Project of CAD module for Knitting Patterns Design

Elena Zaharieva-Stoyanova

Abstract — This paper suggests an approach to CAD system development based on its creation as a set of programming modules. Some of these modules can be used in next generation of CAD systems or they can be embedded in another CAD software. The main reason to create such project is that it can be used as software application from fashion designers to make boutique collections of knitting products. The project develops a graphic editor for design of knitting pattern structures. It gives designers possibility to create different types of knitting structures, such as: jacquard, intarsia, gusset, lace, aran, cables and others Suggested CAD module would be used as an application for making boutique collections by fashion designers or as a part of another system.

Index Terms — CAD/CAM systems, computer graphics, computer-aided design, knitting industry, knitting patterns.

1 Introduction

The development of CAD/CAM systems for knitting industry automation is conditioned by technological improvement of knitting machines and by the advance in computer science, as well. Software rapidly changes along with hardware technologies development. New Operation Systems (OS) and a number of platforms and programming environments are continuously being introduced to the market.

Normally, the companies manufacturing knitting machines also put on the market CAD/CAM/CAI software packages delivered with whole hardware equipment. Non-standard equipment was usually in use before due to the existing a trademark protection policy. However this increases CAD/CAM systems' prices several times as shown in [1], [2], [3], [4].

It's important to mention that Computer-aided design is not only used in the industrial production. There exist other users, who are interested in such kind of software. Many people perceive hand knitting as hobby and they are searching new knitting models continuously. Usually, they take such samples from magazines. There are a lot of magazines for hand crafts – knitting, embroidery, gobelins. Some of them are published by famous companies, which offer also materials and accessories for hand crafts [5], [6], [7], [8], [9].

Creating knitting patterns editors of such kind of magazines use a multy-functional software packages as word processors and spreadsheet programs. To use a professional CAD/CAM system in this case is non-efficient. First of all, the functionality of each CAD/CAM system in knitting industry is bound by knitting machines' features. It means that only parts of CAD module might be used, so, the most of whole CAD/CAM system would be useless.

The second reason to do not use CAD/CAM system is that software delivered with knitting machines is custom developed. The user of such kind of a system must be well familiar with knitting machine features and knitting technologies process as a whole. For a fashion designer, who develops knitting patterns only, such software is hard to handle.

CAD/CAM systems are expensive software and their usage must be profitable. On the other side, a wide range of customers are interested of CAD modules as software for knitting design.

The goal of this paper is to offer a project to a programming module of specific CAD system development for knitting pattern structures. It can be used in next generation of CAD systems or they can be embedded in CAD software [10]. The users of this software application would be: designers of new knitting boutique collections; editors of knitting hobby magazines; people, who are interested in knitting as a hobby; ethnographers, who make investigations in the area of old traditional costumes and hand-made knitting. The project aims at more user-friendly software oriented to all these users.

This CAD module is a part from another CAD software package. The base feature of this system is that it is developed as set of programming modules [10], [11], [12].

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2 DEMANDS TO CAD SOFTWARE FOR KNITTING PRODUCTS DESIGN

Generally, application of computer graphics in knitting industry CAD/CAM systems has two aspects: knitting structures design and design of knitting pattern shapes. The second one is related to knitting machine's capacity to make products by fully-fashion (FF) method. It means that the machine knits the cuts of products, or the whole products. This method allows to avoid cutting the materials, reduces the number of the operations and it leads to reducing the waste products to a minimum. FF knitting method is based on the technology of hand knitting.

Because the images presented knitting structures are completely different in comparison with knitting pattern shapes, the CAD systems must contains two graphics editors – the first one to create a knitting structure, the second one to create a model of the product made by FF knitting method.

According to the conventional design, the model of a knit product (jacket, sweater, cardigan, etc.) is created based on some standard constructions. The term "construction" determines the whole style of the product; the number of its parts and their shape - see [9], [10], [11], [12].

Each model can be manufactured in several sizes, determined by the Standards of knit products. They define the sizes of knitting products' cuts. To create original and authentic models designers make use of different kinds of knitting techniques such as jacquard, intarsia, gusset, lace, aran, cables, and other knitting structures. The techniques employed are involved as a part of the model. It means that creation of knitting structures is a part of a whole process of knitting design [1], [2].

All aspects of a knitting design process and their relations to each other is shown on figure1.

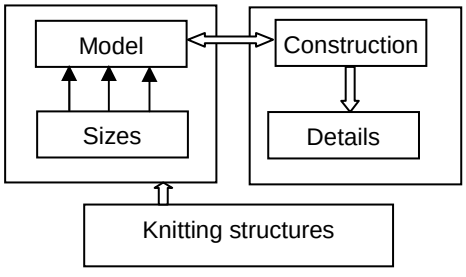

Fig. 1. The aspects of knitting process.

