Textile Surface Design Combining Knitting and Weaving Within A Non-Seam Process

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Abstract – Surface affects everything around us and everything that we see, touch and use has a surface. This interaction cycle is very important in production design. Developments in science, design and new technology have an enormous effect on this interaction period. Surface Design is a combination of coloring, patterning, and structuring of materials. These kinds of design applications appear in different fields. Especially in Textiles, Surface Design can be considered one of the most powerful applications because they have versatile combination of properties, structures, raw materials, and production techniques. There are three different techniques of creating a surface in Textiles: Knitting, Weaving and Non-woven techniques. Each technique has its own advantages and disadvantages. In this study, it is aimed at combining two of these techniques (knitting and weaving) to suspend the disadvantages and create an optimal surface highlighting the advantages. Three different fabric samples having different surface densities were produced. First by weaving technique, fabric samples were woven in a special plate within three different yarn densities. Then by knitting technique, fabric samples were knitted by using the same weft yarn without interruption. Woven and knitted fabric surfaces were assembled within non-seam process. A whole seamless textile surface was created by combining with weaving and knitting. These textile surfaces were analyzed via Image Analysis.

Keywords – Surface Design, Seamless, Non-seam, Textile Design, Image Analysis

I. INTRODUCTION

Surface can be defined in many ways as “the outside part of the uppermost layer of something” or “the outward appearance as distinct from less obvious aspects”. The Surface Design Association has a definition that is “Surface design encompasses the coloring, patterning, and structuring of fibre and fabric. This involves creative exploration of process such as dying, painting, stitching, embellishing, quilting, weaving, knitting, felting and papermaking” [1]. In this aspect, Surface design attracts textile design and textile designer in future projects.

Science also plays an important role in future exploration for generating surfaces. Developments with new technologies in material and science have an enormous effect on these improvements.

Surface Design is a combination of coloring, patterning, and structuring of materials. These kinds of design applications appear in different fields. Especially in Textiles, Surface Design can be considered one of the most powerful applications because they have versatile combination of properties, structures, raw materials, and production techniques [2]. There are

three different techniques of creating a surface in Textiles: Knitting, Weaving and Non-woven techniques. Each technique has its own advantages and disadvantages.

Both knitted and woven fabrics can be produced in a multitude of surface designs. Multicolored effects, textured designs, stripes, and Jacquards are common to both types of structures. The significant differences between the processes of knitting and weaving, and the characteristics of the fabrics made by these processes are shown in Table 1 [3].

Table 1. Comparison of knitting and waving [3]

	Knitting	**Weaving**
Comfort and appearance retention	Mobile elastic fabric, adapts easily to body movement, good recovery from wrinkling	Rigid to stress (unless made with stretch yarns), varies with the weave
Handle	Soft bulky handle	Firm, smooth handle
Cover	Porous, more open spaces between yarns permits wind to penetrate	Provides maximum cover per weight of yarn
Versatility	Design patterns can be changed quickly to meet fashion needs	Machinery less adaptable to rapid changes in fashion
Economics	Process is less expensive but is offset by more expensive, raw material costs. Faster, regardless of fabric width	Most economical method of producing a unit of cover. Wider looms weave more slowly than narrow looms
Product areas	Sportswear, underwear, hosiery	Suits, shirts, furnishings

In this study, it is aimed at combining of these techniques (knitting and weaving) to suspend the disadvantages and create an optimal surface highlighting the advantages.

Shady, et al. researched on identifying the pattern of a woven structure in addition to evaluating other surface parameters via the digital image process. In their study, the samples included three fabric structures with two constructions for each structure were investigated manually using a magnifier and the results were compared to those of the digital image approach developed. The approach results showed good agreement compared to the results [4].

Imrith, et al. researched on several different methods to determine the porosity of knitted fabrics, which include digital imaging, geometrical modelling, and air permeability. Results showed that digital imaging is an adequate technique to determine the porosity of high-porosity fabrics [5].

Rudy, et al. managed a method of measuring the stitch density (course per inch and wale per inch) of a knitted fabric. The result of this study presented that the pixel counting method yields equal result with the manual operation [6].

Jamshaid, et al. aimed to compare the functional properties of woven and knitted denim fabrics in their study. The results showed that the knitted denim fabric exhibited better moisture management, air permeability and thermal resistance value. Although pilling resistance of woven denim is better than knitted denim. knitted denim fabric performed better than woven structure on the basis of comfort and value [7].

