

# An Approach to Digital Presentation of Traditional Bulgarian Embroidery Patterns

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**Abstract.** This paper studies problems related to the development of cross-stitch software as part of craft software. It treats an approach to the digital presentation of embroidery patterns. The software is designed for people engaged in traditional Bulgarian embroidery. In a digital way, the paper presents a variety of stitch types used in Bulgarian embroidery and a digital description of whole cross-stitch patterns. This study describes the entire pattern as a set of smaller groups of items. Often, some of these items are identical, which can facilitate pattern description. In general, the developed application is oriented toward Computer-aided Design stitch features of old cross-stitch patterns, which are found in ethnographic exhibits.

**Keywords:** Cross-stitch Pattern Software, Craft Software, CAD Systems, Domestic Handicrafts, Digital Preservation, Cultural Heritage, Computer-aided Design.

## 1 Introduction

Traditional Bulgarian national costumes are richly decorated with embroidery, laces, and other additional adorning elements. Generally, embroideries are this part of the dress look, distinguished by its brightness; they even form the whole appearance of the costume. As part of the Bulgarian folk ornaments, the embroideries show national features of style and relief in their general structure, rich rhythms, and intricately shaded and decorative color schemes (Popov, 2020).

It is necessary to emphasize that embroidery ornaments have not only a decorative aspect; they have their own secret symbolism; they are symbols and signs that would convey magical meaning; they protect and cure; ensure good health, prosperity and fertility (Veleva et al., 2018). In this way, each embroidery pattern contains a certain symbolism passed down over the centuries; therefore, the preservation of intangible cultural heritage also includes preservation and protection of old embroidery patterns.

There is no doubt, embroidery as needlework related to the manufacture homespun textile, has a material expression. It is part of the old traditional costume, being an example of tangible cultural heritage. In this case, there is an interconnection between tangible and intangible cultural heritage, represented by textile products on the one

hand and craftsmanship as well as a kind of certain symbolism involved in them on the other.

Interest in embroidery, particularly Bulgarian embroidery as part of cultural heritage, has not been recent. Already in the 20s of the 20th century, Bulgarian embroideries appeared in European fashion trends (Aleksandrova, 2019); and European press took likewise an interest in it (D.M.C. Library, 1975). These facts lead to the conclusion that embroidery is accepted as part of the cultural identity of a particular nation and is crucial in preserving of cultural heritage.

Current digital technologies offer a number of possibilities for the presentation, preservation, and storage of historical and cultural heritage. There are some authors who have dealt with the digital presentation of Bulgarian folklore costumes. For example, an approach for a digital description of Bulgarian national costume and Bulgarian embroideries is given (Tabakova-Komsalova et al., 2023).

This paper deals with Bulgarian embroidery features, it emphasizes not the symbolism in the motifs, but it focuses on the way in which embroidery patterns are presented as graphic elements and the way they can be digitally described. The aim of the paper is the digital presentation of Bulgarian embroidery patterns, taking into account their features and creating the functionality of a software application by means of which is to create replicas of Bulgarian embroidery motifs. Such an application would be of interest primarily to craftsmen involved in embroidery but it could also be used as a tool for presenting and researching ethnographic exhibits.

## 2 Features of Bulgarian Embroidery Patterns

Bulgarian national embroidery has some specific features; it characterizes by numerous plant, geometrical, zoomorphic, and anthropological patterns, as each particular region has different types of motifs (Popov, 2020). The embroidery in these regions also differs in thread color schemes and sometimes in techniques (Dimitrova, 2022; Nasledstvoto, 2024). Since this paper deals with Bulgarian embroidery patterns from a graphical point of view, the study focuses on the elements constructing the patterns. This includes the stitch types and thread colors that build the motifs.