As a process, knitting products design is to cover all these aspects, so that the demands to CAD/CAM systems for knitting industry in general can be described as follows:

- Capacity to create and edit a construction of model including all its parts (cuts) of the product.
- To support a set of standard constructions of knitting models.
- To create a knitting model including all sizes variation.
- To create different types of knitting structures according to machine abilities to manufacture different knitting techniques (jacquards, intarsia, gusset, lace, aran, cables, and so on).
- Automatic generation of knitting control programs implementing the models.

The last one is a CAM module function; the rest is demands to CAD software. As a software application, a CAD system can be determined as a graphics editor creating and describing knitting structures and cuts of knit products [10], [11], [12].

Nevertheless, the last feature refers to industrial production; it has its application in CAD system for hand knitting, too. Introducing a model designer supports it with instructions how to realize the product. For example, figure 2 is a list of instructions for knitting a cable panel. So, the last demand can be converted to "Automatic generation of knitting instruction set".

CABLE PANEL (make 3):
With pair of needles, cast on 49 sts.
Row 1 (wrong side): K3, p6, k11, p3, k3, p3, k11, p6, k3.
Row 2: P3, k6, p11, Cr9B, p11, k6, p3.
Row 3: As Row 1.
Row 4: P3, C6B, p11, k3, p3, k3, p11, C6B, p3.
Row 5: As Row 1.
Row 6: P3, k6, p11, k3, p3, k3, p11, k6, p3.
Row 7: As Row 1.
Row 8: P3, k6, p8, k3, Cr9B, k3, p8, k6, p3.
Row 9: K3, p6, k8, p6, k3, p6, k8, p6, k3.
Row 10: P3, C6B, p8, k6, p3, k6, p8, C6B, p3.
Row 11: As Row 9.
Row 12: P3, k6, p8, k6, p3, k6, p8, k6, p3.
Row 13: As Row 9.
Row 14: P3, k6, p5, k3, Cr6B, k3, Cr6F, k3, p5, k6, p3.
Row 15: K3, p6, k5, p6, k3, p3, k3, p6, k5, p6, k3.
Row 16: P3, C6B, p5, k6, p3, k3, p3, k6, p5, C6B, p3.
Row 17: As Row 15.
Row 18: P3, k6, p5, k6, p3, k3, p3, k6, p5, k6, p3.
Row 19: As Row 15.

Fig. 2. Example of knitting pattern description.

3 Features of Knitting Structures Images

There exist diverse knitting techniques helping the designers to create a big variety of knitting patterns. The features of knitting structures images are determined by the used knitting technique. This paper treats the problems of computer-aided design of knitting structures so, their features will be discussed from computer graphics' point of view.

Generally speaking, a pattern of knitting structure can be drawn as a raster graphics image, where the smallest item of the grid corresponds to a knitting stitch. To describe a knitting pattern structure, the grid's items are filled with different colors (see figure 3) or they are consisted of icons (small bit-map images) as it shown on figure 4.

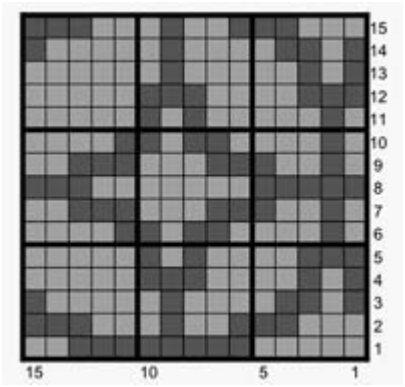

Fig. 3. Knitting pattern structure "jacquard".

According the image view, the knitting patters, describing knitting structures can be divided in two groups:

- color images;
- images, consisted of icons – small bit-map images.

The first group presents knitting structures, realized by using of the following knitting techniques: jacquard, intarsia, and stripe. The second group includes images presenting laces, arans, cables, for example. The common feature of all these technique is that they use a different kind of stitch together. It allows to obtain interesting and attractive knitting structures. The different icons present different stitches such as: *knit stitch*, *purl stitch*, *yarn over*, *cross* and so on.

It is important to mention that some knitting techniques are incompatible – they can't be used together. For example, knitting on the right side and purling on the other side realize the colored knitting structures obtained by usage of intarsia or jacquard technique but it is impossible to knit arans and cables in such knitting structure. Knitting stripes is an exception. It can be realized knitting structures by using different stitches and transverse stripes in different colors together.

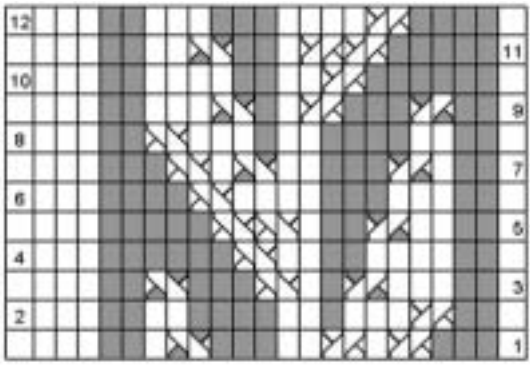

Fig. 4. Knittng pattern structure "aran".

