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## IMPLEMENTATION OF NEW DESIGNS THROUGH THE JACQUARD SYSTEM IN FABRIC PATTERNING

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### Abstract

Computer Assisted Design (CAD) systems have been widely used almost in every sector, as in the textile sector. By means of computer design programs, more than one fabric design could be made in a very short time with jacquard weaving designs. However, as a result of mass production, it is likely to encounter with similar designs so often. In this study, an analysis of the new jacquard fabric design was planned in accordance with the principles of textile design training and a total of 4 different fabric designs and applications were made.

**Keywords:** Jacquard Weaving, Computer Assisted Design, Fabric Design, Theme

### 1. INTRODUCTION

The Turks brought their traditions, customs and works of art with them when coming to Anatolia. Since they used to ranch at that period, the art of weaving was very important to them. However, the art of weaving, whose influence increasingly faded away in Anatolia in the 11<sup>th</sup> century, was revitalized in the Seljukian Period and the Period of Principalities (İnalçık, 2008: 13).

Human being has been carrying on weaving that emerged to meet the needs of him from the past up to current time and developing in line with these needs and adapted the principle of variety and difference in woven fabric designs with an idea to keep up with the changes and developments appearing day by day. In this way, the features of weaving looms used to produce fabric designs have increased using high technology.

Spiral, brace, floor, hole, high and whip looms that were all used in carpet and plain weaving commonly have been replaced by dobby and jacquard weaving looms currently with the effect of industrialization in weaving. The first significant development of jacquard weaving loom was automatic punching mechanism with the help of a holed design paper rolled around a cylinder prepared depending on the design of the weaving and allowing to choose warp to be lifted by M. Bouchon in 1725. M. Falcon designed a square prism strengthening the cards instead of the holed paper and formed an endless card chain sticking the design paper on a panel in 1728. In 1745, Jacques de Vaucanson was able to choose the needles carrying the reed wires and in the lights of all these developments Jacquard simplified the holed card system in the loom and developing a system allowing the automatic lift of the warps and automated the loom (Bradbury, 1912 ; Dölen, 1992).

As it is possible to give movement to the warp yarns separately through the jacquard system, the report sizes of the jacquard design are larger than report sizes implemented in the dobbies (Türkyılmaz, 2008: 271). Thanks to this characteristic, colour and weaving plans could be applied in the woven fabric designs limitlessly and limitlessness provide a great advantage.

Computer programs work in connection with the machinery in making the designs of jacquard fabrics in textile sector today. The design of the desired fabric is able to be designed with the help of the program and produced in jacquard weaving machine in a very short time. The CAD (Computer Aided Design) systems that are preferred for designing, producing and weaving processes have been used and they are compatible with electronic dobby and jacquard mechanisms. Besides the prediction of fabric mechanism, CAD systems are also used to calculate the structure of the woven fabric. With its features of easy-to-use, the speed of processing, flexibility in working, technical support and updatable software, (dobby and jacquard weaving fabric) provides a rapid and easy process in creating different design ideas (Kolcavova Sirkova & Mertova, 2010).

The jacquard weaving machines equipped with high technology in textile sector have a significant place today. These machines have an opportunity for rich designing in both single faced and double faced

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woven fabrics. Due to the difficulty of designing in jacquard fabrics, the production is made by giving different colours to the same design instead of producing new designs.

The jacquard designs produced with various floral and geometric motifs are preferred intensively currently. However, Akpınarlı (2009: 20) grouped the motifs reflecting joy, happiness, sadness, trouble, missing, strength, events and norms that are the most significant part of designs into five categories as: geometric ornaments (triangle, square, diagonal lines etc.), floristic ornaments (tree, leaf, flower etc.), figured ornaments (bird, scorpion, human, etc.), ornaments with an object (pitcher, coffeepot, chest etc.) and symbolic (abstract) ornaments (camel eye, hand on the belly etc.). In this way the attention drawn to the rich motif treasure that we have by grouping various ornaments (motifs) into categories in the place of similar motif designs of current time.