There are applications for Computer-aided Design of cross-stitch patterns, known as **cross-stitch software**. Examples of such software are StitchFiddle (StitchFiddle, 2024), Floss Cross (FlossCross-Designer, 2024), and Pixel-Stitch (Pixel-Stitch, 2024). Comparing these applications, Floss Cross proves to be more appropriate for the presentation of Bulgarian embroidery patterns because it supports some of the most commonly used stitch types (*cross*, *continental*, and *black stitch*). Unfortunately, neither Floss Cross, nor the other mentioned applications support all the stitch types used in Bulgarian embroidery. According to English-speaking authors, most people confuse cross-stitch for embroidery because it is essentially a type of embroidery work; however, it requires counted needlework, which differentiates it from regular types of embroidery. The most commonly seen and practised cross-stitch is an X-shaped stitch on divided squares of a fabric that forms a pattern when combined (Bella, 2023). Never-

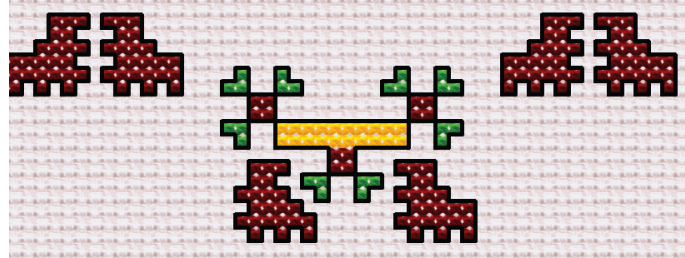
theless, the cross is the most commonly used stitch type in traditional Bulgarian embroidery, and authors use the term embroidery instead of cross-stitch in ethnographic publications (D.M.C. Library, 1975; Dimitrova, 2022; Popov, 2020). The most likely reason for this is that a variety of techniques is applied in Bulgarian embroidery. Therefore, this paper adheres to the term **embroidery**.

Typically, embroidery patterns are described as colored graphical symbols in a raster grid that correspond to an embroidery canvas. The graphical symbols represent the different types of stitches. Like other similar embroidery or cross-stitch patterns in the world, the most frequently used stitches in Bulgarian embroidery are *full stitch* (or *cross*), *half* (or *continental*, or *slanted*), and *black*. It is necessary to note that the description of Bulgarian embroidery by non-Bulgarian authors use the term *slanting Slav stitch* (D.M.C. Library, 1975) instead *slanted stitch*. The slanted stitch can be made in many different variants (left to right, right to left) and can also be doubled to obtain the so-called long arm half stitch or can be made with an under-stitch (half cross stitch with a leading thread).

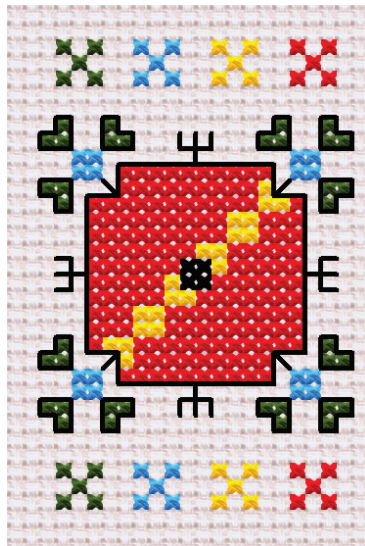
Other widely used types of stitches are: *running*; *zigzag*; *herring bone*; *triangle*; *straight*; *chain*, *Lazy Daisies*, etc. There exist unique stitches used in local areas as “*Samokovski X*” (from the town of Samokov) – upright outlined cross; “*zabka*” (*tooth*) *stitch*; “*Tronski bod*” (*Tronky stitch*). “*Tronky*” is the name for a local ethnographic group in Strandzha region (Bulgaria).

Any graphic presentation of Bulgarian embroidery patterns, whether they are taken from ethnographic publications (D.M.C. Library, 1975; Dimitrova, 2022; Nasledstvoto, 2024), or they are published on the Internet, always uses a corresponding symbol that graphically represents the stitch (Zaharieva-Stoyanova, 2022). Some craft software applications consider the type of stitches in the particular network pattern (Floss Cross, for example), but most of them do not support the different types of stitches. In general, applications emphasize the colors of threads with which the embroidery is made. To a large extent, this is determined by the fact that applications are aimed at designing embroidery, cross-stitch, or tapestry patterns that are implemented with only one type of stitch: full or half. However, this is not typical for the implementation of traditional Bulgarian embroidery, where a number of different stitches could be combined. Therefore, the development of craft software aimed at the specific needs of people engaged in traditional Bulgarian needlework and stitch types must necessarily be included as graphic elements.

