also presented to Midjourney to enable comparative data analysis. The consistency and accuracy of Midjourney's responses may evolve over time—today's answers (04/07/1403, Persian calendar) could differ in future interactions—as AI systems learn continuously from user engagement. The images generated by Midjourney AI, based on the user's prompts, are presented in Table 2.

Table 2. Images generated by Midjourney AI in response to prompts posed by the end-user. Source: Authors.

Prompt	Draw a carpet pattern with an Isfahan design.	Provide me with a carpet with a high-pile weave and an Isfahan design.
Image		
Number	Figure 8	Figure 9
Prompt	Provide a rug loom with a weaver at work.	Modify the uploaded carpet pattern.
Image		Unfortunately, Midjourney AI could not recognize the uploaded carpet pattern for modification.
Number	Figure 10	

Here, three images have been analyzed, each highlighting areas where Midjourney excels in carpet design and where further development is needed. Midjourney AI does not fully grasp the unique design elements, individual color points, and shading techniques essential in carpet design. Although it lacks the deep machine-learning capabilities needed to create an entire carpet pattern, it can partially recognize certain elements of a woven carpet. As depicted in Figure 8, Midjourney shows promise in identifying curved designs, capturing many of the key shapes typical of Isfahan carpet patterns. Foundational elements of carpet design, though basic, are represented in a manner that aligns with an introductory understanding of the craft. Figure 9 reflects some limitations in depicting carpet piles. Although a closer look reveals some attempt to depict the pile texture, the carpet is shown within a historical context rather than as an isolated design. Figure 10 offers a detailed rendering of a horizontal loom in use, presenting a unique and informative view of a carpet-

weaving workshop. The warp and weft resemble jute yarn, with attention to detail evident in the depiction of the weaving process. Additional images generated from this prompt suggest that Midjourney lacks a clear understanding of the traditional carpet loom and seems more familiar with textile weaving techniques than those used for carpet weaving. Overall, Midjourney demonstrates a growing capability to interpret certain aspects of carpet weaving but still requires significant progress to accurately capture and model the finer, more intricate details specific to diverse carpet weaving techniques.

3. AI in Photoshop: Photoshop is widely used in both handmade and machine-made carpet design and production. Its accessibility and affordability make it an invaluable tool for professionals. With its pixel management capabilities, Photoshop assists in managing colors and point-based elements within carpet designs. While often used manually to adjust dimensions and refine patterns, Photoshop's AI (Firefly) functionality is less frequently employed as a design assistant, particularly for tasks involving coloring, dotting, and dimension adjustments. Notably, similar prompts given to Photoshop's AI went unanswered, and Photoshop's AI is unable to understand or convert those four prompts into images. It also lacks the ability to distinguish between shaded and unshaded pixel colors, which limits its effectiveness in accurately rendering these variations.

4. Specialized Carpet Design Software, Booria[4]: Several specialized software programs are available for carpet design, including «Booria», «Tooba»[5], and «Naghshineh»[6]. As of this study, only one of these—Booria—has been specifically designed and developed for the carpet industry by a company of the same name. While Booria incorporates some AI capabilities, these are limited and focus primarily on specific, predefined functions. Unlike previous AI tools, Booria lacks interactive Q&A features, requiring all commands to be entered using a set of shortcut commands. It responds only to specific commands within designated functions. Unlike previous AI tools, Booria does not generate images. Although it addresses various technical issues in carpet design, it lacks the adaptive flexibility and creative problem-solving that a full AI assistant might offer. Without integrated assistant-like features, Booria is unable to respond to the first three prompts posed in this study. Booria's AI-driven features include shortcut keys for correcting and refining carpet patterns. This functionality partially addresses the fourth prompt, «Modify the uploaded carpet pattern». However, as previously noted, Booria's AI functions are limited to command keys and are not adaptive. It can load carpet designs, make basic adjustments, and convert patterns through key commands and standard tools such as a mouse and keyboard. Unlike Photoshop, Booria is designed as a specialized carpet design tool, covering essential tasks like color selection, pattern creation, and design refinement. The initial AI features in Booria allow for simple transformations, such as converting tile patterns, switching between quarter (1/4) and full (4/4) designs, and making limited corrections. In its updated versions, Booria provides significant support for editing large-format carpet designs and scaling. However, it has been less successful in adjusting designs for smaller carpets, such as those under 9 square meters.

