Digital Representation of Knitting Patterns in Traditional Costumes

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Abstract. The paper presents the application of a CAD system for digital representation of traditional knitting. The CAD system is oriented to hand knitting. As a software application the system is developed by using C# programming language and .NET platform. The paper focuses on the applied side of the software and its usage as a means of representing and storing ethnographic exhibits.

Keywords: CAD Systems, Hand-Made Knitting, Knitting Pattern, Digitalization, Software Applications.

1 Introduction

Information technologies play an important role in the development of up-to-date human society. They are applied in almost all aspects of our life. The software applications are used in all branches of modern industrial production. Examples of such software are CAD/CAM systems used to cover the whole industrial process, from the project design to the manufacturing of products. In particular, CAD/CAM systems are also used in textile industry. The design process of fabrics, knitting, and embroideries, on the one hand and, the control of looms, knitting machines and embroidery machines, on the other hand, are implemented with the help of these systems.

Notwithstanding the fact that the whole production in modern society is entirely industrial, a lot of people are interested in handmade textiles. Knitting, embroidery, tapestry and crochet as activities are a kind of hobby for them. Usually these people take ideas from journals related to knitting, embroidery or crochet. They also share their models with each other. Many of them use Internet – there are a lot of web-sites and blogs for handiworks, where people share some experience, skills and mastery [5], [12], [16]. An electronic version of journals for knitting, embroidery and crochet exists there [6], [13], [17]. Famous companies, which also produce materials and accessories for hand crafts also suggest models for handiworks [7]. Moreover, people who are engaged in traditional occupations such as hand knitting, embroidery, crochet, etc. are a target group for these companies. They appear a target group for the ethnographers studying handicrafts and domestic occupations, too. Practically, these people carry on the old traditions and hand crafts. They themselves are interested in ethnography and quite often they seek out and reproduce patterns of knitting and embroidery from the olden days thus keeping the tradition alive.

CAD software could be applied in handicraft sector, too. The examples of such applications are software for jewellery manufacture [1] and a CAD system for brassware products [2]. People dealing with hand-made knitting and embroidery are also interested in Computer-Aided Design. Embroidery software – CAD systems for embroidery pattern design, exists there [14], [15]. Although few, there are CAD systems for hand knitting [8], [10], [11]. Usually, such software applications could be applied for machine knitting, too [8]. It makes software more universal but it results in adding extra functions. However, the applications become hard to handle.

CAD systems as software applications could be used for digital representation of elements of the old traditional costumes (knitted socks, pieces of embroidery in traditional shirts and chemises), table-cloths, bed covers, towels, etc. Using CAD systems is better than using digital photographs because the systems have possibilities for presenting complete and detailed information about the samples and methods of their implementation. Photographs cannot provide all these details, so it's possible to lose information about the exhibits.

The authors of this paper have already suggested two versions of a CAD system as a software application [3], [4]. The system is oriented to handmade knitting. The goal of this paper is to present how to use CAD systems for digital representations of knitting pattern samples and how to alter the systems' functionality to utilize them for preservation of ethnographic exhibits.

2 Knitting in Traditional Costumes

Knitting is an integral part of the traditional Bulgarian costume. Over the centuries, thanks to the skills of the Bulgarian women, hundreds of beautiful knitting patterns, fabrics and embroideries have been created. Today, these products are the subject of ethnographic interest as part of the cultural heritage. Patterns of these garments can successfully be used in the new designer collections, too.

Knitted products in traditional Bulgarian costume are socks and slippers. In most cases, socks and slippers are knitted on five needles (circular knitting), but sometimes it is possible to knit them on two needles (flat knitting) and after that get the knitted section sewn. To achieve a better aesthetic effect of knitting, different knitting techniques are used. The simplest and most commonly used technique is a ***stockinette stitch***. Knitting a stockinette stitch is easy, but it fails to have the desired aesthetic effect. Therefore, multiple colors or a combination of different types of stitches are used to give the desired effect.

Depending on whether the fibers are used with different colors or different kinds of stitches, knitted structures can be divided into:

- Patterns with multiple colors (colored patterns) – done when yarns of different colors are knitted.
- Textured patterns – realized by using combinations of different type of stitches (*knit, purl, yarn over*, etc.)

Patterns with multiple colors are knitted by using the following knitted techniques: *jacquard*, *intarsia*, and *stripe*. Patterns realized by combinations of different stitches are *laces*, *cables* and *arans*. It is possible to combine colored patterns with textured patterns.

