

Digital Transformation of the Bulgarian Rose in Sustainable Fashion Design through Specialized Machine Embroidery Software

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Abstract - This study examines the process of digital transformation of the traditional motif of the Bulgarian oil-bearing rose (*Rosa damascena*) within the context of sustainable fashion design through the use of specialized embroidery software. The research explores the adaptation of natural forms into a digital environment by combining artistic stylization and technological implementation. A methodology is proposed, involving the creation of an initial ornament using cross-stitch techniques in Pattern Maker, followed by digitization and optimization of the embroidery design in Artistic Digitizer. The final design is executed through machine embroidery on textile products. The results demonstrate that the digital approach enables an effective integration of cultural heritage and modern technologies, while contributing to sustainable fashion practices through resource optimization and increased product durability.

Keywords - Bulgarian rose; cultural heritage; digitization; digital transformation; machine embroidery; sustainable fashion; textile design.

I. INTRODUCTION

In the context of globalization and the dynamic development of the fashion industry [1], the issue of preserving and interpreting cultural identity is becoming increasingly significant. Contemporary fashion design seeks to integrate traditional elements into a new context, thereby creating sustainable connections between the past and the present [2]. Similar approaches can also be observed in contemporary research focused on integrating traditional embroidery techniques into sustainable textile production and cultural preservation practices [3]. In this process, digital technologies and CAD-based design systems play a key role, enabling the transformation of traditional motifs into contemporary and sustainable design solutions [2], [4].

The Bulgarian oil-bearing rose (*Rosa damascena*) represents one of the most recognizable national symbols of Bulgaria, established in both cultural-historical and economic contexts. It is closely associated with the region of the Rose Valley [5], which has become a world-renowned center for the production of rose oil—a product of high added value and international significance.

The rose symbolizes beauty, femininity, purity, and spirituality, while also functioning as a visual identifier of Bulgarian cultural identity of the country in the global cultural space. Its presence in traditional Bulgarian embroidery and decorative-applied arts testifies to its deep integration into folk aesthetics.

In contemporary fashion design, this symbol holds the potential to be interpreted as a visual code that combines national identity with global aesthetics. Recent research in cross-cultural textile design also highlights the role of traditional visual codes in developing innovative sustainable fashion concepts within a global design context [6].

The present study is focused on exploring the possibilities for the digital transformation of the “Bulgarian rose” motif through the use of specialized software for machine embroidery. The main emphasis is placed on the process of creation, digitization, and technological realization of original embroidery motifs based on a stylized interpretation of *Rosa damascena*.

The study has an interdisciplinary character and integrates knowledge from the fields of fashion design, textile technologies, and digital design systems. The main objective of the research is to develop a model for integrating original motifs inspired by the Bulgarian rose into contemporary fashion collections through the use of

Online ISSN 3044-7771

<https://doi.org/10.68302/std2026.vol2.40>

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machine embroidery. To achieve this objective, the following tasks have been defined:

- analysis of the symbolism of the Bulgarian rose as a cultural and national emblem;
- investigation of contemporary Bulgarian practices in the field of embroidered textiles;
- development of original motifs through digital tools;
- experimental application of the motifs in fashion products;

The scientific novelty of the study lies in the systematic examination of the process of digital transformation of a traditional symbol within the context of sustainable fashion design, as well as in the development of original embroidery motifs adapted to contemporary machine embroidery technologies.

II. MATERIALS AND METHODS

II.1. Characteristics of the Bulgarian Rose as a National Symbol and a visual identifier of Bulgarian cultural identity of Bulgaria

The Bulgarian oil-bearing rose (*Rosa damascena*) occupies a central place in the cultural and economic history of Bulgaria, establishing itself as one of the most recognizable national symbols. Its cultivation is primarily concentrated in the region of the Rose Valley, where natural and climatic conditions create favorable prerequisites for the production of high-quality rose oil, known worldwide.

The rose carries a multifaceted significance that goes beyond its botanical characteristics. It symbolizes beauty, harmony, femininity, and spirituality, while also being closely linked to the labor traditions and livelihood of the local population. In this sense, *Rosa damascena* functions as a cultural sign that integrates natural, economic, and social dimensions.

