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Employing Artificial Intelligence to Design Clothing Inspired by the Najdi Art of Sadu

Basmah Abdulmohsen Alshaikh* , ***Nermeen Abdelrahman Abdelbast Mohamed***

Department Fashion and Textiles, Faculty of Human Sciences and Design, King Abdulaziz University, Jeddah, Saudi Arabia.

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* *Corresponding author:*
alshaikhbasmah@gmail.com

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Abstract

Objectives This study aims to design women's dresses inspired by digital patterns of Najdi Sadu art, using an innovative approach based on artificial intelligence and specialized fashion design software.

Methods The research employed a descriptive-analytical approach to describe and analyze the heritage background of Sadu textile, its manufacturing methods, the materials used in its production, its symbolic meanings, and the importance of these heritage symbols. The study also applied experimental research using artificial intelligence tools to innovate contemporary clothing designs inspired by Najdi Sadu. The study sample included six experts in the field of fashion design to evaluate the proposed digital fashion designs. A questionnaire was used as a tool to obtain the opinions of experts on the proposed designs.

Results: The findings showed that Design 3 excelled in the aesthetic aspect, obtaining the highest relative weight percentage of 95%. In terms of functionality, Design 3 also stood out with a relative weight percentage of 94%, followed by Design 2 with 87%. The remaining design options obtained relative weight percentages ranging from 73.23% to 46.43%, indicating a moderate level of quality.

Conclusions: This research demonstrates the successful use of artificial intelligence as a transformative tool in designing clothing inspired by Sadu art, effectively embodying both its aesthetic value and functional aspects. By harnessing the power of artificial intelligence, we not only ensure the preservation of traditional arts such as Sadu weaving but also pave the way for the sustainable production of culturally significant clothing.

Keywords: Najdi Sadu fabric, Artificial intelligence, Sadu Patterns, CLO3D program, Woman Fashion.

توظيف الذكاء الاصطناعي لتصميم الملابس مستوحاة من فن السدو النجدي

بسمة عبدالمحسن الشيخ**، نرمين عبدالرحمن عبدالباسط محمد

قسم الأزياء والنسيج، كلية العلوم والتصاميم، جامعة الملك عبدالعزيز، السعودية.

ملخّص

الأهداف سعت هذه الدراسة إلى تصميم فساتين نسائية مستوحاة من الأنماط الرقمية لفن السدو النجدي، وذلك باستخدام أسلوب مبتكر يعتمد على الذكاء الاصطناعي وبرامج تصميم الأزياء المتخصصة.

المنهجية: استخدم البحث المنهج الوصفي التحليلي لوصف وتحليل الخلفية التراثية لنسيج السدو، وطرائق تصنيعه، والمواد المستخدمة في صناعته، ودلالاته الرمزية، وأهمية هذه الدلالات التراثية. كما طبق البحث المنهج التجريبي باستخدام أدوات الذكاء الاصطناعي لابتكار تصميمات ملابس معاصرة مستوحاة من نجدي السدو. شملت عينة الدراسة ستة خبراء في مجال تصميم الأزياء لتقييم تصاميم الأزياء الرقمية المقترحة. وتم استخدام الاستبيان كأداة للحصول على آراء المختصين حول التصاميم المقترحة.

النتائج: أظهرت النتائج أن التصميم 3 يتفوق في الجانب الجمالي، حيث حصل على أعلى نسبة وزن نسبي قدرها 95%. ومن حيث الجانب الوظيفي، يبرز التصميم 3 أيضًا بنسبة وزن نسبية تبلغ 94%، يليه التصميم 2 بنسبة 87%. وحصلت خيارات التصميم المتبقية على نسب وزنية نسبية تتراوح بين 73.23% إلى 46.43%، مما يشير إلى مستوى متوسط من الجودة.

الخلاصة: يوضح هذا البحث الاستخدام الناجح للذكاء الاصطناعي كأداة تحويلية في تصميم الملابس المستوحاة من فن السدو، وتجسيد القيمة الجمالية الأساسية وجوانبه الوظيفية بشكل فعال. ومن خلال تسخير قوة الذكاء الاصطناعي، فإننا لا نضمن الحفاظ على الفنون التقليدية مثل نسج السدو فحسب، بل نمهد الطريق أيضًا لإنتاج مستدام للملابس ذات الأهمية الثقافية.

الكلمات الدالة: نسيج السدو النجدي، الذكاء الاصطناعي، أنماط السدو، برنامج CLO3D، أزياء المرأة.

1. Introduction

The human sciences are intimately connected to humanity, influencing our civilization and culture. They contribute significantly to the formation of both the historical and existential aspects of our past and present. Therefore, studying this type of science is extremely important to understand the past and transition to the present in good ways that contribute to preserving it in a renewed form called heritage, one of the aspects of these human sciences. (Al-Hilil, 2007) Heritage and its preservation in all its forms is a social issue that people have been keen to care for, preserve, and pass on to generations one after the other. In recent years, the Kingdom of Saudi Arabia has shown a strong commitment to preserving its heritage. It has made concerted efforts to present its heritage in the most favourable light and register its properties with various institutions that specialize in this field (Al-Faiz, 2016).

Handicrafts, and especially textiles, hold significant historical connotations within Saudi society. The Najdi Sadu weaving is one of the most important handicrafts that the Bedouin women in the Kingdom of Saudi Arabia used to work on. It is one of Saudi heritage and culture's most important and famous aspects. The Kingdom has been keen to register its ownership within the list of intangible cultural heritage at “UNESCO” as a joint file with the sisterly State of Kuwait (KSA for Unesco, 2021).

Artificial intelligence is one of the aspects of human life development that has affected the shape and requirements of life. With this technological revolution that has superior capabilities to influence various aspects, such as presenting realistic innovations that can be implemented and others that are unrealistic, it was necessary to emphasize the heritage and culture from which the fathers and ancestors originated and made an effort to achieve its continuity. Because the Sadu weaving is one of the aspects of art and a heritage and cultural treasure for the Kingdom of Saudi Arabia, it is necessary to preserve and update it in one way or another in the form of products that increase the aesthetic and heritage value.

The application of Artificial Intelligence (AI) in the realm of fashion design has been the subject of comprehensive research by numerous scholars. Choi et al. (2023) collected and analysed existing cases of AI-based garment design tools to identify the similarities and differences between the garment development processes of human designers and the existing AI-based garment design tools. Al Qatari and Abu Rady (2023) created various designs for women’s clothing using artificial intelligence (AI) tools to generate images. Most of these studies have used complicated AI software to produce the designs.

