

**Reimagining the Symbolic Fabric: Turkmen Carpet Motifs in Sufi
Cosmology, Islamic Aesthetics, and Digital Visual Culture**

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Abstract

The present study explores Turkmen carpet motifs as symbolic expressions in Islamic aesthetics, Sufi cosmology, and digital visual culture. Drawing on the theoretical work of such thinkers as Mircea Eliade (sacred geometry and the notion of center), Titus Burckhardt (Islamic aesthetics), and Gilbert Durand (symbolic motifs), the present study investigates the continuity and transformation of said motifs from traditional paradigms to modern applications. The study employs a qualitative approach, symbolic hermeneutic methods, comparative analysis, and visual semiotics to demonstrate that motifs like the Chalipa in Akhal carpets serve as mediators between the material and spiritual worlds, conveying ideas of divine unity through sacred geometry. The motifs are associated with the rhythms of Sufi recitation and are understood as "visual dhikr". Furthermore, by taking the relationship between raw carpet materials (wool and natural colours) and environmental sustainability into account, it is argued that digital reimagining can maintain traditional visual experiences while mitigating the negative environmental impact of traditional production. Through the case study of the reinterpretation of motifs in digital designs such as user interfaces, this study questions the common belief regarding the purely decorative nature of said motifs. The findings demonstrate the significant potential of these motifs in expressing metaphysical ideas in digital media, establishing a meaningful dialogue between innovation and tradition with cultural sensitivity, and strengthening historical continuity in Islamic societies.

Keywords: Chalipa, Cultural Design, Digital Culture, Islamic Aesthetics, Sacred Geometry, Sufi Symbolism, Turkmen Carpet Motifs, Visual Dhikr

1. Introduction

Turkmen carpets with their complex geometric flowers, patterns, and symbols like the Chalipa and Gul Teke serve not only as decorative elements but also as a symbolic medium for expressing deep mystical, cosmic, and cultural ideas [10,1]. The motifs are based on the Sufi worldview and Islamic aesthetics and have been of great importance throughout history in reflecting Turkmen identity, rituals, and social life [10,1]. In the case of Chalipa, for instance, the use of sacred geometry evokes notions of cosmic balance and unity in diversity, while Gul Teke, as the axis of mystical journey, generates a spiritual experience for the viewer [6]. This study takes an interdisciplinary approach to the study of Turkmen carpet motifs in the following

three areas: Islamic aesthetics, Sufi cosmology, and the digital recreation of Turkmen carpet motifs in contemporary visual culture. The main study questions are as follows:

How are Sufi and cosmic ideas represented in Turkmen carpet motifs?

How are these motifs related to Islamic aesthetics and sacred geometry?

How can digital reimagining conserve traditional heritage and broaden new applications?

How do raw carpet materials contribute to environmental sustainability?

A review of the existing literature reveals that previous studies have mainly concentrated on three axes: Ethnographic and historical analysis of Turkmen carpets [10,1], analysis of Islamic aesthetics and symbolic motifs [6,15], and reinterpretation of traditional patterns in digital media [2]. However, few studies have holistically explored these dimensions with a focus on the relationship between art, mysticism, and technology [11,8].

The objective of this study is to investigate the process of continuity and evolution of Turkmen carpet motifs from tradition to contemporary applications. Specific objectives are as follows: explaining the symbolism of patterns in the context of mysticism and Islamic art, studying the relationship between raw materials and environmental sustainability, and examining the potential of digital reimagining for integrating Turkmen heritage with contemporary design. This study suggests that the combination of cultural sensitivity and new technologies generates a dynamic discourse between tradition and modernity, which reinforces the global standing of Turkmen art.

2. Brief Theoretical Framework

The present study is founded on three theoretical approaches to the Turkmen carpet motifs: The concepts of center, world representation, and sacred geometry by Mircea Eliade [11], Islamic aesthetics and the connection between art and mysticism by Titus Burckhardt [6], and symbolic motifs and daily image regime by Gilbert Durand [8]. These structures provide a theoretical foundation to the mystical, cosmic, and visual elements of Turkmen carpet designs.

2.1. Mircea Eliade: Center, World Representation, and Sacred Geometry

Mircea Eliade, in his work on religious symbols and myths, introduces the concept of center as the cosmic axis that fills the gap between the material and spiritual worlds [11]. He believes that sacred geometry, such as symmetrical and repeating patterns, is an embodiment of the cosmic order and an expression of the experience of the sacred. Chalipa and Gul Teke are some of the central motifs in Turkmen carpets, which are used to show the cosmic harmony and unity in diversity [11]. These patterns, with their geometric composition, represent a Sufi world and invite the viewer to ponder the divine order. This experiential quality provides an optimistic platform of translation into interactive digital media, where sacred geometry can be reimagined dynamically in virtual space.