Research on models of knitted articles in the inventory of the Etara Ethnographic Museum [9] has been conducted. Exhibits from all Bulgarian regions can be found in the inventory. Table 1 gives information about the knitting technique used and the features of the exhibits. Within the 31 models studied 30 are knitted socks and one model of slippers. As a whole, most patterns are with multiple colors. Jacquard is the most commonly used technique – 27 out of 31 exhibits are made by using this technique. Most of these exhibits are made by using a combination of different techniques. For example, they start with a stripe in the foot or in the heel and then they are decorated with a jacquard in the upper part of the sock; or vice verse – jacquard in the foot and a stripe in the upper part of the sock. The arans, cables and laces are less used knitting techniques. The example of old traditional socks is given on Fig.1 and Fig. 2.

Table 1.

Knitting technique	Number of exhibits
Jacquard	27
Intarsia	8
Stripe	14
Lace	3
Arans	2
Cables	2
Ribbing	7
Welting	5
Crochet	8

Fig. 1. Traditional Bulgarian socks

Knitting techniques *ribbing* and *welting*, are applied for the upper end of the socks (near the knees). Sometimes, upon the completion of knitting, in the upper part of the sock *crochet* is used. This technique makes it possible to set a cord to lace up the socks. Another similar technique is yarning over and knitting 2 stitches together in turn (see Fig. 1).

Fig. 2. The pattern of traditional Bulgarian socks

Another feature in the manufacture of socks is the way of their casting on – from the foot or from the top of the sock. Most of the exhibits in the inventory of the Etara Ethnographic Museum are made by casting on from the foot, but some of them are made by casting on from the top. Rarely an additional decoration using "non-knitting" techniques could be seen: sewn with lame or with a woolen thread; beading – decoration with beads (see Fig. 2).

3 Application of CAD Systems for Digital Representation of Traditional Knitting Works' Patterns

This paper views the possibilities of *Visual Studio for Knitting Pattern Design* CAD systems for the digital presentation of the knitting charts of old traditional socks. The application is hand-made knitting software. It is developed on the basis of the editor of raster graphic images placed onto a rectangular grid. Each item of the grid corresponds to a knitting stitch. The editor do the images representing knitting patterns. According to the image view, the chart of knitting patterns, describing the knitting structures, can be divided in two groups: *color images* and *images consisting of icons* – small bitmap images. The editor processes both kinds of images. The first group presents knitting structures, realized by using the knitting techniques: jacquard, intarsia, and stripe. The second group (bitmaps images) includes images presenting *laces*, *arans*, *cables* and other structures, which use a different kind of stitches together. The different icons present different stitches such as: *knit stitch*, *purl stitch*, *yarn over*, *cross* and so on. The system does not allow using colors and bitmap icons on the same pattern together. This is a drawback of the current version of the system, which will be eliminated in the next version.

The CAD system is created as a multiple document application so that both types of images could be visible at the same time. Figure 3 shows the main window of the *Visual Studio for Knitting Pattern Design* CAD system and the possibilities for opening two different types of documents at the same time. The examples of the pattern charts are taken from the model on Fig.1.

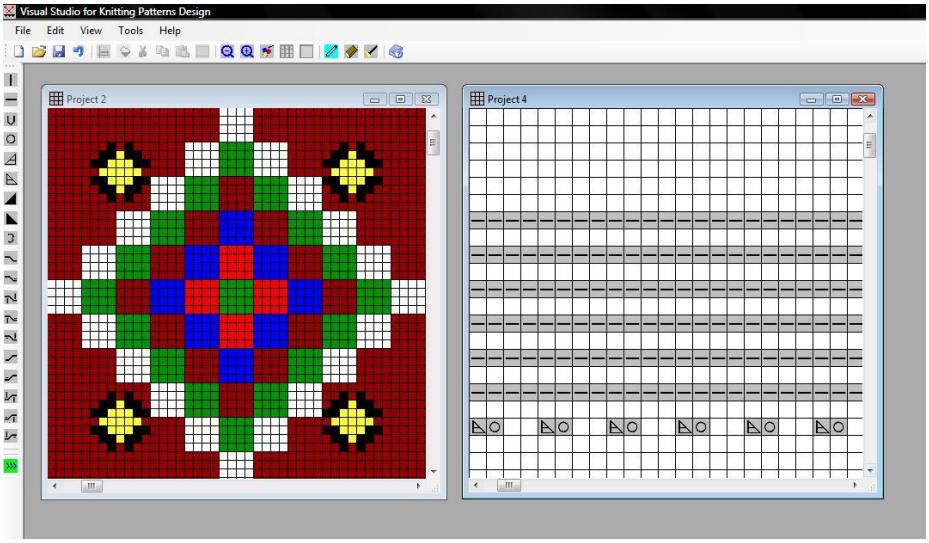

Fig. 3. Visual Studio for Knitting Pattern Design CAD system – main window

The core of the CAD system is an editor of raster graphic images. It supports the following functions:

- Fill raster cells with a different color;
- Fill raster cells with different bit-map icons;
- Select color palette;
- Select bit-map icons palette;
- Select erase mode to remove an item of the raster grid.