However, this study has come with a simple innovation that combines AI tools with specialized fashion design programs to design women's dresses inspired by digital patterns of Najdi Sadu art.

1.1 Statement of the Problem

The research problem addressed in this paper is the need to preserve and update the art and heritage of Najdi Sadu weaving in the Kingdom of Saudi Arabia through the application of artificial intelligence (AI) in fashion design. While previous research has explored the use of AI in garment design (Jelil, 2018), there is a gap in the literature regarding the integration of AI tools with specialized fashion design programs to create women's dresses inspired by digital patterns of Najdi Sadu art. This research problem stems from the importance of preserving cultural heritage, such as the art of Najdi Sadu weaving, and the potential of AI technology to enhance the aesthetic and heritage value of fashion designs while maintaining the authenticity of Saudi identity.

Based on the research problem described, the following research questions can be formulated:

1.2 Research Questions

1. How can artificial intelligence (AI) tools be effectively integrated with specialized fashion design programs to create women's dresses inspired by digital patterns of Najdi Sadu art?
2. What are the key design elements and characteristics of Najdi Sadu weaving that can be incorporated into AI-generated fashion designs?
3. What are the perceptions of fashion specialists towards AI-generated fashion designs inspired by Najdi Sadu art?

1.3 Research Objectives

1. To demonstrate how artificial intelligence (AI) tools can be integrated with specialized fashion design programs to create women's dresses inspired by digital patterns of Najdi Sadu art.

2. To identify and analyze the key design elements and characteristics of Najdi Sadu weaving that can be incorporated into AI-generated fashion designs.
3. To assess the perceptions of fashion experts towards AI-generated fashion designs inspired by Najdi Sadu art.

1.4 Research significance

1. This research contributes to the preservation and promotion of Saudi Arabia's cultural heritage by utilizing artificial intelligence (AI) to create fashion designs inspired by the art of Najdi Sadu weaving,
2. It offers a novel approach to update and preserve the traditional art form, ensuring its continuity and relevance in contemporary fashion.
3. The integration of AI technology with the cultural patterns of Najdi Sadu art helps reinforce the Saudi identity in the realm of fashion design, by incorporating authentic cultural elements into AI-generated designs, the paper fosters a sense of pride, uniqueness, and cultural representation for Saudi society.
4. The research contributes to the advancement of the fashion industry by showcasing how AI can be effectively integrated with specialized fashion design programs to enhance creativity, efficiency, and design possibilities.
5. The research addresses the growing interest in AI-driven fashion design tools and their potential impact on the industry, providing valuable insights for fashion designers, researchers, and industry professionals on the possibilities and challenges associated with integrating AI into the creative process while maintaining cultural authenticity.

1.5 Research Hypothesis

H1: There are statistically significant differences between the opinions of specialist regarding the three proposed designs from an aesthetic and functional perspective.

1.6 Research Delimitations

Geographical Delimitation: The research was conducted in the city of Jeddah in Saudia Arabia

Time Delimitation: This research was carried between October 2023 to December 2023.

Population Delimitation: Six specialists in the fashion and design industry. The study primarily considers the perspectives of fashion specialists in utilizing AI tools and incorporating cultural heritage into their designs

Conceptual Delimitation: The study will focus on the utilization of AI tools in fashion design, specifically in creating women's dresses inspired by Najdi Sadu art.

1.7 Research terms

Najdi Sadu fabric

Najdi Sadu fabric, also known as Najdi Sadu weaving or simply Sadu, is a traditional textile craft and weaving technique originating from the Najd region in Saudi Arabia. It is characterized by its vibrant colors, geometric patterns, and intricate designs. The fabric is traditionally handwoven using a simple loom called a "tawheed," which consists of two vertical wooden beams connected by horizontal bars. The warp threads are stretched tightly between the beams, and the weaver uses a shuttle to pass the weft threads through, creating the fabric. Najdi Sadu fabric is typically made from sheep wool, which is dyed in various colors using natural dyes derived from plants and minerals. The patterns and motifs in Najdi Sadu often reflect the region's cultural heritage, including elements such as palm trees, camels, geometric shapes, and tribal symbols. These designs hold symbolic meanings and are often used to tell stories or convey cultural identity (Khazi & Manal, 2016).

Artificial Intelligence

Artificial Intelligence (AI) is the theory and development of computer systems able to perform tasks normally requiring human intelligence, such as visual perception, speech recognition, decision-making, and translation between languages. It refers to computer systems capable of performing complex tasks that historically only a human could do, such as reasoning, making decisions, or solving problems (Sheikh et al., 2023).

Midjourney

Midjourney is an independent research lab that explores new mediums of thought and expands the imaginative powers of the human species. They are a small, self-funded team focused on design, human infrastructure, and AI. Midjourney also

offers a unique and immersive experience for art enthusiasts and creators alike through their platform centered around an AI art generator. This groundbreaking feature allows users to create stunning pieces of AI art. (Hanna, 2023)

2. Previous studies

2.1 studies that focused on the application of AI tools

2.1.1 Developing an AI-based automated fashion design system: reflecting the work process of fashion designers (Choi et al., 2023)

This research aims to collect and analyze existing cases of AI-based garment design tools in order to identify the similarities and differences between the garment development processes of human designers and the existing AI-based garment design tools. Based on this analysis, the research aims to develop an AI-based garment development system that takes into consideration the garment development process of human designers, incorporating fashion domain knowledge. The study suggests that the adoption of AI-based garment design generation technology can increase work efficiency. It also highlights that despite the fashion industry having a shorter product lifecycle than other industries, the field of fashion design has traditionally relied on designer intuition for decision-making.

2.1.2 Artificial intelligence and sustainability in the fashion industry: a review from 2010 to 2022 (Ramos et al., 2023)

This literature review explores how AI can contribute to the fashion industry's sustainability, highlighting its potential benefits and limitations. Following PRISMA guidelines, a review of scientific documents was condcuted, focusing on the period from 2010 to 2022. After a meticulous selection process, 37 scholarly articles were analyzed to distill their key insights and contributions. The findings demonstrate that AI has diverse applications in different aspects of the fashion industry, enhancing sustainability efforts in supply chain management, creative design, sales and promotion, waste control, and data analysis. While AI offers significant potential, it is important to acknowledge limitations, such as the volume of data required and associated implementation costs. The reviewed literature aligns with the multifaceted nature of sustainability, emphasizing responsible resource management, accessible services, and efficient customer satisfaction, both now and in the future. In conclusion, despite some reservations, AI stands as a crucial partner in guiding the fashion industry toward a more sustainable future.