2.2. Titus Burckhardt: Islamic Aesthetics and the Relationship between Art and Mysticism

Titus Burckhardt examines Islamic aesthetics as a manifestation of the unity of God in visual and geometric shapes [6]. He implies that Islamic art, with its repetitive patterns and arabesques, creates an impression of timelessness and spacelessness, which is reminiscent of

Sufi mysticism. The principles are manifested in the geometric designs in Turkmen carpets, such as the Chalipa and rhythmic repetitions of flowers, which are considered as the visual dhikr that directs the viewer to the mystical contemplation [6]. Burckhardt emphasizes that these motifs, in addition to decoration, are intermediaries in communication with the transcendent. This mystical-artistic connection can be digitalized in the form of pattern-generating algorithms into virtual spiritual experience tools.

2-3. Gilbert Durand: Symbolic Motifs and the Daily Image Regime

In his theory of "anthropological structures of imagination," Gilbert Durand interprets symbolic motifs as manifestations of the collective unconscious and daily image regime [8]. He believes that geometric and repetitive patterns, such as flowers and stars, are associated with biological and cosmic rhythms, and that they communicate an experience of order and harmony. In Turkmen carpets, motifs such as Gul Teke and star-like patterns are used to depict this daily regime and create a sense of mystical movement and dynamism through their rhythmic repetition [8]. As symbols of cosmic cycles, the motifs have a profound relationship with the Sufi worldview, and their dynamic rhythm can be reimagined in contemporary animation and digital arts.

Theoretical approaches, which highlight the relationship between mysticism, geometry, and imagination, allow for multi-layered interpretation of Turkmen carpet patterns and open the way to the study of their digital recreation. While Eliade's system is concerned with the static and cosmic order of patterns [11], Durand's theory is concerned with their dynamic and biological rhythm [8], and Burckhardt's interpretation of the manifestation of the transcendent in aesthetics lies somewhere in between the two [6].

3. The Shared Tradition of Turkmen Carpets: From Motifs to Material and Cultural Contexts

As one of the most important examples of traditional Turkmen art, Turkmen carpets are more than technical and aesthetic masterpieces. They also have strong cultural, environmental, and historical implications. This section talks about the three facets of this tradition: Historical context and geographical scope, symbolic explanation of motifs, and the relationship of raw materials, cultural identity, and environmental sustainability.

3.1. History and Transboundary Geography

Historical Background

The Turkmen carpet weaving history is rooted in the ancient tradition of Turkmen nomads, that were common in Iran and Central Asia since medieval times. Turkmen carpets, especially tribal carpets, Yomut, Teke, and Saryk, were found to be a part of Turkmen material culture since the 9th century AD [10]. These carpets are often woven for domestic, ritual, and commercial purposes, and represent the nomadic life of Turkmens and their profound attachment to nature and the cosmos.

Transboundary Nature of Turkmen Traditions

Due to the migrations and cultural interactions, the tradition of the Turkmen carpet weaving has evolved in a transboundary area that includes Iran, especially the northeastern Iran,

Gulestan, Uzbekistan, and parts of Afghanistan [1]. This geographical dispersion has led to variation in designs and weaving styles. One such illustration of such diversity is a Teke carpet of the 19th century from the Washington Textile Museum (Figure 1) [14].



Figure 1. A 19th-Century Teke Carpet, Washington Textile Museum

Teke carpets in Turkmenistan are distinguished by Gul Teke motifs, while Yomut carpets in Iran show more variety in colors and patterns [10].

3.2. Typology and Symbolic Analysis of Motifs

Flower, Geometric, and Star Patterns

The motifs of Turkmen carpets are mostly flowers (e.g., Gul Teke) and geometric and star patterns with their respective symbolism. The main symbol of the Teke tribe, Gul Teke, is often woven in a reiterated and symmetrical pattern. According to some researchers, Gul Teke symbolizes the cosmic axis and the world center [15]. The sky and the celestial order are also related to the patterns of stars, which are also based on the Turkmen Sufi worldview.

Boteh and Rhythmic Repetitions

The presence of the Boteh motif, which is in the form of curvilinear and plant-like figures in Turkmen carpets, represents fertility, growth, and cycles of nature [1]. The dynamic quality of these motifs is created through the rhythmic repetition of these motifs, like in the Sufi dhikr. Turkmen carpets have three major motifs: Gul Teke (cosmic axis), Chalipa (four-directional balance), Boteh (fertility and growth), and Star (celestial order). These symbols will be compared and discussed later.