The cultural importance of the Bulgarian rose is reflected in a number of traditions and events, among which the Rose Festival holds a prominent place. The festival showcases customs related to rose picking and contributes to the promotion of Bulgarian culture in an international context.

From the perspective of visual culture, the rose is widely present in decorative and applied arts, including textiles, ceramics, and traditional embroidery. In Bulgarian folk embroidery, it is often stylized and combined with geometric elements [7]. This stylization creates favorable conditions for its adaptation to contemporary design.

In the context of the modern global cultural environment, the Bulgarian rose has established itself as a visual identifier of Bulgarian cultural identity, representing a strong visual and marketing symbol. It is used not only in traditional products but also in contemporary design solutions, including fashion, where it becomes a means of expressing national identity within a global context [8].

Within the framework of the present study, *Rosa damascena* is considered not merely as a decorative element, but as a conceptual foundation for the creation of original embroidery motifs. Such approaches correspond to contemporary research focused on the digital preservation and reinterpretation of cultural heritage in fashion design [9]. Through the process of digital transformation, it is transformed into a universal visual language that combines tradition, technology, and sustainability.

II.2. Analysis of Bulgarian companies offering clothing and accessories through machine embroidery with *Rosa damascena* motifs

The contemporary Bulgarian market for clothing and accessories decorated with machine embroidery is characterized by dynamic development and a growing interest in integrating traditional ornamental motifs into modern products. Within the framework of the present study, an analysis was conducted of established Bulgarian brands that use machine embroidery as a primary means of artistic expression in their products.

Among them, brands such as Brodika [10], Vezba [11], BULGARKA.BG [12], and SHEVICA BG [13] stand out, offering a diverse range of products—from everyday clothing to accessories with ethnic inspiration. What they share in common is the use of machine embroidery as a tool for achieving serial production, precision, and relative affordability of the products.

The analysis of product lines shows that decorative solutions are predominantly based on traditional Bulgarian embroidery, characterized by geometric compositions and stylized floral elements. The rose motif is relatively rarely used as an independent compositional center and more often appears as a secondary or complementary decorative element.

From a compositional perspective, the placement of embroidered motifs follows the traditional principles of Bulgarian folk costume—on the sleeves, around the neckline, and along the hemline. This positioning has both aesthetic and symbolic functions, associated with notions of protection, harmony, and the structural organization of the garment [14]. In the contemporary context, however, this symbolism is often reduced to a purely decorative effect.

Significant differences among the analyzed brands can be observed in terms of the degree of stylization and adaptation to current fashion trends. For example, Vezba is characterized by a minimalist approach, where decoration is reduced to a minimum and the emphasis is placed on form, material, and product sustainability. The use of natural textiles such as linen and cotton aligns with contemporary concepts of sustainable fashion design [2].

On the other hand, brands such as BULGARKA.BG and SHEVICA BG maintain a higher degree of ornamentation, striving for a closer connection to traditional aesthetics. Their products often feature richly decorated surfaces, which, however, may limit their applicability in a contemporary urban environment.

The overall trend indicates that most brands rely on established ornamental patterns without a significant degree of original interpretation or digital transformation. A notable gap is the lack of clearly conceptualized collections built around a specific national symbol, such as the Bulgarian oil-bearing rose (*Rosa damascena*).

Although the rose motif appears in individual products, it is rarely considered as the primary carrier of the design concept (Fig. 1). This gap creates opportunities for the development of new approaches in which the rose is interpreted not merely as a decorative element, but as a central component of the visual and conceptual identity of the fashion product.



Fig. 1. Selection from the product range of Bulgarian companies featuring rose motifs

Within the framework of the present study, such an approach is proposed, based on the digital transformation of original motifs and their application through machine embroidery.

In conclusion, it can be stated that contemporary Bulgarian brands successfully integrate traditional elements into their products; however, they rarely develop innovative concepts based on clearly defined national symbols.

II.3. Technological Process for Creating a “Stylized *Rosa damascena*” Motif

One of the earliest and most enduring plant motifs in Bulgarian embroidery ornamentation is the rose, which occupies an important place in the decorative system of the traditional costume. According to Ivan Koev [7], it appears in a specific stylized form known as a “rosette” (Fig. 2). In this ornament, the original naturalistic image of the flower is highly reduced and transformed, preserving only the idea of centrality and radial expansion.