2.1.3 Artificial intelligence and its applications in the garment industry. (Hassanein & Yousef, 2022)

The study aims to investigate whether apparel firms can improve their business operations by employing big data and (AI), and in so doing, seek significant data management opportunities using (AI) solutions. The methodology of this research follows the descriptive-analytical approach, Discussion: The study emphasizes the importance of big data and AI in the garment supply chain to determine whether apparel manufacturers could improve company operations using big data and (AI), as well as give opportunities with extensive data management using AI. It also goes over the existing literature on supply chains, big data, AI, and organizational theories in the context of big data, with the garment sector as the core focus. Recommendations: to incorporate other emerging digital technologies such as virtual reality, augmented reality, the internet of things, and block chain technology. 24th of February 2022, accepted 6th of April 2022,

2.2 Studies that focused on the use of AI tools to create fashion and other designs

2.2.1 A comparative analytical study of the use of artificial intelligence (AI) tools in generating various designs for women's clothing (Al-Qatari & Rady, 2023),

The idea of the research is to create a variety of designs for women's clothing by employing artificial intelligence (AI) tools used in generating images, where an inventory of AI tools was made, and through the survey study more than 40 tools of artificial intelligence that are used in Generating images from written texts, and the characteristics of these tools, the way they are used, and their capabilities to create and generate various designs for women's clothing through the written design text, have also been identified. This study shows the similarity of these tools in many characteristics and method of use, while they vary in the quality of the designs created. Through these tools and their compatibility with the written design text, and accordingly, three AI tools (Lexica - Dreamlike - Midjourney) were chosen to be the subject of the applied study,

which resulted in the Midjourney tool being superior to the other two tools in terms of verifying the foundations and elements of design, and achieving The innovative and functional values of the new designs, in addition to the impact of the AI tool used on the characteristics of the new designs, so the Midjourney tool is the best In terms of its use in creating various designs for women's clothing, followed by the Lexica tool, and the Dreamlike tool comes in the last place.

2.2.2 Using Artificial Intelligence Techniques to Create Printable Designs and Enrich the Aesthetic Value of Clothing Design (Hagag, 2023).

This research seeks to use one of the most-important AI-applications "Midjourney" to create printable designs for garments inspired by some symbols of the Pharaonic civilization to emphasize the Egyptian identity and add artistic and aesthetic value to the "T-Shirt", The researcher made (52) innovative designs that were all completely created within the application of AI through some descriptive phrases for the desired design, then selected the best of these designs and processed them digitally to be suitable for printing on the "T-Shirt", The number of final design reached to (15) design, that judged by (10) professors specializing in the clothing and textile industries to determine which designs best achieved the foundations and elements of design and the aesthetic and innovative aspects of design for application and printing. The research resulted in achieving design No. (2), (14), (5) with the highest relative averages and the success of raising the aesthetic and artistic value of the clothing design, as well as recommending the need to research the possibility of benefiting from artificial intelligence technology in many other applications, as it is easy to use, accurate in implementation, effortless and timesaving.

2.2.3 From Image to Imagination: Exploring the Impact of Generative AI on cultural translation in jewelry design (Lyu et al., 2023).

This study aims to assess the impact of generative AI on cultural translation within jewelry design. Specifically, a comprehensive study was conducted through a design-action experiment, collecting 46 student designers' design-action data and self-reports, and enlisting the evaluation from 30 design experts. The findings highlight the substantial influence of generative AI on the ideation phase of jewelry design, especially in depth rather than breadth, and in the shape factor at the technical level such as detailization and unexpected composition. Leveraging AI image generators has shifted the designer's focus from technical tasks to strategic decisions related to visual appeal, cognitive engagement, and emotional resonance. Furthermore, the challenges inherent in human–AI collaboration have been revealed, stemming from communication difficulties and the risk of fixating on specific details to stylistic constraints. Based on data analysis, a novel hybrid model regarding human–AI co-creation on cultural translation in jewelry design is proposed.

2.3 Commenting on the previous studies

The study by Al-Qatari and Rady (2023) provides an inventory of AI tools used in generating designs for women's clothing. The current research benefited from their analysis of the characteristics, capabilities, and quality of these tools to select the most suitable AI tool for creating various designs in the context of the current research. Moreover, drawing inspiration from Hagag's findings, the current study explored how AI tools can be utilized to enrich the aesthetic and artistic value of clothing design. Additionally, the current research built upon Lyu et al. (2023) insights to investigate the impact of AI on cultural translation within the specific context of fashion design, potentially uncovering new perspectives and challenges related to human-AI collaboration.

3. Theoretical study

3.1 History of Sadu

Al-Sadu is a traditional weaving technique of some Gulf Countries and is central to Bedouin culture. In the resource-scarce lands of the Arabian Peninsula, the craft emerged from Bedouin ingenuity and resourcefulness. Ibn Hilil (2020, 127) defines Sadu as "the process of weaving wool, using the loom that makes woven textiles." Al-Masri (2019, 4) defines it as "the traditional Bedouin textile". Accordingly, Sadu is one of the most prominent artistic traditions in the Arab world, characterized by its unique aesthetic manifestations and deep expression. It is one of the oldest Bedouin crafts in the Arabian Peninsula. When we delve into the origins of the term "Sadu," we discover that it was used by desert dwellers to denote the

act of weaving with wool. During that era, the wool of goats or sheep was commonly employed for this purpose.

One of the first uses of weaving in the art of Sadu was to make Bedouin tents to protect them from the sun's rays and the cold desert weather, and most of those who worked in these crafts were women (Al-Masri, 2019, p. 4).

Therefore, girls learn to weave Sadu from a young age, and women take on the task of teaching them the basics of spinning and dyeing methods. As they grow older, these girls become familiar with various patterns. Those who excel in this craft stand out from their peers in weaving patterns with difficult details. Indeed, women from the tribes traditionally collaborated in the construction of tents.

Despite the technological advancements that this industry has witnessed, Sadu art stands as a testament to the Arab heritage in the countries of the Arabian Peninsula and the authenticity of this craft (Al-Salal, 2021, p. 117).

Thus, the history of Sadu art extends for thousands of years. Numerous archaeological evidences indicate that embroidery and sewing in decoration and ornamentation began in prehistoric times. Over the ages, the techniques of Sadu art have evolved and become more complex and diverse, reflecting the local cultures and traditions of the societies in which they originated.