Chalipa and Gul Teke: Motifs and Anthropological Interpretation

The Chalipa motif, which has a cross-like shape, refers to the four points of the world and cosmic order [15]. One of the best illustrations of such a motif is a 20th-century Yomut carpet from the Metropolitan Museum (Figure 2) [7].



Figure 2. Chalipa Motif with Cross Structure in a 20th-Century Yomut Carpet, The Metropolitan Museum

Gul Teke is a symbol of tribal identity and refers to the axis of mystical journey and divine unity in Turkmen culture [1]. These motifs are based on sacred geometry and convey an experience of cosmic order to the viewer.

3.3. Material Substrate: Color, Wool, and Environmental Connections

Wool Sources and the Environmental Impact of Livestock Breeding

The primary raw material of Turkmen carpets is wool. This wool material is sourced from the sheep native to the Turkmen Sahra and Central Asia. Though it falls under the nomadic lifestyle, livestock grazing in these areas has some environmental consequences, including soil erosion and diminution of water supply [17].

Natural and Artificial Colors and Environmental Impacts

Colours of Turkmen carpets, particularly Dark red and deep blue, were once obtained naturally using sources like madder and indigo [10]. Following industrialization, the use of artificial colors grew, and this brought adverse effects on the environment, such as water pollution [17]. One of the best examples of the natural color application can be seen in one of the Saryk carpets belonging to the Iranian Carpet Museum (Figure 3) [16].



Figure 3. The Use of Natural Dark Red and Deep Blue Colors in a Saryk Carpet, The Iranian Carpet Museum

Connection of Raw Materials with Cultural Tradition and Identity

The raw materials of carpets, including wool and colors, are not just technical tools, as they are part of the Turkmen cultural identity. The choice of the particular colors, including dark red as a symbol of life, and the nomadic use of the local wool are tied into the nomadic way of life and the natural setting [1]. The reproduction of these materials and colors digitally can minimize the environmental effects and preserve the Turkmen heritage in new forms. This shift from material to digital substrate constitutes the primary axis of the sixth section of this study.

4. Turkmen Carpet and Sufi Cosmology

The geometric and intricate patterns of Turkmen carpets go beyond being simple artistic pieces; they are a symbolic vehicle for translating deep-rooted Sufi cosmological beliefs. The symbols are based on repetitive patterns and sacred geometry, which strive to provide the viewer with a religious experience while creating a deep association with the Sufi worldview [11]. This section uses the theories of Mircea Eliade on the belief about the center and the role of sacred geometry [11], Burckhardt on the belief about divine unity [6], and those of Gilbert Durand on the study of cosmic rhythms [8], to study the geometrical patterns of Turkmen carpets representing a mystical axis, cosmic unity, and oneness of diversity. The star, Gul Teke, and

Chalipa invite the viewer to ponder on religious order and on the religious path through their symmetrical and rhythmic patterns.

Sacred Geometry and the Concept of Center

The symbolism of the cosmic order is reflected in the form of the sacred geometry, which is expressed in Turkmen carpets of the Gul Teke type [11], which are symmetrically centered. The concept of the center is represented by Mircea Eliade as a cosmic axis that links the physical world to the supernatural world [11]. The Gul Teke motif is usually found in the center of a Turkmen carpet, serving as a connecting axis between heaven and earth, thus leading the viewer to an awareness of cosmic order. The motif gives the visual impression of divine harmony and inspires a feeling of religious concentration due to its mathematically perfect symmetry. An example of such a motif is found on a 19th century Teke carpet in the Washington Textile Museum (Figure 4) [14].



Figure 4. Gul Teke Motif in the Center of a 19th-Century Teke Carpet, Washington Textile Museum

Chalipa as a Symbol of Balance and the Four Directions of the World

The Chalipa motif represents balance and the four directions of the world (East, West, North, and South) and the harmony among the creative elements in Sufi cosmology [6]. This is a typical pattern of Yomut carpets that invites the viewer to ponder the cosmic balance and the divine order with its cross-like design. The Chalipa lies at the center or border of the carpet and communicates the visual experience of unity in multiplicity, and gives a feeling of harmony and balance. A great example of this motif can be seen in a 20th century Yomut carpet from the Metropolitan Museum (Figure 5) [7].



Figure 5. Chalipa Motif in a 20th-century Yomut Carpet, the Metropolitan Museum

Gul Teke as a Symbol of the Center and the Mystical Journey Axis

Gul Teke is a symbol of Teke tribal identity and represents the axis of the mystical journey and divine unity within the context of Sufi cosmology [6]. This repetitive and symmetrical motif creates a feeling of movement towards a spiritual center, as in the mystical journey in Sufism.