Fig. 2. Embroidered ornaments from shirt sleeves from the Provadia region

The rosette represents a composition with a clearly defined center, typically shaped as a circle or square, around which elements resembling petals are symmetrically arranged. These elements are often geometrized and take on the form of star-like structures, which are subsequently interpreted as plant motifs.

Fig. 3a shows a detail from the sleeve of a women’s shirt from the Samokov region [15]. The central element is developed as an eight-petaled rosette, enclosed within a geometric frame, from which additional motifs radiate, interpreted as the “tree of life.”

In Fig. 3b, on the chest panel of a women’s shirt from the Stanke Dimitrovo region, the rosette is reduced to a repeating module—an eight-petaled flower arranged in horizontal bands. Here, the motif loses its centrality but retains its recognizable structure and rhythmic function within the composition.

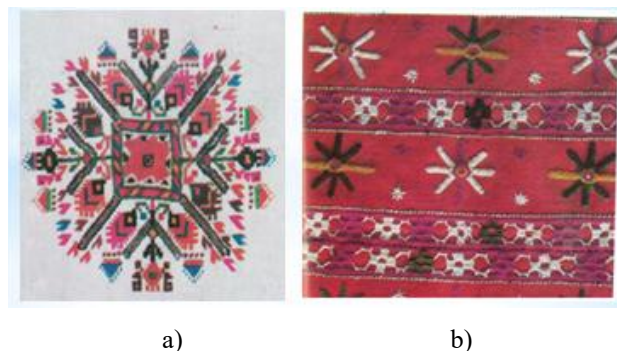


Fig. 3. Rosettes

A characteristic feature of these ornaments is that, despite their strong geometrization, they preserve the idea of a plant origin. It is precisely this transformation—from a naturalistic rose to an abstract rosette—that enables the easy adaptation of the motif to the cross-stitch technique and its widespread use across different ethnographic regions.

In the context of the present study, this traditional stylization is of key importance, as it demonstrates how a natural form can be transformed into a universal decorative sign. The creation of the original “*Rosa damascena*” motif is based on this principle, but further develops it toward greater visual recognizability and digital adaptability.

The digitization process of the original “*Rosa damascena*” motif was carried out through the sequential use of the specialized software systems Pattern Maker for Cross Stitch and Artistik Digitizer, which enable the transformation of the visual image into a technologically applicable model for machine embroidery. This approach corresponds to contemporary CAD-based practices in sustainable fashion and digital textile design [4].

For the transformation, an embroidery ornament was selected (Fig. 4), representing a four-rayed geometrized rosette, in which the image of the rose is reduced to a cross-shaped symmetrical structure.



Fig. 4. Embroidered ornaments from the skirts of shirts from the Samokov region

Stage 1: Creating a Pattern in Pattern Maker

The motif from Fig. 4 undergoes the following stages of transformation (Fig. 5.):

- Structural analysis of the motif (Fig. 5.a);
- progressive transformation of geometric structures into biomorphic floral forms (Fig. 5.b);
- Addition of naturalistic elements (Fig. 5.c);
- Preservation of the pixel-based structure. (Fig. 5.d);
- Contemporary interpretation (Fig. 5.e).

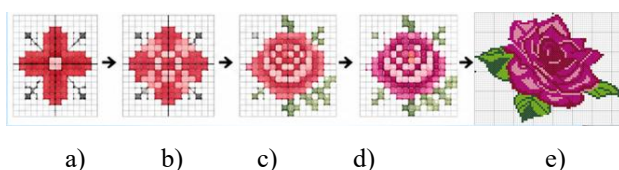


Fig. 5. Stages of transformation of a rosette embroidery ornament into a digital original motif „Rosa Damascena“

The original motif is adapted through the cross-stitch technique. In this phase, the image of the rose is transformed into a pixel-based structure (grid), corresponding to the stitch system.