3.2 Sadu making

In order to have a clearer understanding of Sadu, it was imperative to shed light on the key aspects involved in manufacturing a Sadu fabric. The initial step in the process is the preparation of textile materials. The Bedouins, in particular, employ specific types of threads for this purpose. They use cotton threads in the weft, also referred to as Sada. For making the warp, they use wool threads, including materials like wool and hair (Karateen, 1989).

The process begins with the shearing of the wool, which is then sorted based on its colour and length. Subsequently, this material undergoes a thorough cleaning process, where it is vigorously blown and shaken to effectively eliminate any residual plant matter, thorns, dust, or soil. It is then soaked in hot or cold water three or more times, using soap or detergent powder for further cleaning. Following the cleaning, a blowing process fragments the material into smaller pieces. Then, the artist spun the hair, fur, or wool into yarn through the use of a drop spindle. This yarn is then dyed, frequently with vibrant hues, utilizing local flora and spices. These include henna, turmeric, saffron, cactus, and indigo. Traditional Al-Sadu colours are black, white, brown, and beige.

The yarns are then woven on a floor loom made from the palm tree. Two tools are typically used for this process: the spinning wheel and the spindle (Al-Sabah, 2000, p. 41). Several looms are used when a large quantity of Al-Sadu material is required, such as for a tent or for a wedding.

Weavers traditionally gathered in small groups to spin and weave these items, exchanging family news and occasionally chanting or reciting poetry, such as Al-Taghrooda.

Fig. 1. Spinning and Spindle (Al-Dajani, 1993 -109)

3.3 Types of Sadu

There are seven types of Sadu, including Al-Falij (Fig.2). It is the longest and easiest type of Asdiya to work because it consists of only one color because it is woven from black hair threads that do not need dyes (Al-Dajani, Mani' – 1993, 108).

Fig. 2. Al-Falij Sadu Type
(Al-Dajani, 1993 -108)

The second type is Al-Dharaa (Fig. 3). It is one of the long types of Asdiya and consists of three pieces of Asdiya; each one is woven separately, and they are knitted so that the black color is on the edges, and the white in the middle.

Fig. 3. Al-Dharaa Sadu Type
(Al-Dajani, 1993 -108)

The third type is Al-Qatat (Fig. 4). It consists of five colored Asdiya; each one is woven separately, and then they are assembled by knitting and appear in its final form inlaid with colors to give a beautiful view, and the basic function of Al-Qatat is to be a curtain in the Bedouin tent that separates the place designated for men and the place designated for women.

Fig. 4. Al-Qatat Sadu Type
(Al-Dajani, 1993 -109)

The fourth type is Al-Sahah (Fig. 5). The weaving of Al-Sahah resembles the weaving of Al-Qatat to some extent, except that it differs from it in that Al-Qatat consists of different parts. The weaving of Al-Sahah consists of only one colored weave, and its length and width vary according to the purpose for which it is woven (Al-Ghanim, Dalal- 1987-63).

Fig. 5. Al-Qatat Sadu Type
(Al-Dajani, 1993 -109)

The fifth type is called Al-Muzawida (Fig. 6). The Bedouin woman weaves the Al-Muzawida Sadu from goat fur threads of white and red color and a little black. Its length is approximately two meters. The woman folds this Sadu in half and sews it from both sides so that one side remains open to resemble a bag, and two loops of braided fur threads are placed to carry it.

Fig. 6. Al-Muzawida Sadu Type
(Al-Dajani, 1993 -109)

The sixth type is Al-Kharj; it resembles the Al-Muzawida Sadu but differs in colors because it is used to make bags specifically for men.

Fig. 7. Al-Kharj Sadu Type
(Al-Dajani, 1993 -109)

The seventh and last type is Al-Tariqa (Fig. 8). It is one of the easiest and fastest types of Asdiya. It only requires one day to complete and is of two colors, black and white. Its width ranges between approximately 20:30 cm. This type of Sadu is used to weave the roof of the Bedouin tent to increase its strength and prevent it from tearing (Al-Dajani, Mani' - 1993 - 109).

Fig. 8. Al-Tariqa Sadu Type
(Al-Dajani, 1993 -109)

3.4 Sadu Techniques

There are traditional techniques that the Bedouin woman cannot do without during the Sadu process.

To implement Sadu techniques, a variety of special tools are required. Al-Mubsha (fig. 9) is one such tool, a wooden stick wrapped with a long and braided thread. This tool facilitates the interlacing of threads with each other. Another tool, Al-Mudara, consists of a small piece of wood with a small iron piece at its head, and bent at the top. The Bedouin woman in the Sadu uses this tool.

The third tool is Al-Manshaza. It is a piece of wood that ranges in length from 90 to 120 cm and in width from 10 to 13 cm. Its function is to isolate the upper Sadu threads from the lower Sadu threads, thereby facilitating the entry of Al-Mubsha between them. The last tool is Al-Naira. It is a stick raised on two wooden bases to which all the extended Sadu threads are attached. This tool is used to adjust the balance of the Sadu threads so that they rise and fall during the Sadu process (Qumia, 1997, p. 12).

Fig. 9. Al-Mubsha tool used to weave Sadu (Qumia, 1997, 12)

3.5 Weaving techniques used in Sadu weaving

There are two common structures used in Sadu weaving: simple textile structure and composite textile structure. The simple textile structure includes many techniques. The first is a plain weave "extended from the weft. It is one of the most commonly used techniques, where the number of weft threads is more than the warp, so the warp threads disappear under the weft threads as their purpose is to trap only, and they do not affect the surface of the fabric. This technique appeared in the plain striped Sadu with longitudinal pens from the weft, and in this type, the back of the fabric matches its face. It is also used in Sadu using two colors in the weft threads to produce the required decoration, where the color and the required number of weft threads are chosen. The rest of the threads with unwanted colors are hidden on the back of the fabric, and this type is used only on the face (Tortora 2005- 77).

The second technique is a plain weave extended from the warp. This type of fabric is constructed opposite to the method followed with the *extended-from-the-weft*, meaning that every two adjacent threads or more from the weft threads move in one movement so that the warp thread passes over them or under them.