The woven surfaces that are formed as a result of passing the weft and warp threads under and over each other with certain angles, and the designs are designed and produced depending on working principles of dobby and jacquard weaving machines. Depending on the jacquard weaving machines, it is likely to say that it is of great importance to produce the designing of single and double faced fabrics endlessly because of the fact that the number of warp threads comprising harness system is so high and it has various types of thread scales. However, the gradual increase in the designs having similarities as a result of rapid production shows that more innovative and original designs are produced scarcely any with regard to textile product equipped with high technology. Therefore, the current study was carried out to plan new designs in line with a certain program depending on a theme with an innovative perspective and transfer them on the jacquard design.

## **2. METHOD**

The study is a descriptive survey and an empirical one in terms of its application. A detailed review of the related literature was made into jacquard weaving design and the Turkish and English sources obtained were examined. Direct and indirect extraction were made from the sources obtained from the literature review and they were used under suitable headings in certain parts of the study. Prepared new designs have been implemented.

## **3. THE FEATURES OF JACQUARD WEAVING MACHINES**

The type of loom emerging as an electronic jacquard weaving machine produced with the integration of computer technology and air jet weaving machine has a feature of latest technology offering an endless design opportunity as a result of the fact that it can easily control the position of warp threads and placing various colourful weft threads. The machine is compliant with computer aided design (CAD) system, allowing easy and rapid design changes with a 600/m peak weaving speed. Damask, Brokar, Goblen and Tapestry are the examples of fabrics woven in jacquard machine (Kadolph & Langford, 2002: 202-203).

Jacquard weaving looms have two types as manual and electronic ones. However, manual looms have been used so rarely while the electronic ones have been used widely. Electronic jacquard weaving looms have two features as reading-selecting and transmitting. In the feature of reading and selecting, jacquard card plan created in the computer program is loaded on the mainboard in the jacquard mechanism by means of a USB disk in the form of a digital file. In the design read by jacquard card, which warp thread will be lifted up during each weft thread is transmitted to selenoids (electromagnetics) and platinum are excited by selenoids, leading to the selection of the warp threads to be lifted. As for the feature of transmitting, weaving could be made with more than one weft selector in the jacquard mechanism. The order of the weft to be thrown during design making and the related selector (weft selector) are determined in the computer program. Depending on the design, the data with regard to which selector would through the weft is read and transmitted to platinum through selenoids (Özlen Özmutlu, 2010: 4).

Jacquard weaving consists of the processes of warp resolution, pattern preparation, and weaving. Pattern preparation plays the most important role in among operation principles of the workbenches. The process of jacquard pattern preparation is conducted with various programmes in the electronic jacquard weaving machines. In this study, Nedgraphics, as a jacquard weaving pattern design programme, was used, and the pattern design was analysed and implemented starting from the new theme in accordance with the textile design criteria. Processes of pattern preparation and implementation with the jacquard system are presented below.

In line with the data obtained by the experts in the textile sector, it was indicated that the software program of Nedgraphics, which provides design and 3D simulation image, is the mostly preferred program in jacquard weaving machines today. Besides that, some other programs such as Simetri (Domestic Software), Most (Domestic Software) and EAT (Foreign Software) are used.

## **4. JACQUARD WEAVING DESIGN AND APPLICATIONS**

Jacquard weaving design is made in two different methods. With regard to the design of the fabrics ordered by firms, such stages as the width and length of the current fabric, warp-weft colour rapport, warp-weft weaving system, the wire number of warp and weft in a rapport and weaving report are analysed and the desired design is obtained depending on this data. In the other method, a fabric design is taking the capacity of the jacquard machine into consideration depending on a theme. However, it is likely to see that only the processing stages are different but the design preparation processes are the same regardless of design program while the design is being prepared.