The main operations include: (Fig. 6.):

- Setting the canvas dimensions and stitch density (stitches per inch/cm): For the development of the original Rosa damascena motif, the project parameters were configured in the „Canvas Properties“ section with a cross-stitch density of 12 stitches per inch (12 count) in the horizontal direction. The initial project dimensions were set to 80 mm in width and 60 mm in height. Following the digitization and scaling process, the finalized embroidery motif was generated with dimensions of 83 × 64 stitches, corresponding to an actual embroidery size of approximately 168 × 126 mm. These parameters were selected to ensure optimal visual clarity of the ornament, preservation of the stylized floral structure, and suitability for machine embroidery implementation.

- Selection and optimization of the color palette: The color palette was reduced and optimized through the selection of a balanced chromatic composition comprising five colors—two green tonal variations for the leaves and three tonal gradations for the rose petals. This approach contributed to improved visual clarity of the motif, technological feasibility of the embroidery process, and harmonious color balance.

- Manual refinement of contours to achieve a clearly recognizable form.

- Balancing between level of detail and technological feasibility: A balance between ornamental detail and technological feasibility was achieved through the elimination of isolated single-color cross stitches. This optimization reduced excessive thread transitions and knot formation during the embroidery process, thereby improving the precision, structural stability, and production efficiency of the machine embroidery implementation.

As a result, a digital pattern is obtained that combines the traditional aesthetics of cross-stitch with the author's interpretation of the rose.

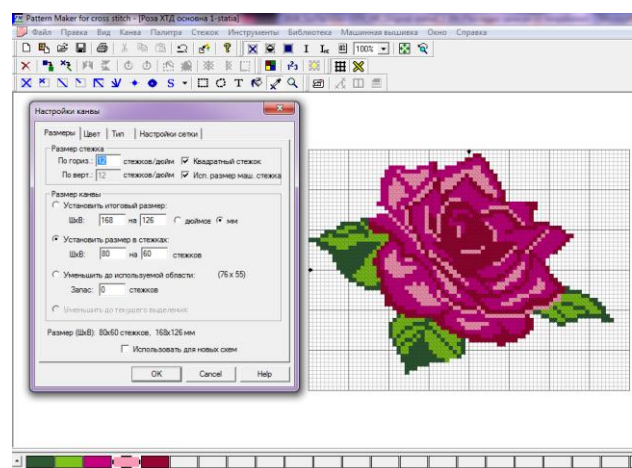


Fig. 6. Part of the operations involved in the digitization of the motif

The next step involves exporting the created pattern into a file for machine embroidery (Fig. 7). The following parameters are defined: the embroidery file format according to the type of embroidery machine; the file name and storage location; the hoop size; and the stitch thickness for machine embroidery.

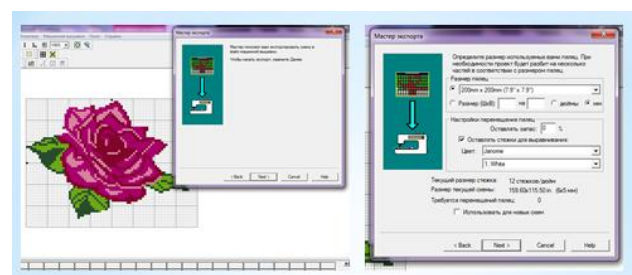


Fig. 7. Exporting the pattern into a machine embroidery file

Stage 2: Conversion into a machine embroidery file using the specialized embroidery software Artistik Digitizer

This stage involves transforming the pattern into a machine-readable file using the software Artistik Digitizer 1.7. At this stage, the so-called “digitizing” process is carried out—converting graphical information into a sequence of embroidery stitches.

The key operations in this stage include (Fig. 8.):

- importing the pattern and converting it into vector format;
- selection of a color scheme in accordance with the design concept;
- optimization of the embroidery sequence to reduce thread breaks and transitions;
- simulation of the embroidery process and correction of potential defects.

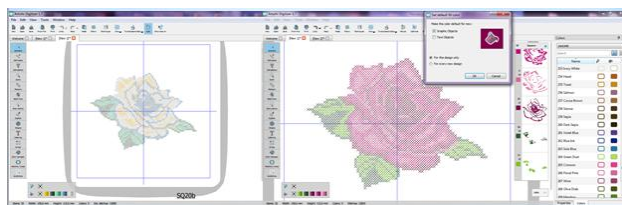


Fig. 8. Part of the operations in Stage 2

The final result is a file (Fig. 9), compatible with an embroidery machine (Elna eXpressive 830 L), which enables precise reproduction of the motif on a textile base (Fig. 10.).