The *simple textile structure* also includes twill fabrics of three types. The first type is ordinary twills. They are called right twills, since the twill line in them goes from the bottom of the north to the top of the right, and they are divided into simple twills and regular twills like twill 2/2 or twill 3/3, i.e., the amount of appearance of threads of both the weft and the warp is equal. There are also irregular twills, i.e., the amount of appearance and disappearance of threads of both the weft and the warp above or below the threads of the other direction is not equal, such as twill 2/1 or twill 1/2 or 3/2 or 2/3 or 4/3 or 3/4. The second type is reverse twills. They are referred to as left twills, as the twill line goes from the top of the north to the bottom of the right. The third type is the direct reverse twills. They combine the previous two types.

However, the *composite textile structures* include four techniques. The first is the non-extended warp weave (Tapestry). This technique creates geometric decorations consisting of adjacent triangles of various colors. This technique creates geometric patterns composed of adjacent triangles with different multi-coloured threads. It employs the plain weave method, but with discontinuous weft threads. It is not necessary for the same weft thread to extend along the horizontal line but may stop after a limited number of interlacing threads and continue with another color of weft threads, depending on the desired design. (Milan, 2008).

The second is an ordinary pattern. The methods of producing patterned fabrics using the ordinary pattern method vary according to the warps' colors. It is possible to use one color of the warps or two, three, or four colors depending on the multiplicity of design colors reflected in the textile structures used to show color gradations within the woven fabric. This is created by interlocking simple (basic) textile structures to produce a new composite structure from one or more basic simple structures.

Additional pattern fabrics: These patterns can be achieved using one of the following methods:

- Patterned fabrics with additional weft: These fabrics are used to produce types of fabrics with simple patterns. They are operated using two shuttles, and each shuttle is woven on a separate pirn due to the significant difference in the length of the patterned weft (additional weft) and the length of the ground weft, which interlaces with the warp in simple weave structures. The additional weft (pattern weft) can be used in either one or two colors in the same area as the pattern, in addition to the color of the ground weft. The pattern weft threads are arranged in the pattern areas to form a pattern weft

pick, or two ground weft picks followed by a pattern weft pick, depending on the thickness of the threads used in the additional pattern weft.

- Patterned fabrics with additional weft: This type of fabric requires one shuttle on one pirn. The weft consists of a ground weft and a pattern weft. The additional weft threads appear on the face of the fabric in the desired pattern areas and are concealed on the back of the fabric. It is possible to create decorative marks to shorten the length of the long floats of the additional weft threads on the back of the fabric, retaining only the pattern on the face of the fabric.
- Patterned fabrics combining both types (shuttle and additional weft): It is possible to combine the previous types in a single design, requiring the use of two shuttles in this case. One shuttle is used for the ground weft, and the other for the additional pattern weft.
- Backed fabrics: These are fabrics with a woven structure on the back of the fabric to reinforce it and provide the desired density for the intended use. There are two types:

– Backed fabrics with a ground weft: To create these fabrics, two shuttles are required, one for the ground and the other for the backing. Different weaving structures can be used for each.

– Backed fabrics with an additional weft: To create these fabrics, two additional wefts are used, one for the ground and the other for the backing (Kadolph & Marcketti, 2017b) (Grosicki, 2014).

3.6 Decorative units used in Sadu weaving

The decorative units used in Sadu weaving are part of the Bedouin community as they express different meanings in their lives. The artistic meaning and purpose vary from one form to another. They reveal beliefs and lifestyles in this community by drawing inspiration from environmentally-themed meanings in a simple artistic style. The weaver creates the decorations of her tribe on the Sadu pieces and sometimes adds decorations of other tribes as a kind of linkage between the tribes. The Bedouin woman uses colored threads to execute the decorations by weaving adjacent colored threads to produce longitudinal or latitudinal spaces with different adjacent colors. Most of the decorative elements used in Sadu are based on simple geometric shapes employed by the weaver in different ways, such as interlocking, overlapping, and symmetry. All symbols and shapes appear as repetitive decorative elements that fundamentally rely on the principle of proportion and regularity. These decorations are very famous in all regions of the kingdom. They have specific names, including "Duroos Al-Khail, Al-Haboub, Al-Areejat, Al-Oweirjan, Al-Marausa, Al-Shanaf, Al-Muqass, Al-Misht, Alshajara, Althoraya, Al Mazkhar, and Almatroud."

Al-Oweirjan (Fig. 10) is the most common type of these decorations. It consists of equilateral triangles stacked in the form of consecutive triangles to form a longitudinal line in the fabric. It is one of the most widespread decorations in Sadu weaving and are known by other names such as “Al-Tourisa” and “Al-Mu’taqaba” (Al-Mutairi, 2003-179).

Fig. 10. Al-Oweirjan
(Al-Mutairi, 2003, 179)

Duroos Al-Khail is also widely used. This is a decoration in the form of a rectangular area with a black background and contains horizontal lines in the middle made up of four to five weft threads of another color followed by the same number of black threads. On the sides, there are horizontal lines with a size that represents half the size of the middle lines. It is usually made up of two alternating weft threads and is one of the most widespread decorations in Sadu weaving (Al-Dajani, 1993- 79).

Fig. 11. Duroos Al-Khail
(Al-Mutairi, 2003, 179)

Thus, the key design elements and characteristics of Najdi Sadu weaving that can be incorporated into AI-generated fashion designs are identified.

3.7 Concept of Artificial Intelligence

There have been numerous definitions of artificial intelligence. Ahmed (2023, 105) defines artificial intelligence as "the connection between two concepts: intelligence, which is characterized by the ability to think, understand, and infer, which are characteristics of the human mind, and artificial, represented by the ability to make human-made calculations perform tasks of thinking, understanding, and inference." Daher et al. (2022, p. 326) define artificial intelligence as "a set of software and computer hardware, which mimic the capabilities of the human mind, and have the ability to behave, make decisions, and solve problems in order to employ and benefit from them in the educational process to achieve the desired educational goals."

Artificial intelligence (AI) is intelligence demonstrated by machines, unlike the natural intelligence displayed by humans and animals." (Russell and Norvig, 2022). Stuart Russell and Peter Norvig have defined AI in the widely used textbook "Artificial Intelligence: A Modern Approach" as machines that display behavior considered intelligent if observed in humans. John McCarthy, who coined the term "artificial intelligence" in 1955, defined it along with colleagues as machines that can perform tasks typically requiring human intelligence, like recognizing images or answering questions. According to Mohammad (2020) artificial intelligence aims to develop technological systems capable of dealing with information, solving problems, and making decisions independently and intelligently.