Gul Teke, particularly in the ceremonial carpets, serves as the center of the world and leads the viewer to a transcendental experience. This theme, with its emphasis on centrality and symmetry, evokes a feeling of mystical concentration and unity with the divine [11]. A great example of this motif may be seen in a Teke carpet from a private collection at the Los Angeles County Museum of Art (Figure 6) [19].

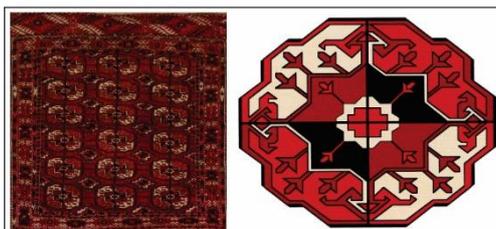


Figure 6. Gul Teke in a Teke Carpet from a Private Collection, Los Angeles County Museum of Art

Celestial and Cosmic Symbols in Motifs

The star and geometric patterns, such as the eight-pointed motif, represent the sky and divine order and are based on Turkmen cosmic beliefs in Sufi cosmology [8]. These patterns, typical of Saryk and Yomut carpets, provide a sense of cosmic infinity through their repetitive patterns. The geometric form of stars is a symbol of divine order and creates a feeling of wonder and interrelation with the sky in the observer. A great example of these motifs can be seen in a Saryk carpet from the Iranian Carpet Museum (Figure 7) [16].



Figure 7. Star and Geometric Motifs, Such as Eight-Pointed Patterns in a Saryk Carpet

Unity in Multiplicity and Repetition as a Spiritual Journey

The rhythmic repetitive motifs in Turkmen carpets, such as flowers and geometrical patterns, represent unity in multiplicity, which is a basic principle in Sufi mysticism [6]. These repetitions, like the Sufi songs, create a feeling of spiritual journey and motion toward the divine unity, and evoke a feeling of mystical serenity and focus in the observer. For example, in Teke carpets, Gol Teke is repeated in an organized network to give a sense of cosmic order and harmony, which invites the viewer to reflect on the unity of God [14].

Table 1. Summary of the Connection between the Motifs and Sufi Concepts

Motif	Symbolic / Conceptual Meaning	Representative Example / Museum
Gul Teke	Axis of mystical journey, centrality, unity in multiplicity, and the “heart of the cosmos”	Teke carpet, private collection, Los Angeles County Museum of Art

Motif	Symbolic / Conceptual Meaning	Representative Example / Museum
Chalipa	Cosmic balance, the four directions of the universe, and unity in multiplicity	20th-century Yomut carpet, The Metropolitan Museum of Art
Star Patterns (Eight-Pointed and Geometric)	Reflection of celestial order, the heavens, and cosmic infinitude	Saryk carpet, Carpet Museum of Iran
Rhythmic Repetition of Motifs	Unity in multiplicity, the experience of spiritual journey, and visual dhikr	Teke carpets with regular Gul Teke grid patterns

5. Islamic Aesthetics and Its Reflection in Turkmen Weaving

Turkmen carpets with their geometric motifs, rhythmic patterns, and vibrant colors are not only a manifestation of traditional Turkmen art, but also reflect fundamental principles of Islamic aesthetics that include concepts of timelessness, spacelessness, and sacred geometry [5]. This section is based on the views of Titus Burckhardt on Islamic aesthetics, especially his books *Art of Islam: Language and Meaning* (1976) and *Mirror of the Intellect* (1987) [5,6], and Gulru Necipoglu's studies on geometry in Islamic art [15]. This section explores the reflection of these principles in Turkmen carpets and their relationship with other Islamic arts such as arabesque, floral patterns, and illumination. By giving the viewer an impression of the unity and infinity, these motifs beckon the viewer to consider divine order and the transcendent, which creates a basis for the digital reimaging of these ideas.

Principles of Islamic Aesthetics (Timelessness, Spacelessness, and Sacred Geometry)

The Islamic aesthetics, particularly in the perception of Burckhardt, is focused on timelessness and spacelessness, whereby the artistic creations overcome the material and temporal constraints and refer to the divine unity [5]. Sacred geometry, in the form of symmetric and repeating patterns, is expressed in Turkmen carpets in the form of motifs such as Gul Teke and Chalipa. Their strict geometrical forms imbue these motifs with a feeling of infinity and divine order to the viewer and create a sense of timelessness. As an illustration, Gul Teke, which is located in the middle of the carpet, serves as a cosmic axis and leads the viewer to the perception of transcendent unity. A good example of this characteristic can be seen in a 19th-century Teke carpet in the Washington Textile Museum (Figure 8) [14].