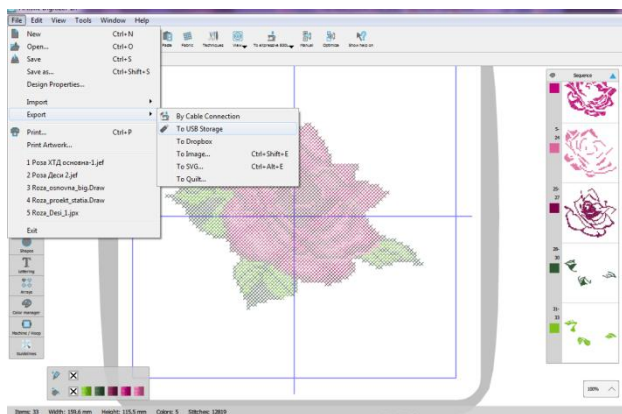


Fig. 9. Export to USB in a file format for an embroidery machine



Fig. 10. “Rosa damascena” motif embroidered on cotton canvas fabric

III. RESULTS AND DISCUSSION

In addition to the main original motif “Rosa damascena,” two additional stylized variations of the rose ornament were developed within the framework of the present study. They preserve the connection to traditional stylization while offering different degrees of geometrization and artistic interpretation. The three motifs function as a unified visual system (Fig. 11) and are incorporated into the design of the proposed project collection.

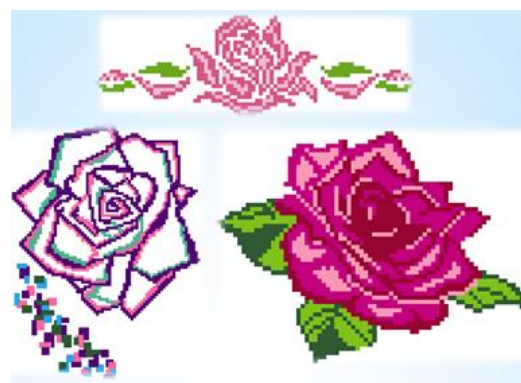


Fig. 11. Designed stylized variations of the “rose” ornament

The inspiration for the creation of the original collection stems from the Bulgarian oil-bearing rose (Rosa damascena) as an emblematic symbol of national culture and natural heritage. The mood board presented in Fig. 12 brings together visual references to the Rose Valley, traditional rose harvesting, and authentic Bulgarian embroidery, emphasizing the transformation of the floral motif into a contemporary design element.



Fig. 12. Atmosphere - map of the collection. /Moodboard/

III.2. Application of Original Rosa damascena Motifs in Contemporary Fashion Collections

Based on the conducted research and the developed original motifs of the “stylized Bulgarian rose,” a project proposal for a fashion collection has been created, structured into three thematic lines: **ethnic**, **romantic**, and **classic**. Each of them interprets the relationship between tradition and modernity in a different way, while maintaining a common conceptual framework—sustainable design based on cultural identity.

The color composition of the designs is fully aligned with global Spring–Summer 2026 fashion trends [16]:

- current pastel and natural colors are used;
- saturated accent tones are integrated;
- the principle of harmony between calmness and expressiveness is followed.

In this sense, the collection not only reflects contemporary fashion trends but also interprets them through the lens of Bulgarian cultural identity, creating a contemporary, sustainable, and recognizable design product.

• Ethnic line – “Root”

The first line (Fig. 13) is directly inspired by the Bulgarian traditional costume, particularly the “barchanka”-type shirt and the tunic-style garment. It is characterized by a loose silhouette, constructive simplicity, and emphasized functionality.

Main characteristics include:

- **Silhouette:** straight or slightly A-line, without a clearly defined waist seam;
- **Sleeves:** dropped shoulder or raglan sleeves, medium to long length, with the possibility of adjustment using ties;
- **Materials:** linen and cotton with a natural texture;
- **Decoration:** embroidery positioned in traditional areas—around the neckline, on the sleeves, and along the hem.

In this line, the rose motif is interpreted in a more geometrized form. It functions as a central symbolic element, balanced by complementary ornaments of a geometric nature.