3.8 Emergence of Artificial Intelligence in Fashion

In the face of various business challenges, the clothing industry has witnessed numerous applications of big data and artificial intelligence over the past decade. With the increasing demand for customized goods and services that enhance their brand experience and satisfaction, supply chain managers in clothing companies are constantly striving to develop their market strategies so that their companies can benefit from speed and cost-effectiveness. Artificial intelligence technologies used at different stages of the clothing supply chain help improve business processes. Artificial intelligence technologies are used to develop data-based solutions using product-related data provided by manufacturers and designers of clothing products. Big data helps provide customized offers to customers (Ismaiel & Yousef, 2022, p. 203).

Thus, artificial intelligence appears to be a major shift in the fashion industry, enhancing design, production, marketing, and sustainability. Benefiting from artificial intelligence applications in the fashion industry is an exciting opportunity to develop products, improve the consumer experience, and contribute to environmental sustainability. These promising developments provide new possibilities for the fashion industry's future.

3.9 Use of Artificial Intelligence and Design Programs in Fashion

Fashion design use several types of AI, including machine learning, deep learning, and computer vision. Machine learning algorithms analyse data and generate insights to inform the design process. Deep learning algorithms create neural networks that can identify patterns and make predictions based on the data. Computer vision technology analyses images and identifies patterns, shapes, and colors (Hendrick, 2023).

Designers use artificial intelligence not only for quality control but also for clothing production. Various technologies can be used to produce large quantities of materials, including lasers controlled by computers, cutting tools, water jets, plasma, and ultrasonic waves. In addition, machine sewing is prevalent in manufacturing, although it is still in its primitive

stage. In 2019, ITMA released the advanced Juki Network System (JaNet), which combines software and hardware support to collect data on production processes, including interconnected sewing machines. As a result, digital sewing machines have become indispensable for detecting sewing errors in mass production (Ismaiel & Yousef, 2022, p. 204).

In addition, artificial intelligence and its many subfields are powerful tools at every step of the fashion value chain, from concept and design to sourcing materials, production, logistics services, and retail. It can achieve developments such as accelerating processes and expanding their scope, dealing with quantities of data humans cannot handle, and providing new ways for consumers to experience retail. Artificial intelligence predicts trends based on data and innovative design. In the field of materials, artificial intelligence works to improve the cultivation of natural fibers, in addition to being a tool for quality control and assisting in the production of knitted and woven textiles (Evangelista, 2020, p. 15).

Also, with machine vision technology, robots can accurately recognize the size and shape of the piece and then cut it according to the survey results. This process requires robots to accurately judge the circumference of the cut piece, extract the data, and record it on the computer. There is another step which is sorting the pieces. This process classifies many mixed pieces together, and the pieces required for ready-to-wear clothes must be divided together. Otherwise, the cutting process will be superfluous or missing during sewing so that we can perform automatic sorting through artificial intelligence (Lu, 2022, p. 365).

Common artificial intelligence methods include genetic algorithms, neural networks, decision-making processes, virtual networks, and knowledge-based systems and their diversity. Therefore, the fashion industry uses all these technologies (Wang & Rasheed, 2014, p. 1).

From this standpoint, the fashion industry is one of the industries that is rapidly evolving and increasingly adopting artificial intelligence technology. Artificial intelligence is key to transforming the fashion industry and improving processes and consumer experiences.

AI technology can also generate design ideas, helping you come up with unique and creative concepts that may not have been possible otherwise. One example is (Midjourney -Discord), deep learning algorithms that can create new images based on existing data sets (Hendrick, 2023).

Midjourney, a generative artificial intelligence program and service, is the brainchild of the independent research lab Midjourney, Inc., based in San Francisco. It generates images from textual descriptions, called prompts, akin to OpenAI's DALL-E and Stability AI's Stable Diffusion (Hertzmann, 2022). It is a key player in the AI Spring.

Midjourney is available on the Discord bot on its official server. Users can interact with the bot directly or invite it to a third-party server. The /imagine command is used to generate images by typing in a prompt (Stanley-Becker & Harwell, 2023). The bot then produces four images, from which users can select the ones they wish to upscale. Midjourney is also developing a web interface.

In addition to the /imagine command, Midjourney provides a variety of other commands for the Discord bot. These include the /blend command, which enables users to merge two images, and the /shorten command, which offers suggestions for shortening lengthy prompts, among others, to enhance the Midjourney experience.

CLO is a 3D costume design software that mimics the actual costume creation process. Unlike traditional 3D modeling software like Maya or Max, where the 3D mesh's surface is sculpted to form a costume, CLO creates 2D pattern pieces and stitches them together to create 3D costumes.

CLO's powerful Simulation engine allows users to create styles with numerous layers and intricate details. It allows the design of a wide range of garments, from a simple blouse to technical outerwear with complex pattern pieces and construction. CLO's capabilities extend beyond garment design, enabling the creation of any fabric-constructed item, including hats, bags, wallets, lingerie, swimsuits, and more (iRendercs, 2022).

Thus, the first question of the research regarding how can artificial intelligence (AI) tools be effectively integrated with specialized fashion design programs to create women's dresses inspired by digital patterns of Najdi Sadu art is answered.

4. Research methodology and procedures

4.1 Research methodology

The current research follows a descriptive-analytical approach to describe and analyse the heritage background of Sadu weaving, its manufacturing methods, the materials used in its manufacture, its symbolic implications, and the importance of these heritage implications. It will also analyse how receptive specialists are likely towards the proposed designs. The research also follows an experimental approach by using artificial intelligence tools to create contemporary textile designs inspired by Najdi Sadu. The study sample comprises 6 specialists in fashion and textile design and manufacturing. The study used a questionnaire to measure the opinions of the specialists on modern digital designs inspired by Najdi Sadu.

4.2 Research procedures

The researcher created three designs for women's dresses. Each design is based on a digital image of a Sadu pattern that the researcher had previously captured during an exhibition dedicated to Sadu weaving. The researchers uploaded the digital image of the Sadu pattern to the artificial intelligence application (Midjourney) to obtain enhanced image suggestions. Midjourney provided different designs for the digital Sadu image so that a choice could be made among them. The researcher chose the best design for the Sadu pattern and made additional improvements using Adobe Illustrator. After finalizing the appropriate patterns, the researcher designed a white dress using the ClO3D program. After completing the dress design, the researcher again uploaded the image of the white dress design to the Midjourney application with a request to merge the Sadu pattern into the design. Midjourney constructs the final design after merging the Sadu pattern with it. After that, the researcher uploaded the images in the ClO3D application to obtain the final version of the design.

Below are illustrations of the design process.

Table (1) Shows the steps followed in implementing each design.