4 Project of CAD Module for Knitting Structure

4.1 General Overview

The CAD module for knitting structures is a part of whole CAD system for knitting industry automation. It can be realized as an editor of raster graphics images put into rectangular grid. The size grid elements must be conformable to the size of the icon corresponding to a stitch – *knit stitch*; *purl stitch*; *yarn over*; *knit 2 stitches together*; *purl 2 stitches together* and so on.

The editor will support two types of images: colored images and images consisted of icons (small bit-maps). They would be chosen alternatively according to the selected knitting technique.

To create a colored image, the designer needs color palettes. Practically, the number of the yarns for one knitting pattern is limited because of knitting technique's features. Usually, two, three or four different yarn colors are used for one pattern. The situation when more than four yarn colors are involved happens very rare. Nevertheless, the modern computer technique has possibilities to handle with thousands colors, so, there is no reason to restrict the designer when he or she selects the workbench colors.

To create an image like to the one presenting on figure 4, the designer needs a group of icons corresponding to the different types of stitches. The problem is that there is not unification for these symbols (see [5], [6], [7], [8], [9]). So, one kind of stitch, purl for example, could be present by two or more different symbol. The want of unification could be get over by using of some sets of icons (symbols) describing the stitch types. The designer will select the set of symbols, which

is like him.

The general overview of the CAD module structure is given on figure 5. It includes all aspects of computer-aided design of knitting products discussed above.

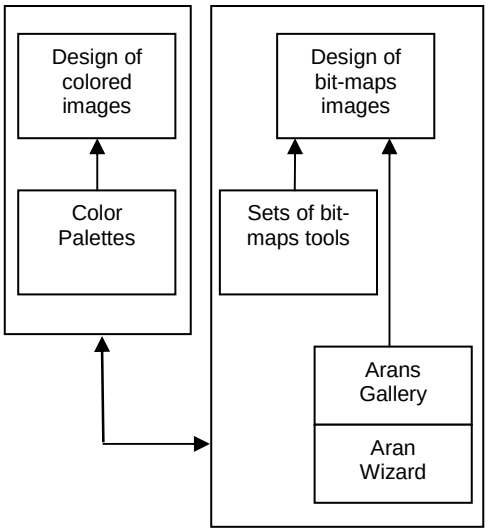

Fig. 5. Structure of CAD module for knitting structures.

4.2 Aran Gallery

The feature of the arans is that they consist of more than one stitch. It means that they need more than one raster's element – two, three or more stitches are joined to each other and they are taken as one whole element in. Because there is a big variety of arans and the designer could be make kinds of arans by himself, the decision of the problem is to create a Gallery of arans.

The Galley will be supported by the Wizard program, which allows creating arans. The Wizard needs following information:

- number of crossing stitches;
- the kind of each stitch (knit or purl stitch);
- the cross point;
- the crossing direction (to the right ot to the left).

4.3 Image Editing

Unless color palettes, sets of stitch icons and aran Gallery, the editor can be supplied with tools to draw, fill, or erase the part of the images. Existing of menu items Cut, Copy, and Paste is recommendable.

Saving image to standard graphic formats is convenient and reasonable because of the unification but by reason of further image processing it is better to duplicate information presenting an image. Because each item of the raster corresponds to the knitting stitch, a matrix form of an image data representation is suitable.

Usually, graphic editors use some tools to select areas (rectangular selection, free-hands selection), to erase selected areas, to cut or copy them, to fill them, or to put drops in different colors.

Flipping and rotation are used, too. To transform a colored image by these operations is not a problem but to do that on an image presenting lace or aran means that its structure must be changed. For example, flipping an item knit 2 st. together will be changed to cross and knit 2 st. together. This feature must be recognized when flip and rotate operations are realized.

5 CONCLUSION

This paper suggests an approach to CAD module for knitting structures. The project develops a graphic editor for design of knitting pattern structures. It gives designers possibility to create different types of knitting structures, such as: jacquard, intarsia, gusset, lace, aran, cables, and others.

The project is a part of CAD system development based on its creation as a set of programming modules. Some of these modules can be used in next generation of CAD systems or they can be embedded in another system - CAD software. The main reason to create such project is that it can be used as software application from fashion designers to make boutique collections of knitting products.

The CAD system would be used as an application for making boutique collections by fashion designers or as a part of another system. The users of this software application would be also editors of knitting hobby magazines; people, who are interested in knitting as hobby; ethnographers, who make investigations in the area of old traditional costumes and hand-made knitting. The project can be used as an example for CAD system development.

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