The ethnic line demonstrates the strongest connection to cultural heritage and can be considered the foundation of the entire collection.



Fig. 13. Ethnic line

• Romantic line – “Bloom”

The second line (Fig. 14) presents a more emotional and artistic interpretation of the rose theme. It is aimed at young women and is characterized by greater plasticity, dynamism, and decorative richness.

Main characteristics include:

- **Silhouette:** semi-fitted or trapeze-shaped, often with an emphasized waist through a belt;
- **Construction solutions:** asymmetry, layering, and ruffles;
- **Sleeves:** puff sleeves, off-shoulder, or bell-shaped;
- **Length:** varies from short to maxi, with movement in the hem;
- **Accessories:** textile bags, belts, and decorative ties.

In this line, the rose motif functions as a compositional focal element with greater artistic freedom—often in a larger scale and with a more organic form. The embroidery

follows the line of the silhouette, emphasizing the movement of the body and the construction of the garment.

The models are characterized by an ethereal silhouette, enhanced femininity, and visual lightness, achieved through the use of transparent and layered fabrics. Structurally, they feature soft lines, asymmetrical solutions, and свободни форми, които създават усещане за движение и динамика. Decorative elements are based on delicately distributed floral rose motifs, executed in stylized embroidery and combined with fine geometric ornaments. The color palette includes soft pastel shades—ecru, powder pink, and light natural tones, which enhance the romantic expression.



Fig. 14. Romantic line

• Classical line – “Style”

The third line (Fig. 15) presents the most refined and contemporary interpretation of the theme. It is oriented toward the urban environment and everyday elegance.

Main characteristics include:

- **Silhouette:** fitted or semi-fitted, with a clearly structured form;
- **Construction:** minimalist, emphasizing the female silhouette;
- **Length:** knee-length or midi;
- **Materials:** finely processed cotton, linen, or blended sustainable textiles;
- **Accessories:** bags and shoes with subtle embroidery.

In this line, the rose motif is reduced and integrated as a subtle decorative element, often positioned asymmetrically—along the shoulder line, the left side seam, or the hem. This corresponds to contemporary trends in minimalism and functionality in fashion design [2].

The classical line demonstrates the highest level of adaptation to the contemporary lifestyle, while preserving cultural identity through subtle visual codes.



Fig. 15. Classical line

The three lines of the project collection form a unified system, in which the unifying element is the original *Rosa damascena* motif, realized through machine embroidery. It functions as a visual marker of Bulgarian identity, while simultaneously allowing for diverse interpretations depending on the design concept.

IV. CONCLUSIONS

The present study examines the possibilities for the digital transformation of the Bulgarian oil-bearing rose (*Rosa damascena*) as a visual and cultural symbol within the context of sustainable fashion design. Through an interdisciplinary approach combining fashion design, textile technologies, and digital design tools, a comprehensive model for the creation and application of original embroidery motifs was developed.

The results of the study demonstrate that contemporary technologies, particularly specialized machine embroidery software, provide broad opportunities for adapting traditional ornaments to modern design practices. The digitization process using software such as Pattern Maker and Artistik Digitizer enables not only technical implementation but also the creative interpretation of cultural heritage.

The analysis of Bulgarian companies in the field of embroidered textiles revealed that, although there is an established practice of using traditional motifs, there is a lack of a systematic approach to developing original concepts based on specific national symbols. The proposed project contributes to filling this gap by creating a collection structured into three lines—ethnic, romantic, and classical.

A significant contribution of the study is the integration of sustainable design principles through the use of natural materials and optimized production processes. Machine embroidery is established as an effective tool that combines high quality, repeatability, and the possibility of local production. Similar sustainable approaches integrating traditional embroidery practices with contemporary textile

production have also been discussed in recent international research focused on cultural preservation and textile waste reduction [3].

In conclusion, it can be stated that the digital transformation of traditional symbols, such as the Bulgarian rose, represents a promising direction for the development of contemporary fashion design. This approach not only preserves cultural identity but also adapts it to the global context, creating new opportunities for sustainable and innovative development of the fashion industry in Bulgaria.

ACKNOWLEDGMENTS

This research was supported by Project No. 261HTD0005-16 funded by the Research and Development Sector of the Technical University of Sofia.

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