First design

Table 1. Steps for implementing the first design

1. Selection of the Najdi Sadu fabric pattern.	
2. Uploading the pattern image into the artificial intelligence application Midjourney to obtain several designs for a Sadu fabric pattern.	

Table 1. Steps for implementing the first design

3. One of the Sadu patterns resulting from the artificial intelligence application is selected and improved using Adobe Illustrator	
4. Designing a white dress using the CLO 3D program.	
5. After inserting the image of the white dress into the artificial intelligence application, Midjourney, we obtain four different designs, each incorporating the Sadu pattern.	
6. Producing the design using the artificial intelligence application Midjourney	

Table 1. Steps for implementing the first design

7. The creation of the final form of the design using the CLO 3D program.	

Second design

Table 2. Steps for implementing the second design

1. Selection of a Najdi Sadu fabric pattern.	
2. Uploading the pattern image into the artificial intelligence application Midjourney to obtain several designs for a Sadu fabric pattern.	
3. One of the Sadu patterns resulting from the artificial intelligence application is selected and improved using Adobe Illustrator	

Table 2. Steps for implementing the second design

4. Designing a white dress using the CLO 3D program.	
5. After inserting the image of the white dress into the artificial intelligence application, Midjourney, we obtain four different designs, each incorporating the Sadu pattern.	
6. Producing the design using the artificial intelligence application Midjourney	
7. The creation of the final form of the design using the CLO 3D program.	

Third design

Table 3. Steps for implementing the third design

1. Selection of a Najdi Sadu fabric pattern.	
2. Uploading the pattern image into the artificial intelligence application Midjourney to obtain several designs for a Sadu fabric pattern.	
3. One of the Sadu patterns resulting from the artificial intelligence application is selected and improved using Adobe Illustrator	
4. Designing a white dress using the CLO 3D program.	

Table 3. Steps for implementing the third design

5. After inserting the image of the white dress into the artificial intelligence application, Midjourney, we obtain four different designs, each incorporating the Sadu pattern.	
6. Producing the design using the artificial intelligence application Midjourney	
7. The creation of the final form of the design using the CLO 3D program.	

5. Discussion and Findings

A group of specialists in fashion and textile manufacturing and design assessed the designing processes and the resulting designs. Data from their feedback were collected and input into the statistical analysis software SPSS. The researchers carried out data processing and analysis to study the efficiency of artificial intelligence applications in dress design.

The researchers used a questionnaire to evaluate the experimental Al Sadu designs. The questionnaire has two aspects: the first focuses on the aesthetic aspect (four statements), and the second focuses on the functional aspect (four statements).

Statements about the functional aspect:

- The design incorporates the aesthetics of Sadu art in a contemporary spirit.
- The shape and space of the decorative unit, inspired by the art of Sadu, harmonize with the design.
- The color and lines of the decorative unit, inspired by Sadu art, complement the colors and lines of the design.
- The locations of the decorative unit (Sadu) have been adapted to fit the clothing design.

Statements about the aesthetic aspect:

- The design is versatile and suitable for women to wear on various occasions.
- The art of Sadu offers the potential for creating contemporary textile designs.
- The design balances the authenticity of heritage and the modernity of fashion through decorative unity.
- The final form of the design aligns with international fashion lines.

The study applied the five-point Likert scale analysis because respondents can easily answer questions in this format; they can just simply choose from already given answers, and to facilitate the analysis process.

The researchers utilized the Statistical Package for Social Sciences (SPSS), a widely recognized tool to analyse the data. The study employed several statistical measures and tests in this process.

The researchers used percentages as a key measure, helping to determine the proportion or distribution of responses about the total sample size. The researchers calculated the mean to identify the average value or central tendency of the data. This measure offered a single representative value for the dataset, providing a snapshot of the overall trend. The researchers employed the standard deviation to measure the dispersion or variability of the data points around the mean. The researchers utilized the Cronbach's alpha to assess the internal consistency and reliability of the questionnaire items. They applied the Anova Single Factor test to examine the statistical differences among the means of multiple groups or conditions. Finally, the researchers used the relative weight to determine the importance or significance of different variables or factors in relation to each other.

The results of the study were of two main sections. The first section focuses on the aesthetical aspect of the three designs, analysing their visual appeal, artistic value, heritage representation, color harmony, and overall aesthetic qualities. The second section explores the functional aspect of the three designs, examining their practicality, usability, efficiency, and performance in fulfilling their intended functional purposes.

Evaluation of the impartiality of experts for the aesthetical aspect of designs by using ANOVA single factor at a significant level of 95%.

The ANOVA single factor test evaluated the variation of the experts' results for the aesthetical aspect of the questionnaire for all designs.

Table (4) shows the significant effect between the experts' evaluation of the aesthetical aspects of the first, second, third, fourth, and fifth designs at the significance level of 95%.

Table 4. ANOVA single-factor analysis for the aesthetical aspect

Design Nr.	Source of Variation	SS	d.f.	MS	F	P-value	F crit.
1	Between Groups	6.836	13.000	0.523	2.538	0.00	1.899
2	Between Groups	8.84	13.00	0.68	3.95	0.000	1.850
3	Between Groups	10.286	13.000	0.792	4.053	0.000	1.842

Table 4 shows that the critical F-value is lower than the calculated F-value, and the statistical significance falls within the range of 0.000 to 0.001, which is less than the threshold of 0.05. These findings suggest that the experts have varying degrees of significance concerning the questionnaire results, indicating their impartiality in evaluating the questionnaire.

The Reliability of the questionnaire on the aesthetical aspect of designs

The researchers assessed the reliability of the questionnaire using Cronbach's alpha, denoted by α coefficient alpha. This measure evaluates the reliability of multiple-question Likert scale questionnaires, which aim to capture hidden or unobservable variables that are challenging to measure directly in real-life situations. Table (5) presents Cronbach's alpha value, which indicates the degree of interrelatedness among a set of test items as a group.

Table 5. Cronbach's alpha for the aesthetical aspect

Design Number	Research Tool	Items of evaluation	Cronbach's Alpha
1	Questionnaire	8	0.983
2	Questionnaire	8	0.952
3	Questionnaire	8	0.941

Table (5) provides insights into the reliability of the questionnaire for the three designs of the aesthetical aspect. Notably, all three designs exhibit Cronbach's alpha values higher than 0.7, indicating a high level of questionnaire reliability.