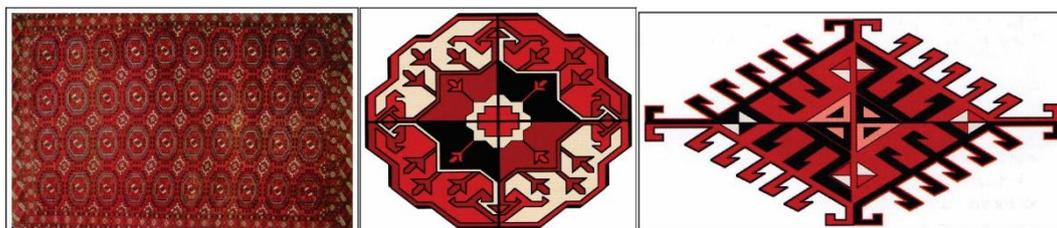


Figure 8. Gul Teke and Chalipa Motifs in a 19th-century Teke Carpet, Washington Textile Museum

Relationship of Turkmen Carpet with Arabesque, Floral Patterns, and Islamic Illumination

These aesthetic principles form profound links between the Turkmen carpets and other Islamic arts. Turkmen carpets with their geometric and rhythmic motifs have similarities with arabesque, floral patterns, and illumination [15]. Arabesque, based on complex geometric patterns, is reflected in Turkmen carpets in the form of regular networks of motifs such as Chalipa and star patterns. These patterns with their precise symmetry are a representation of divine order and give a sense of cosmic balance to the viewer. Floral patterns, with their curved and plant-like lines, are observed in the Boteh motifs of Turkmen carpets, which represent fertility, growth, and spiritual movement [6]. Illumination, which is known in Islamic manuscript decorations for its vibrant colors and symmetric patterns, is represented in Turkmen carpets by the use of deep red, deep blue, and bright yellow colors. A good example of this link can be seen in a Saryk carpet from the Iran Carpet Museum (Figure 9) [16].



Figure 9. A prominent Example of This Connection in a Saryk Carpet, Iran Carpet Museum
Arabesque: Represented through regular networks of motifs such as Chalipa and star patterns.
Floral patterns: Represented through curved and plant-like lines in the Boteh motifs of Turkmen carpets.
Illumination: Represented through the use of deep red, deep blue, and bright yellow colors

The combination of geometric patterns and floral patterns in this carpet shows how closely the art of Turkmen carpet weaving and other Islamic arts are related to each other, producing a visual impression of harmony and movement.

Visual Experience of Unity and Infiniteness

Turkmen carpet motifs purport a sense of unity and infiniteness as rhythms and geometric symmetry form a visual representation consistent with Islamic aesthetic principles [5]. These patterns, like Sufi prayers, encourage the viewer to reflect on divine unity and world order. As an example, the repetition of Gul Teke on Teke carpets brings out a feeling of spiritual calm and concentration, whereas the star patterns on Yomut carpets, through their depiction of the sky and its heavenly order, bring a feeling of infinity. A great example of this visual experience can be seen in a 20th century Yomut carpet from the Metropolitan Museum collection (Figure 10) [7].

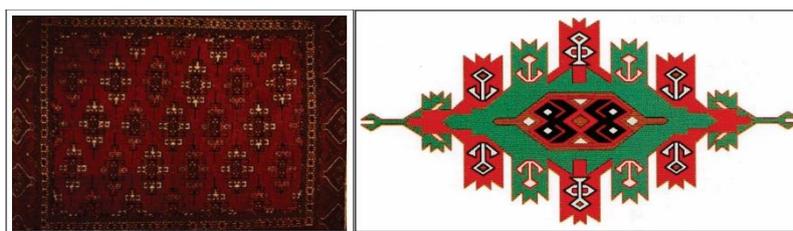


Figure 10. Repetition of Gul Teke in 20th-century Teke Carpets, Metropolitan Museum

This carpet leads the viewer to the understanding of transcendent unity and cosmic infiniteness with the combination of star patterns and vibrant colors.