A color palette and a bit-map icons palette form two different tool bars. The designer determines which one of them will be used. The new version of the CAD system gives the user possibilities for setting up the color palette (Fig 4). Actually, the user can operate with unlimited number of colors.

Using the above functions the user creates images of knitting structures. The CAD system has possibilities for editing a marked region of the image. The application supports the following functions:

- Select a region of raster grid;
- Copy the selected region;
- Paste the selected region;
- Fill the selected region;

- Rotate to 90°, 180°, 270° the selected region;
- Erase the selected region.

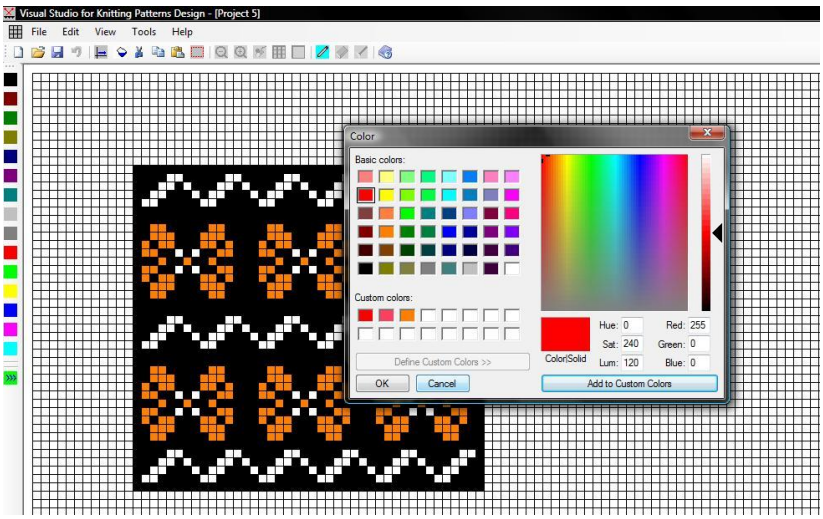

Fig. 4. Color dialog box for setting up of color palette

An example of copy and rotation functions is given on Fig. 5 and Fig. 6. Function rotation is an advantage of the suggested system. In practice, not many CAD systems similar to *Visual Studio for Knitting Pattern Design* have the possibility for rotating an image region.