Table 6. The main statistical analysis for the aesthetical aspect

Design Nr.	Mean	S.D	C.V%	Relative Weight %	Rank
1	4.38	4.88	5.5	89	3
2	4.32	4.9	6	91	2
3	4.48	4.7	5	95	1

Table (6) presents the main statistical analysis for the aesthetical aspect. The mean values for the questions range from 4.25 to 4.48, which are quite favourable. Furthermore, the standard deviation and coefficient of variation show small variations among the results, indicating acceptable consistency. Overall, these findings suggest that the scores obtained from the questionnaire are relatively satisfactory.

According to the ranking in Table (6) based on relative weight, design number three stands out as the best design for the aesthetical aspect. The following reasons further support this conclusion:

- Expression of aesthetic and artistic values: Design number three effectively communicates the aesthetic and artistic values associated with Al-Sadu weaving. It incorporated elements and patterns that are visually appealing and demonstrate a high level of artistic design.
- Emphasis on heritage aspect: The design prominently presented the heritage aspect of Al-Sadu weaving. It likely incorporates traditional motifs, techniques, or symbols that represent the rich cultural heritage associated with Al-Sadu weaving.
- Harmonious color scheme: The colors used to decorate Al-Sadu fabric in design number three correspond harmoniously with the overall design. The color choices are likely complementary, enhancing the design's visual impact and overall aesthetic appeal.

For these reasons, design number three emerges as the preferred choice for the aesthetical aspect.

Evaluation of the impartiality of experts for the functional aspect of designs by using ANOVA single factor at a significant level of 95%

The researchers assessed the impartiality of the experts' evaluations of the functional aspect of the designs using an ANOVA single-factor test at a significance level of 95%, in order to evaluate the variation in the results provided by the experts for all designs.

Table (4) presents the ANOVA single factor analysis results for the functional aspect. It demonstrates the significant effect observed among the expert evaluations for the functional aspects of all designs at the 95% significance level.

The ANOVA single-factor test allows for a comprehensive examination of the variation and differences in the expert evaluations, providing valuable insights into the experts' impartiality and consensus regarding the designs' functional aspects.

Table 7. ANOVA single-factor analysis for the functional aspect

Design Nr.	Source of Variation	SS	d.f.	MS	F	P-value	F crit.
1	Between Groups	11.771	13.000	0.905	5.331	0.000	1.799
2	Between Groups	11.436	13.000	0.880	5.155	0.000	1.877
3	Between Groups	8.543	13.000	0.657	3.508	0.000	2.046

The Reliability of the questionnaire on the functional aspect of designs

The researchers assessed the reliability of the questionnaire for the functional aspect of designs using Cronbach's alpha coefficient, which measures the internal consistency of a set of test items. Table (5) presents the Cronbach's alpha values for the questionnaire of each design, along with the number of items evaluated.

Table 8. Cronbach's alpha for functional aspect

Design Number	Research Tool	Items of evaluation	Cronbach's Alpha
1	Questionnaire	10	0.891
2	Questionnaire	10	0.924
3	Questionnaire	10	0.871

The findings indicate that Cronbach's alpha values for the functional aspect questionnaire range from 0.871 to 0.924, demonstrating a high level of reliability. These values suggest a close relationship between the items of the questionnaire as a group and consistently measure the desired construct.

Furthermore, the range of Cronbach's alpha values (0.847 to 0.924) falls within an acceptable range, further supporting the reliability of the questionnaire. Generally, a Cronbach's alpha value above 0.7 is acceptable, and all the values in this range exceed that threshold.

Evaluation of the score of experts for the questionnaire on the functional aspect of designs

Table 9. The main statistical analysis for the functional aspect

Design Nr.	Mean	S.D	C.V%	Relative Weight %	Rank
1	4.46	4.6	5.5	94	3
2	4.08	5.98	6.9	87	2
3	4.22	5.4	6.2	90	1

Table (9) displays the main statistical analysis for the functional aspect of the designs, including the mean scores, standard deviations (S.D.), coefficient of variation (C.V%), relative weight percentages, and ranks assigned to each design based on the experts' evaluations.

The means of the scores provided by the experts range from 4.08 to 5.98. The standard deviation and coefficient of variation values are relatively small, indicating less variability or deviation among the results. These findings suggest that the scores obtained from the questionnaire are reasonably consistent and reliable.

The relative weight percentage represents the importance or significance assigned to each design based on the experts' evaluations. According to the experts, the design number (3) received the highest relative weight percentage of 94%, indicating higher quality or preference, followed by design number (2) with a relative weight percentage of 87%. The remaining design has a relative weight percentage ranging from 73.23% to 46.43%, representing an average level of quality for designs (3) and (2).

Thus, the research's hypothesis which states that there are statistically significant differences between the opinions of specialist regarding the three proposed designs from an aesthetic and functional perspective, is answered. Moreover, the third question of the research regarding the perceptions of fashion specialists towards AI-generated fashion designs inspired by Najdi Sadu art is answered.

6. Conclusion and recommendations

Innovation: This groundbreaking research demonstrates the successful utilization of AI as a transformative tool in designing clothing inspired by Sadu art, effectively capturing its essential aesthetic values and functional aspects. By harnessing the power of AI, we not only ensure the preservation of traditional arts like Sadu weaving but also pave the way for sustainable production of culturally significant clothing. This innovative approach opens up new possibilities for the fashion industry, combining technology and heritage to create a harmonious blend of tradition and innovation.

The research findings demonstrate the successful implementation of AI in designing clothing inspired by Sadu art, effectively capturing essential aesthetic values and functionality. The impartial evaluation by experts further validates the

quality of the generated designs. This application of AI shows great promise for Sadu-inspired fashion design, offering a sustainable approach to producing culturally significant clothing while preserving traditional arts like Sadu weaving.

To maximize the impact of this approach, designers are encouraged to explore ways to seamlessly integrate cultural heritage, such as Sadu art, with modern design elements, striking a balance between authenticity and contemporaneity. Improving the aesthetic and functional aspects of the designs should be a priority, considering the preferences and expectations of the target market. Continued investment in AI applications will enhance design processes and unlock new creative possibilities, emphasizing both innovation and authenticity.

To further improve and develop future designs, additional research is crucial to understand the influence of technology and artificial intelligence on customer preferences and fashion trends. It is recommended to devise marketing strategies that highlight the fusion of traditional and modern elements within the designs, attracting a broader customer base and individuals interested in fashion. By empowering artisans and spreading cultural heritage, this innovative approach can contribute to the preservation and appreciation of Sadu weaving, while simultaneously driving forward the fashion industry.

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