Usually, figures in Bulgarian embroidery patterns are made using cross or slanted stitches, and they are outlined using black stitches, as shown in fig. 1 and fig 2. Considering that Bulgarian embroidery uses slanted stitches with understitch in different ways, it is suggested that a sequence of the same stitches can be described as a combined stitch. In Zaharieva-Stoyanova (2022) introduced the term *cluster stitch*. Cluster stitch is implemented as a whole part with the same color thread. A group of slanted stitches with an understitch or Tronsky stitch always forms a cluster stitch. A group of same-colored crosses can also form clusters. In practice, these elements are made together.



**Fig. 1.** Embroidery pattern of chemise decoration from Saparevo village, Dupnitsa region.



**Fig. 2.** Embroidery pattern of chemise decoration from Sofia region.

Another feature of Bulgarian embroidery patterns is that they are composed of repeating elements. An example of such a pattern is the floral motif in fig. 3 – three identical in shape but differently colored flowers. As part of the entire pattern, each flower can be split into several groups of repeating elements. For example, the group forms a blossom and the same elements are repeated four times. Any single element is rotated to 90, 180, and 270 degrees. The leaf is described as two identical symmetrically placed elements. Repetition and symmetrical arrangement of identical elements also occur, as shown in Fig. 1, where a stylized image resembling a flying bird can be seen. Floral and zoomorphic motifs have been recently used in Bulgarian embroidery. The same elements are observed in different patterns. For example, stylized leaves occur in both patterns shown in Figs. 1 and 2.

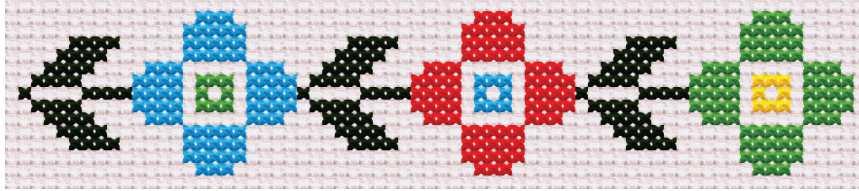


Fig. 3. Embroidery pattern of chemise decoration from Kyustendil region.

The development of craft software for Computer-aided Design of Bulgarian embroidery patterns requires the consideration of features listed above. The application should include various stitch types and allow for the formation of patterns consisting of multiple repeating groups of elements.

### 3 Digital Presentation of Embroidery Patterns

As previously mentioned, this paper focuses on an approach to graphically describe cross-stitch patterns used for the decoration of traditional Bulgarian national costumes. In such a kind of application, what has to be taken into account in the first place, is that the whole pattern consists of groups of repeating elements. Each group can be further divided into smaller groups. A single stitch is the smallest item of the pattern. A close look at the entire embroidery decoration of a particular costume shows that the scheme involves one or more basic patterns. Usually, each pattern consists of repeating elements called *rapports*. Each rapport is a group of different types of stitches. Examples of embroidery pattern rapports are shown in fig. 1, 2, and 3.

#### 3.1 Digital Description of Stitch Types and Program Implementation

The embroidery pattern is graphically described as a set of stitches placed in a canvas. As previously mentioned, some stitches are connected in a group, called a *cluster stitch*. Cluster stitch is implemented as a whole part with the same color thread.

Some stitch types are used to outline contours, and others to fill out figures. Considering the real process of embroidery, different stitch types can't be combined randomly. Stitch types can be divided into three groups according to their usage:

- **Stitch types for filling out.** The most frequently used stitches are cross and slanted stitches belonging to this group. So do straight and straight front stitches, as well as "Bulgarian cross" (Smyrna cross stitch variation). These stitches can be implemented as a single stitch or a cluster.
- **Stitch types for outlining a contour:** black, running, and slam stitches. A characteristic feature of these stitches is that they can outline contours of figures filled out with stitches from the first group. From the point of view of graphic presentation, points from the first and second groups can occupy the same positions on the canvas.
- **Stitch types for describing a decorative border:** triangle, chain, zigzag, etc. Usually, such stitch types are used to form a border - to make a hem of the dress

(chemise, for instance), or to end up cuffs and wristbands. In essence, they also delineated contours, but unlike the second group, they cannot be combined with stitches from the first group used to fill out. In this case, the borders themselves are solid and filled out accordingly.