In the current study, Nedgraphics program was used to make a jacquard weaving design and pattern design has been analyzed and implemented depending on a new theme, in accordance with textile design criteria. Therefore, the design preparation and application stages below are followed:

**Process 1.** Determining the theme,

**Process 2.** Determining and drawing the motif,

**Process 3.** Determining the colour

**Process 4.** Determining the rapport

**Process 5.** Preparing the weaving fabric and weaving

**Process 6.** Making the final finishing process

#### 4.1. Analysis on Pattern Preparation and Implementation in Jacquard Weaving

Design and weaving processes conducted starting from a theme with the jacquard system are described in this section.

##### Process 1. Determining the theme

While starting a jacquard design, the source of inspiration (nature, element etc.) is determined and a theme is chosen regarding this source of inspiration. In the current study, nature was chosen as a source of inspiration for the design of jacquard fabric and a reincarnation theme was determined depending on source of inspiration. The story of a design was mentioned as; "Reincarnation is a case where a spirit continuously come to the new world with another body, a migration of a soul. In the design, the flower of dandelion was chosen as the inspired natural element. The feature of this flower is that while it is a flower with yellow petals, it closes its petals and sometime later turns out to be a flower with white buds and leaves its seeds with the wind flying its buds, which means that while the flower of dandelion is dying, it revives another flower that will grow in another place as a reincarnation". The theme suitable for the design and the visuals regarding the theme were investigated.

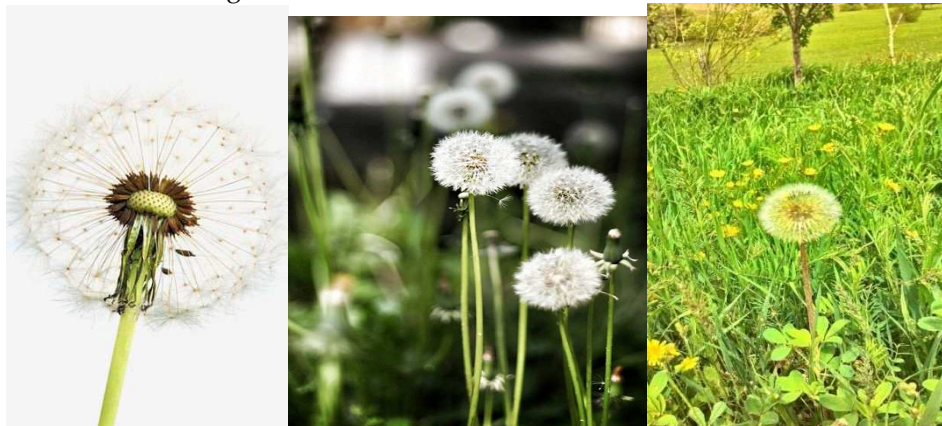


Figure 1. The visuals of dandelion flower (www.pinterest.com)

##### Process 2. Determining the motif and drawing

Four different drawings were made with this theme.

In Design I, mirror symmetry was used by drawing two flowers superimposed as the flower of dandelion in the nature (Figure 2).

In Design II, the petals of the flower were turned to different directions and used in the natural form (Figure 3).

In Design III, only the white bud part of the flower was taken and stylized (Figure 4).

In design IV, all the sections made up of bud, branch and petal were stylized and used in the design of the fabric (Figure 5).

##### Process 3. Determining the colour

In the current study, white colour was preferred for the warp thread and purple, wheat and cream colours were preferred for weft thread. The reason for this was to choose particularly the colours symbolizing soul in relation with the theme of reincarnation for the design of the fabric. Accordingly, the colour of purple that symbolizes the mystery of soul, white colour symbolizing the purity of soul and the

colour of cream symbolizes the liveliness of soul were used in the design of the jacquard fabric. The colours used in the designs are as follows; in Design I 5 colours were used as dark purple, light purple, dark cream, light cream and white. In Design II, III and IV, 3 colours were used as dark purple, dark cream and white. The ground colour was determined as light and dark cream in Design I, dark purple in Design II, white in Design III and dark cream in Design IV.