Table 2. Summary of the Connection between Turkmen Carpet Elements and Islamic Aesthetic Principles, and Their Impact on the Viewer

Carpet Element	Motif / Principles of Islamic Aesthetics	Visual / Semantic Experience for the Viewer	Representative Example / Museum
Gul Teke	Sacred geometry, central axis, and symmetry	Cosmic axis, mystical concentration, and a sense of transcendent unity	Teke carpet, 19th century, Washington Textile Museum [14]
Chalipa	Sacred geometry, symmetry, and cosmic balance	Unity in multiplicity, harmony of elements, and divine order	Yomut carpet, 20th century, Metropolitan Museum of Art [7]
Star Patterns	Sacred geometry and rhythmic repetition	Representation of celestial order and experience of infinitude	Yomut carpet, Metropolitan Museum of Art [7]
Boteh Motifs and Arabesque-like Patterns	Curvilinear and vegetal lines and spiritual rhythm	Fertility, growth, and spiritual movement	Saryk carpet, Carpet Museum of Iran [16]
Bright Colors (Red, Blue, and Yellow)	Illuminative ornamentation and emphasis on sacred beauty	Capturing attention and conveying dynamism and visual unity	Saryk carpet, Carpet Museum of Iran [16]

6. Digital Reimagining, Sustainability, and Contemporary Visual Culture

Turkmen carpets, with their symbolic and geometric patterns, have a high potential for reimagination in digital media, which not only preserves the cultural heritage of the Turkmen people but also allows the extension of modern applications and reduction of environmental impacts [2]. Inspired by Carol Bier's views on reinterpreting Islamic art in digital space [3] and environmental studies in traditional carpet weaving [9], this section discusses the potential of digital media for motif representation, digital translation of motifs such as Gul Teke and Chalipa, and the fusion of this heritage with digital art. This process maintains the Sufi and aesthetic connotations of the motifs and establishes a dynamic interaction of tradition and modernity, enhancing cultural and environmental sustainability.

The Potential of Digital Media in Motif Representation

Digital media, such as sophisticated displays and interactive content, present the possibilities of dynamic and interactive representation of the Turkmen carpet motifs [3]. These media, which reproduce geometric and rhythmic forms, convey the visual experience of unity and infinity based on the aesthetics of Islam to modern viewers. As an example, superior digital displays allow recreation of Gul Teke patterns with accuracy without losing symmetry and sacred geometry, whereas interactive content adds to the effect of spiritual dynamism. A well-known example of this representation is the digital display project of the Turkmenistan pavilion for Expo 2025 Osaka by Unilumin Group (Figure 11) [20].



Figure 11. The Digital Display of Turkmen Carpet Motifs in the Turkmenistan Pavilion

This project employed LED displays and rotating digital content to induce a sense of movement and spiritual focus in the viewer and create a visual connection between tradition and technology.

Digital Translation of Motifs (from Gul Teke to Chalipa)

Digital translation of Turkmen carpet motifs, such as Gul Teke and Chalipa, goes beyond the reproduction of the carpet to reimagining the semantic meaning of these symbols in the digital context [3]. Gul Teke, as a symbol of the cosmic axis, can provide a sense of depth and spiritual movement through 3D animations, which is similar to the experience of a spiritual journey in Sufism. Chalipa, which is cross-shaped, serves as a balance and visual orientation in interactive designs such as user interfaces or computer games. A well-known example of this translation can be seen in the Tilemaker platform by the Qatar Foundation (2023) (Figure 12) [18].

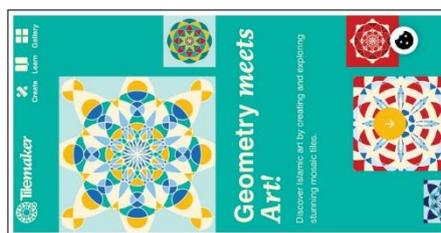


Figure 12. Digital Translation of Turkmen Carpet Motifs in the Tilemaker Platform, Qatar Foundation (2023)

By recreating Chalipa in the virtual space, this platform provides the users with an interactive experience of cosmic balance and geometrical order without losing its Sufi meanings. The process transforms the traditional motifs into the modern visual language and makes the Turkmen heritage accessible to the whole world.

The Integration of Turkmen Heritage with Digital Art and Reducing Environmental Impact

The integration of Turkmen heritage with digital art allows for the preservation and extension of the visual culture of traditional carpets in new platforms [9]. Traditional carpet weaving has been accompanied by challenges due to extensive use of natural resources such as wool and natural dyes [9]. Digital media provide a means of maintaining this heritage without necessarily having to use physical production to reproduce carpet motifs. As an example, the Revival of Aesthetics project by Orkhan Mamedov (2022) applies artificial intelligence methods and digital painting to recreate the Yomut carpet with traditional motifs such as Gul and Kilim and present Turkmen cultural identity in an interactive format (Figure 13) [13].