Figure 11. Resizing a Carpet Design Using Booria AI Software: Conversion from 12-square-meter Dimensions (Left) to 9-square-meter Dimensions (Right). Source: Authors.

As shown in Figure 11, the reduction from 12-square-meter dimensions to 9-square-meter dimensions is accurately achieved. However, Booria's AI occasionally encounters difficulties in interpreting specific motifs, which can lead to overlapping or duplicated design elements. Final adjustments by a human editor are often needed to correct any distortions created during the AI-driven resizing process.

Figure 12. Resizing a Carpet Design Using Booria AI Software: Conversion from 6-Square-Meter Carpet (Left) to Small Rug (Right). Source: Authors.

Figure 12 illustrates the resizing of a 6-square-meter carpet to a rug with dimensions of 1.5 × 2.25 square meters using Booria's AI software, which presents certain quality challenges. The software struggles to maintain consistency in pattern, color, and alignment, resulting in visibly disrupted design elements. Table 3 provides a summary comparison of four AI tools and their carpet design capabilities.

Table 3. Comparison of AI Software Capabilities for Carpet Design. Source: Authors.

AI Tool	Image Creation Assistant	Specialized for Carpet Design	Carpet Design Capability	Coloring and Dotting Capability	Resizing and Design Modification	Design Modification with AI
Midjourney	Yes	No	Partially	No	No	No
Copilot	Yes	No	Partially	No	No	No
Photoshop	Partially	Partially	Yes	Yes	Yes	No
Booria	No	Yes	Yes	Yes	Yes	Partially

In the final phase of the study, a questionnaire and interviews were conducted with specialized carpet designers to understand their perspectives on artificial intelligence (AI) and the future of carpet design careers as AI technology evolves. The questionnaire, which contained 18 qualitative questions, was distributed electronically to 132 field experts aged

19 and older. A total of 50 designers—specializing in handmade and machine-made carpets—participated in the survey. Respondents were chosen through a simple stratified sampling method, and responses were analyzed using statistical software. Of the 50 respondents, 71.4% were women and 28.6% were men. Additionally, 85.7% of participants were between 20 and 40 years old, while the remainder were older. Regarding education, 92.9% of respondents held university degrees, while 7.1% did not (Table 4). The survey included key questions on AI, with findings summarized in Table 4. This table presents the frequency and percentage distribution of responses, providing insight into designers' familiarity with AI, its perceived impact on their careers, and which areas of carpet production they believe are most likely to be affected.

Table 4. Carpet Designers' Perspectives on AI. Source: Authors.

Row	Question	Response Options	Frequency	Percentage
1	Do you have sufficient knowledge of AI?	Yes	21	42.9%
		No	11	21.4%
		Somewhat	18	35.7%
2	Do you have experience using AI-based software?	Yes	11	21.4%
		No	25	50.0%
		Somewhat	14	28.6%
3	What is your view on the future of carpet design with AI?	Positive	18	35.7%
		Negative	18	35.7%
		No opinion	12	28.6%
4	Do you think AI could impact the future of carpet designers' careers?	Yes	29	57.1%
		No	18	35.7%
		No opinion	4	7.1%
5	Which production stage do you believe AI will impact most?	Weaving	4	7.1%
		Dyeing	0	0.0%
		Designing	43	85.7%
		Finishing	0	0.0%
		Sales & Marketing	4	7.1%
6	Which part of the carpet design process will AI impact most?	Designing	14	28.6%
		Painting & Coloring	7	14.3%
		Dotting	11	21.4%
		Dimensioning & Design Adjustment	18	35.7%
7	In which area of carpet production is a designer's career most at risk due to AI?	Handmade Carpet Design	4	7.1%
		Machine-made Carpet Design	46	92.9%
8	Do you have experience with carpet design software?	Yes	39	78.6%
		No	11	21.4%
9	Which design stage is best suited for AI involvement?	Dimension Adjustment	18	35.7%
		Dotting	21	42.9%
		Designing	4	7.1%
		Coloring	7	14.3%
10		Yes	29	57.1%
		No	14	28.6%