#### **Process 4. Determining the rapport**

After determining the motif and colour, it is necessary to determine the rapport design (a design where a design repeats) in order that a design becomes a composition, such as full rapport, half rapport and unit rapport.

Worbin (Worbin, 2010: 23-24) explained the rapport types as follows:

Straight repeat: Repeating a motif by changing a motif in vertical and horizontal directions.

Half drop repeat: It is the repetition of a motif in the warp direction till the half way.

Türkyılmaz (2008) explained the report arrangement in 8 different ways:

- Straight rapport
- Mirror rapport (X / Y Mirror design) in the direction of weft or warp
- Mirror rapport (X - Y Mirror design) in the direction of weft and warp
- Soter rapport (Half design)
- Upper soter rapport (Half design with sliding upside)
- Soter rapport in side direction (Half design with sliding sides)
- Soter rapport upside mirror (Reverse half design)
- Mirror soter rapport in side direction (Vertical turning design)

In the current study 4 different rapport techniques in the production of designs are as follows.

First fabric design; the rapport arrangement was made with dandelion flower overlapping each other without distorting the flying image in a naturalist way by multiplying in the direction of weft and warp with the mirror design (X - Y mirror design) in other words, one-fourth of the motif was weft and by taking the symmetry in the warp direction. The width of the design was 43 cm and the length of the design was 25.7 cm. In addition, the warp density was 34, total number of warp wires was 2.400 and total number of weft wire was 912.



Figure 2. Jacquard fabric design I

Second fabric design; a rapport was arranged depending on the leaves of dandelion flower in a naturalist way with a motif order in a free style as upper mirror soter rapport (reverse half design) in other words by turning the leaves left and right and up and down. The width of the design was 6.7 cm and the length of the design was 7.8 cm. In addition, the warp density of the Design II was 60, weft density was 34, total number of warp wires was 2.400 and total number of weft wire was 528.



Figure 3. Jacquard fabric design II

Third fabric design; a rapport was arranged by stylizing just the petals of dandelion flower with side soter rapport (half design with sliding sides), in other words by sliding the flower 2 cm in the direction of weft. The width of the design was 7.5 cm and the length of the design was 8 cm. In addition, the warp



density of Design III was 60, weft density was 34, total number of warp wires was 2.400 and total number of weft wire was 480.

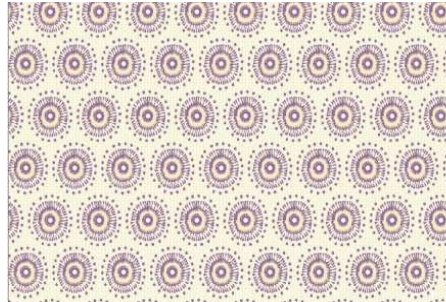


Figure 4. Jacquard fabric design III

Fourth fabric design; all sections of dandelion flower was stylized and a rapport was arranged with upper soter rapport (half design with sliding upward), in other words by sliding the motif 14.5 cm in the direction of warp. The width of the design was 19.5 cm and the length of the design was 29.5 cm. In addition, the warp density of Design IV was 60, weft density was 40, total number of warp wires was 1.200 and total number of weft wire was 1008.



Figure 5. Jacquard fabric design IV

#### **Process 5. Preparing the weaving fabric and weaving**

While preparing the weaving fabric, the weaving pattern is defined separately in the system with regard to the colours used depending on how many different colours of weft threads to use and recorded separately for each colour. As 5 different colours were used in Design I is one of the designs, 5 weaving patterns were defined separately for each colour and 3 weaving patterns were defined as three different colour were used in the others. Weaving patterns in the jacquard weaving system are some different from basic patterns used in the dobby weaving system. The reason for this allow complex patterns by combining with several patterns of weaving pattern used in the jacquard weaving system. As used complex patterns instead of basic patterns in the fabric designs, weaving patterns schematically have been given.