Figure 13. Revival of Aesthetics Project, Orkhan Mamedov (2022)

By applying pattern-generating algorithms, this project preserves the cultural heritage of the Turkmens while translating it into a modern visual language, making this art accessible to the whole world.

Table 3. A Comparison between Traditional Carpet Weaving and Digital Recreation

Aspect	Traditional Carpet Weaving	Digital Recreation	Reference
Final Product	Physical carpet made of wool with natural or synthetic dyes	Digital work reproducing pattern, color, and texture	[2], [3]
Integration with Meaning and Symbolism	Traditional motifs (Gul Teke, Chalipa) associated with mystical experience	Recreation of symbolic meanings through animation and digital interaction	[3], [18]
Visual Experience	Sensory–physical experience and contemplation of order and geometry	Interactive experience and possibility of zooming, movement, rotation, and augmented reality	[20]
Sustainability and Environmental Impact	Dependent on natural resources (wool, dyes); impact on pastures and water	Reduced resource consumption, simulation of texture and color, and sustainable production	[9], [13]
Scope of Application	Limited to use in traditional and cultural spaces	Application in digital design, games, branding, and contemporary art	[13]
Connection with Culture and Heritage	Preservation of local traditions and tribal identity	Expansion of cultural identity and global transmission of Turkmen heritage	[9]

This digital recreation creates a dynamic dialogue between tradition and modernity while preserving Turkmen cultural identity, cementing Turkmen art in contemporary visual culture, and opening novel pathways for the spiritual and aesthetic continuity of this heritage in the digital age.

7. Case Study: Reinterpreting Turkmen Carpet Motifs in Digital Media

The process of digital reproduction of Turkmen carpet patterns offers a unique chance to continue and advance the Turkmen cultural heritage in the digital age without losing its Sufi and aesthetic values [11]. The digital display project of the Turkmenistan Pavilion at Expo 2025 Osaka by Unilumin Group is examined in this section, focusing on the reimagination of Turkmen carpet motifs, its outcomes, and implications for the preservation of cultural heritage

and future outlooks on the integration of tradition and technology. Inspired by Carol Bier's writings on digital Islamic art [3] and environmental sustainability analyses [9], this case study shows how the latest technologies, such as LED displays, can generate a dynamic dialogue between tradition and modernity and cement Turkmen heritage in contemporary visual culture [20].

Analysis of the Digital Display Project for the Turkmenistan Pavilion at Expo 2025 Osaka

One of the best examples of the reinterpretation of Turkmen carpet motifs in the digital environment is the digital display project of the Turkmenistan Pavilion at Expo 2025 Osaka, which was carried out by Unilumin Group [20]. Using Metasight, a project that uses 400 square meters of LED displays, control systems, and digital content, the project transforms traditional motifs such as Gul Teke into a dynamic experience, in which visitors interact with the work [20]. The digital displays, through the accurate reconstruction of the symmetry and rotational motion of Gul Teke, create a sense of mystical dynamism and cosmic order for the viewer [6, 11]. The technology of advanced display, both on the outside and the inside of the pavilion, introduces the cultural heritage of Turkmenistan in the form of stunning visuals. A good example of this representation is the digital projection of Turkmen carpet patterns in the Turkmenistan Pavilion [20]. This unification of technology and Islamic aesthetics in this project invites the viewer to meditate on transcendent unity and cosmic order and creates a visual impression of spiritual pilgrimage. This recreation preserves the symbolic meanings of Gul Teke, but it also translates them into a universal and contemporary language.

Results and Impacts of Digital Recreation on Cultural Heritage Preservation

The Turkmenistan Pavilion project at the Expo 2025 Osaka, which was designed by Unilumin Group, generated several impacts on the preservation and promotion of the Turkmen heritage in the form of digital recreation of the Turkmen carpet motifs. First, the project removed geographical boundaries and presented Turkmen art to the world through the use of innovative LED displays at the Expo pavilion to showcase traditional motifs such as the Gul Teke [20]. For instance, the Expo visitors could interact with the motifs in the pavilion space, which raised the awareness of culture [3]. Second, digital recreation reduced environmental impacts such as soil erosion caused by livestock farming and water pollution caused by artificial dyes by reducing the dependence on physical carpet production [9]. Third, the project connected the younger generations to the traditional Turkmen culture by incorporating Sufi and aesthetic meaning of motifs into the modern digital formats and enhancing cultural belonging. One of the most notable manifestations of this influence was seen in the interactive exhibition of Turkmen carpet patterns at the Turkmenistan Pavilion in Expo 2025 Osaka [20]. Using emerging technologies, this project conserves the Turkmen cultural heritage and converts it into a universal and contemporary language, which will guarantee its continuity in the future.