The .Net platform and C# language are used for program implementation. To describe a stitch, an abstract class `Stitch` is declared:

```
abstract class Stitch
{
    protected Color;
    protected Point;
    // ...
}
```

The fields `color` and `location` correspond to the stitch color and location. Type `Color` is a class representing a thread color – name, number and RGB color code. The values are retrieved from the DMC and Anchor data tables describing floss sets (Zaharieva-Stoyanova, 2019).

To present the stitch types given above, four enum types are defined: `SingleStitchType`, `ClusterStitchType`, `ContourStitchType`, `BorderStitchType`. First two types describe stitches for filling out, the rest are used for describing contours and borders.

Class `Stitch` is inherited by four derived classes `SingleStitch`, `ClusterStitch`, `ContourStitch`, `BorderStitchType`.

An instance of class `SingleStitch` corresponds to a single stitch (cross or slanted stitch) in the canvas, and a `ClusterStitch` instance is a cluster of identical stitches made as a cluster. The instance of class `Contour` consists of a list of points representing a polyline or an enclosed polygon, as follows:

```
class ContourStitch : Stitch
{
    private ContourStitchType stitchType;
    private List<Point> points = new List<Point>();
    /...
}
```

The division of stitch types into groups limits their chaotic usage and combination which can lead to undesirable effects – creation of patterns that are impossible to implemented in practice. Moreover, the developed software would be more useful for craftsmen dealing with embroidery and creating existing motif replicas.

### 3.2 Digital Presentation of Patterns, Grouping and Operations with a Group of Stitches

The presentation of Bulgarian embroidery motifs, based on multiple elements, when some of them repeats manifold, can be implemented in craft software for Computer-aided Design of Bulgarian embroidery patterns. This study presents the entire embroidery pattern as a set of smaller groups of stitches. Unlike clusters, the group comprises multiple types of stitches and describes a particular pattern item. As a programming code, the group is built as a list of `Stitch` type (class `Stitch` instances):

```
class Group
{
    private Point location;
    private int height;
    private int width;
    private List<Stitch> stitches = new List<Stitch>();
//
}
```

Except for the addition of stitches to the canvas and/or their removal, the design process also includes multiple group operations. The group is created after the selection of a canvas rectangular area with stitches.

The required functionality for group operations can be summarized as follows:

- Filtering of stitches with the same type and/or with the same color.
- Replacing the color of the stitches.
- Moving of a group.
- Copying of a group.
- X - Symmetry of a group
- Y - Symmetry of a group.
- Rotation of a group.

The coordinates of the stitch location are different from screen coordinates. They indicate stitching canvas places. The coordinates of the stitch locations are integers. When a group is created, the location of each stitch belonging to it is recalculated according to the group location.

To recalculate the new location for X- Symmetry, formula (1) is used.

$$x2 = x1; y2 = n - y1 \quad (1)$$

To recalculate the new location for Y- Symmetry, formula (2) is used.

$$x2 = m - x1; y2 = y1 \quad (2)$$

Rotation to 90° is done with formula (3).

$$x2 = n - y1; y2 = x1 \quad (3)$$

where  $(x_1, y_1)$  indicates the old location,  $(x_2, y_2)$  indicates the new location, and  $m$  and  $n$  indicate the group sizes.

Presented in this way, formulae (1), (2), and (3) are valid for the graphic transformation of stitches belonging to the second group, `ContourStitch` type. For the remaining groups of stitches, the top-left position fixes the new stitch location.

## 4 Conclusions

Traditional home crafts and occupations are part of the cultural and historical heritage. Embroidery is one of the most frequently practiced domestic crafts. Currently, there is a great interest in Bulgarian embroidery patterns in this country.

This paper presents an approach to digital presentation of traditional Bulgarian embroidery patterns. The idea is to describe the entire pattern as a set of smaller groups of items. Some of these items are often identical, which facilitates pattern descriptions. The goal is to develop cross-stitch/embroidery software oriented to the design patterns of Bulgarian embroidery replicas.

The study examines the features of Bulgarian embroidery patterns and the characteristics of the stitch types used. Special attention is paid to the functionality of the software – the creation of groups of stitches and their operation. The groups describe the elements that build the embroidery pattern, while the defined operations facilitate the entire design process. The proposed approach is used for the developing embroidery software. In general, the application is intended for Computer-aided Design of old cross stitch pattern in Bulgarian cross stitch embroidery.

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