After fabric assignments of the prepared jacquard weaving designs are completed, the type (cotton, viscose, acrylic, polyester, chenille, cationic, air-textured yarn) and color of the yarn are defined. Accordingly, the type of the warp yarn used in the designs is 150-denier twisted polyester yarn and the type of the weft yarn is 4-Nm chenille yarn and 30 denier polyester yarn. The fabric reports are marked in red in the Nedgraphics programme. When the type and color of the yarn used in the design are desired to appear exactly the same on the fabric simulation image, they are defined in the Nedgraphics programme with a spectrometer by firms. However, since the type and color of the yarn are not pre-defined in the programme used, the simulation image was not included. In the Nedgraphics programme, the pattern is displayed in 3D with the simulation image, and if the pattern is ready, it is recorded with the pattern programme in the machine format of weaving. Then it is transferred to the workbench with a flash disc, and weaving is carried out. Fabrics defined according to the colors used in the fabric designs and the weaved jacquard fabrics are presented below.

#### **Design I**

White      Dark Cream      Light Cream      Dark Purple      Light Purple

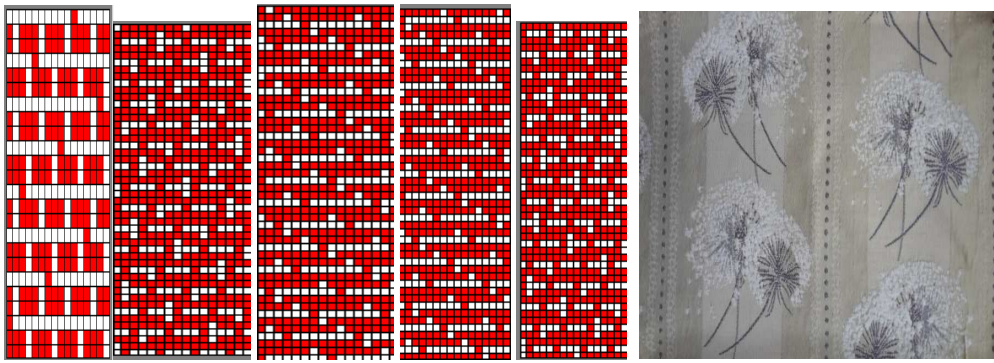


Figure 6. Weaving patterns in terms of the colours used in Design I and Jacquard Woven Fabric I

Design II

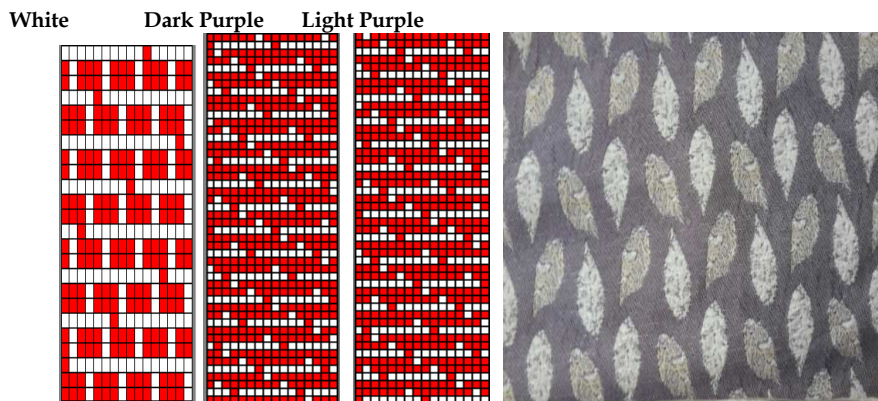


Figure 7. Weaving patterns in terms of the colours used in Design II and Jacquard Woven Fabric II