Row	Question	Response Options	Frequency	Percentage
	Do you think AI will impact the future careers of carpet designers?	No opinion	7	14.3%
11	What size conversion is optimal for AI?	Converting a 12-square-meter design to a larger scale	14	28.6%
		Converting a 9-square-meter design to a 12-square-meter design	14	28.6%
		Converting a 9-square-meter design to a 6-square-meter design	0	0.0%
		Converting a 6-square-meter design to a smaller scale	21	42.9%

As shown in Table 4, 57.1% of respondents are confident that AI will have a direct impact on their career future, while the remaining respondents either disagreed or found it unimportant. So far, respondents have interacted with ChatGPT through a question-and-answer format and are somewhat familiar with it. They would like Photoshop to incorporate AI capabilities to speed up carpet design adjustments, given its accessibility and affordability.

Conclusion

Artificial intelligence is a hallmark of our technological era. The field of carpet design is poised for significant changes due to this groundbreaking invention. If we view artistic and manual creativity as the cornerstone of art in the AI age, industrial carpet design will inevitably undergo major transformations soon. While AI might partially replace human artistic flair, it cannot fully substitute the artist's aesthetic vision or eliminate the need for human artistry in an unfair competition. The integration of AI in carpet design and manufacturing brings numerous opportunities and advantages, but we must also acknowledge the risks and challenges for employees in this field. Addressing these challenges requires suitable educational and retraining programs for workers and artists, as well as measures to reduce disparities in technology access. It is crucial to strike a balance between embracing modern technology and preserving manual craftsmanship to ensure sustainable and equitable growth in the carpet industry. AI tools, capable of learning design data, drawing techniques, and the method of coloring and dotting through machine learning, can act as assistants, significantly reducing the burden of repetitive tasks and accelerating processes. As a result, artists can oversee the machine's performance, ensuring that the final design aligns with their artistic sensibilities for carpet weaving. Just as digital drawing tools have replaced traditional methods, AI is making the design process more accessible, faster, and convenient for carpet designers. While it may be challenging to claim that AI will replace the artistic inclinations and inner inspirations of a carpet designer, it can indeed ease their workload. Is a pottery piece crafted by hand on a wheel not replicable by the ceramics industry? While both serve as vessels to the consumer, they hold different meanings. Similarly, an artist's flair cannot be equated to the final product of an AI assistant. Whether AI replaces designers or not in the near or distant future, this research can greatly assist software developers in creating practical tools to simplify the work of carpet designers, particularly in adjusting and revising carpet maps. AI-assisted carpet design leverages AI to create innovative and personalized patterns. Research indicates that AI, especially deep

generative adversarial networks, can generate new designs based on visual data, leading to high-quality synthetic designs. Moreover, AI integration in carpet design extends beyond aesthetics to functionality.

Author Contributions

This study was conducted in collaboration with all authors. All authors discussed the results and reviewed and approved the final draft.

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Conflict of Interest

The author (s) declare that there are no potential conflicts of interest related to this research, in writing, and publication of this article

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Appendix

1. https://survey.porsline.ir/s/6QuLqoi, 2024/12/05
2. https://www.thispersondoesnotexist.com/, 2024/11/05
3. https://does-this-person-exist.herokuapp.com/static/index2.html, 2024/10/05

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