Future Perspectives for Integrating Tradition and Technology

The integration of tradition and technology in such projects as the digital representation of the Turkmenistan Pavilion at the Expo 2025 Osaka by Unilumin Group has provided new opportunities for the future of art in Turkmenistan [20]. Emerging technologies such as artificial intelligence can be employed to create more complex Turkmen motif patterns, such

as Gul Teke and Chalipa, and blockchain can be used to verify the authenticity and ownership of digital works [4]. Moreover, the creation of online educational platforms, including interactive applications or online courses, can raise awareness of the symbolic and Sufi meanings of Turkmen motifs among the younger generations. One such vivid example is the MLRug project (2025) that relies on artificial intelligence (StyleGAN2-ada) to reproduce traditional motifs in interactive forms [12]. By combining the latest algorithms and conventional aesthetics, these projects save the heritage of carpet weaving and present it as a part of world visual culture. These perspectives allow for the spiritual and aesthetic continuity of traditional arts in the future by enhancing the link between tradition and technology.

8. Conclusion and Recommendations

This study, through the investigation of Turkmen carpet motifs in the context of Sufi cosmology, Islamic aesthetics, material context, and digital recreation, demonstrated that the carpets are not only artistic masterpieces but also carriers of profound cultural, spiritual, and environmental meanings. This section summarizes the most important research results, presenting recommendations for future research and providing recommendations for the preservation and promotion of the Turkmen heritage in traditional and digital contexts.

Research Findings Summary

Turkmen carpets, with motifs such as Gul Teke, Chalipa, and star-shaped patterns, are a reflection of Sufi cosmological ideas (such as unity in multiplicity and cosmic order), and Islamic aesthetic principles (timelessness, spacelessness, and sacred geometry) [11, 5]. Perspective-based analyses by Mircea Eliade, Titus Burckhardt, and Gilbert Durand revealed that these motifs, with their use of symmetry and repetition of rhythms, present a visual impression of divine order and spiritual path to the observer [11, 5, 8]. Examining the history and transboundary geography of Turkmen carpets, including Teke, Yomut, and Saryk tribes, it was revealed that this art is deeply connected to the nomadic lifestyle and cultural interactions in Central Asia and Iran [1]. The material context of carpets, such as wool and natural dyes, revealed the reliance of the art on the natural environment and resulting environmental issues like soil erosion and water pollution [9]. Finally, digital recreation of motifs, as in the case of the Turkmenistan Pavilion project at Expo 2025 Osaka by Unilumin Group, has made it possible to preserve Sufi meanings, increase access from around the world, and minimize environmental impacts [20]. Such a combination of tradition with technology establishes an active dialogue between the past and the future, and reinforces the role of Turkmen art in the visual culture of the present.

Recommendations for Future Research

It is suggested that future research should go further in analyzing emerging technologies such as artificial intelligence and blockchain in recreating and preserving Turkmen carpet motifs, particularly in producing dynamic patterns and ensuring the authenticity of digital work [12]. Moreover, a comparative analysis of the motifs of Turkmen carpets with other Islamic arts like Safavid tilework or Ottoman Girih tile patterns might help in finding common motifs in the aesthetics and symbolism. Moreover, it may be helpful to analyze how digital education (interactive applications and online courses) can be used to make younger generations more

aware of Sufi and the historical significance of Turkmen motifs. Interdisciplinary approaches such as visual data analysis, digital ethnography, and algorithmic pattern modeling can be used in these studies to offer a more in-depth insight into this heritage.

Recommendations for Preserving and Promoting Turkmen Heritage

The following suggestions are made to preserve and promote Turkmen heritage:

Creating Digital Educational Platforms: Inspired by the success of the digital display project of the Turkmenistan Pavilion at Expo 2025 Osaka [20], applications and online courses can be developed to present the Sufi and historical meaning of Turkmen motifs to the world audience.

Shifting to Sustainable Production: Adopting sustainable raw materials for traditional carpet weaving and expanding the use of digital reproduction in order to minimize environmental degradation, including the overgrazing of pasturelands and contamination of springs [9].

Supporting Contemporary Artists: Promoting Turkmen motifs in digital art, such as projects conducted on the online media [12], in order to stimulate creative work and cultural identity.

These suggestions can be summed up in three primary areas: Education, sustainability, and support. By combining tradition and technology, these approaches will preserve Turkmen heritage in the digital era and contribute to the formation of a new discourse on sustainable preservation of cultural heritage in the context of global concerns.

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