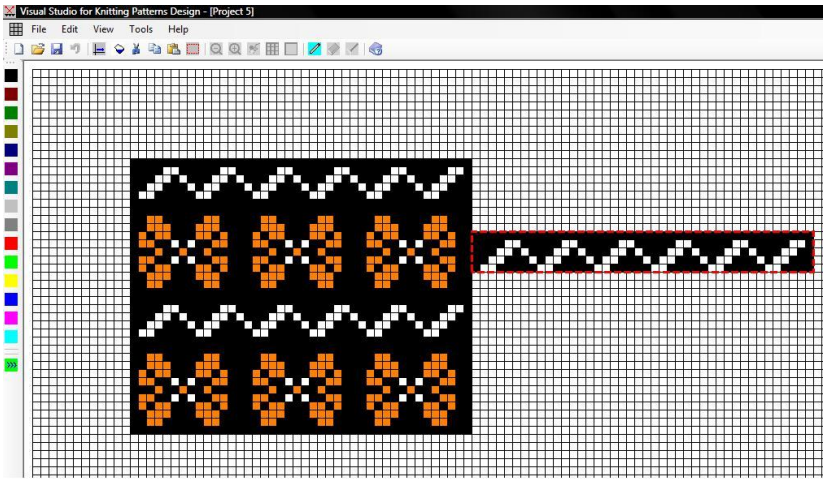

Fig. 5. Demonstration of copy function

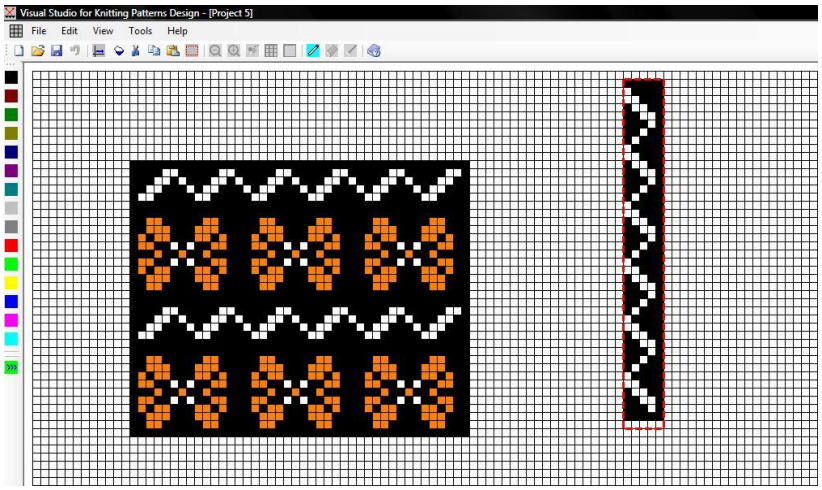

Fig. 6. Demonstration of the rotation function

The user can also set up the properties of the raster grid as follows:

- Remove the raster grid;
- Change the raster grid color;
- Visible/Invisible raster grid (Fig. 7);
- Zoom in/Zoom out.

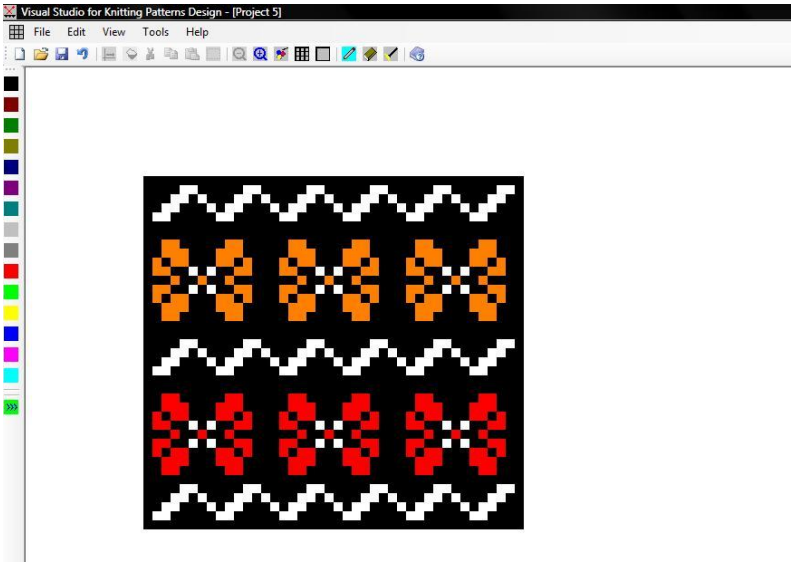

Fig. 7. Pattern put on invisible raster grid

These functions help the user to better take in a color image effect of the knitting structure; to choose the proper color for a particular knitting structure grid; and to edit the graphic image precisely. The *Undo* function is realized, too. The user can return the state of a knitting design 500 steps backward.

The latest version of the *Visual Studio for Knitting Pattern Design* CAD system can be used for presenting knitting charts of traditional socks' models. According to the document's type the system represents either a multi color pattern or a textured pattern. Because it is developed as a multi document application, this disadvantage has been overcome. In the next version this drawback will be eliminated by giving the user a possibility for editing both kinds of patterns together.

To represent an overall model of traditional socks by means of the CAD system, it is necessary to add an extra functionality:

1. Possibilities for representing the entire knitted products. They should provide information about the shape and sizes of a knitted section, stitches' numbers, as well as the place of the patterns on the knitted section.
2. Possibilities for including additional information about the model and its manufacturing. For instance, casting on, casting off, heel knitting, extra decoration and so on.
3. Possibilities for making a knitting chart from the picture (photograph). Thus a great number of ethnographic exhibits can be digitalized for a short time.

To be more effective as a system for ethnographic information, the application has to support data base with ethnographic exhibits (knitting). It's important to classify them by regions.

4 Conclusion

The protection of the world heritage is an important task where digitization plays a significant role. Digitization involves the use of appropriate software, as well as the development of a new one. This paper suggests the application of the *Visual Studio for Knitting Pattern Design* CAD system for digital representation of traditional knitting. As a software application, the system is developed in C# programming language and .NET platform. This CAD system is oriented to hand knitting. Practically, people dealing with hand-made knitting are followers of old handicrafts occupation and keep the tradition alive. The CAD system could be successfully used to store information about the knitting patterns of old traditional socks – ethnographic exhibits. Usually, they are made of wool, which is not a very strong material. There-fore it is important to make digital copies of the exhibits.

To use a CAD system for digital representation of ethnographic exhibits, it has to support specific functions related to the information about models manufacturing. In addition, it has to support data base and possibilities for exhibits classification. The CAD system could be adapted to other hand crafts such as crochet, embroidery and tapestry.

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