Design III

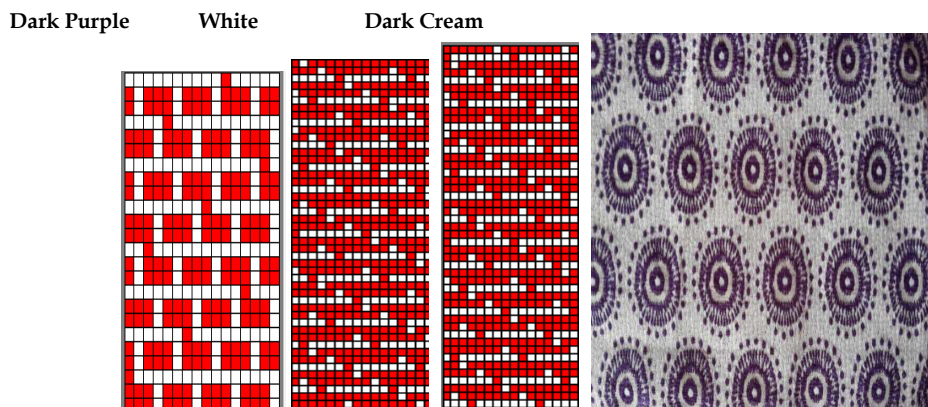


Figure 8. Weaving patterns in terms of the colours used in Design III and Jacquard Woven Fabric III

Design IV

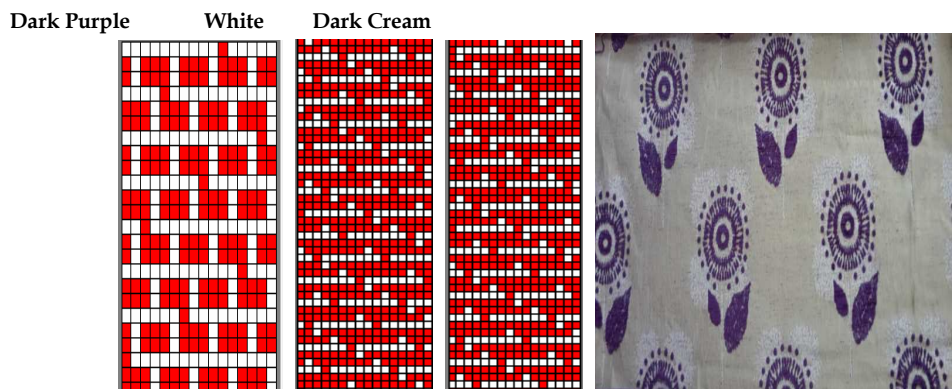


Figure 9. Weaving patterns in terms of the colours used in Design IV and Jacquard Woven Fabric IV

**Process 6. Final finishing**

Only apparelling process was made as the finishing process out of the business where the study was carried out. Depending on the desire of the customers, other finishing works was made in different businesses. However, as the fabrics that were produced were prototype samples, final finishing process was not applied to the fabrics. Finally, after the quality control process, packaging and delivery were made.

## 5. CONCLUSION AND RECOMMENDATIONS

Electronic jacquard weaving loom is a kind of loom being able to act warp threads in large groups and in this way produce large scaled and detailed designs and also allow to determine the positions of the warp threads with computer systems and place weft threads in different colours with various arrangements. As a result of the fact that computer assisted systems both provide savings in time and has no limits in design, innovative fabric designs produced depending on certain principles instead of a perception of ordinary and successive designs are of great importance. Here are some recommendations in this sense:

5.1. Instead of continually using the same designs in the process of jacquard design, making an innovation in designing by combining different designs with different techniques depending on a theme.

5.2. Following up the developments with regard to national and international jacquard fabric design by some firms

5.3. Firms should make their jacquard weaving designs with depending on the principles of original and innovative designs

5.4. The designers working in the department of designing should follow up-to-date trends and make a design planning.

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