In this study, it is aimed at combining two of these techniques (knitting and weaving) to suspend the disadvantages and create an optimal surface highlighting the advantages. Three different fabric samples having different surface densities were produced. First by weaving technique, fabric samples were woven in a special plate within three different warp densities. Then by knitting technique, fabric samples were knitted by using the same pick yarn without interruption. Woven and knitted fabric surfaces were assembled within non-seam process. A whole seamless textile surface was created by combining with weaving and knitting. These textile surfaces were analyzed via Image Analysis.

II. MATERIALS AND METHOD

Two types of yarns were used in fabric samples production: Warp yarn (Ne 36) and weft (6-ply 50gr/125m). First by weaving technique, fabric samples were woven in a special plate within three

different warp densities (yarns/0.75-0.5-0.25cm). Then by knitting technique, fabric samples were knitted by using the same weft yarn without interruption. Woven and knitted fabric surfaces were assembled within non-seam process. A whole seamless textile surface was created by combining with weaving and knitting. These textile surfaces were analyzed via Image Analysis (Digimizer). "Digimizer" is an image analysis software capable of investigating on images.

Fabric sampling process was shown in Figure 1. Fabric samples were woven in a special plate within three different warp densities (yarns/0.75-0.5-0.25cm).

Fig. 1 Fabric sampling in three different warp densities.

In weaving process, the loop heads were created in the beginning of fabric. Then the knitting process was starting within these loops. Fabric samples were knitted by using the same weft yarn without interruption. Woven and knitted fabric surfaces were assembled within non-seam process. A whole seamless textile surface was created by combining with weaving and knitting.

III. RESULTS

After weaving process, the knitting process was completed through the beginning edge of fabric. The completed samples were shown in Figure 2.

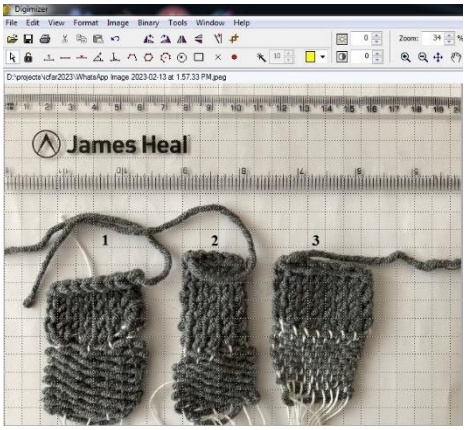

Fig. 2 Completed fabric samples.

In first part of study, the fabric samples were investigated via image analysis software. The yarn densities were measured after defining the unit (cm) corresponding to pixels in the image taken nearby a ruler (Figure 2.).

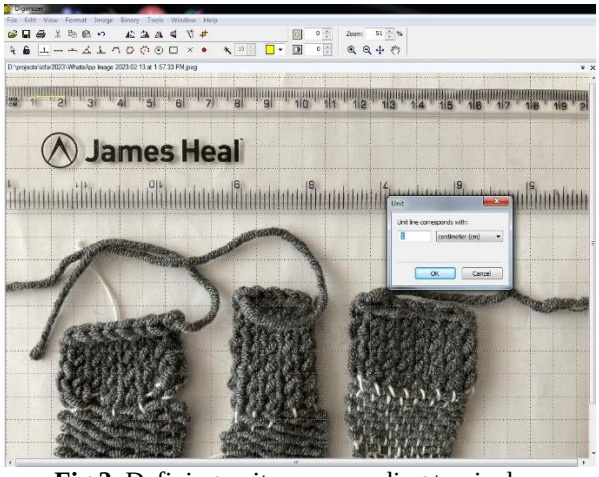

Fig 2. Defining unit corresponding to pixels

The yarn densities were counted via image analysis in both warp/stitch and weft/row directions (Figure 3).

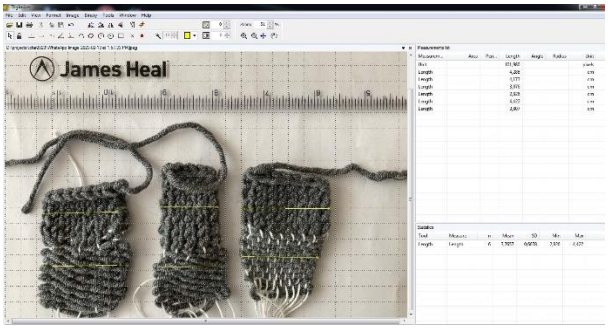

Fig. 3. Measuring the yarn densities in fabric samples

Yarn densities were shown in Tablo 2. The densities in weaving process were different

because of arrangement of special plate. But in knitting process, the same densities can be managed thanks to stitch increase/decrease abilities.

Table 2. Yarn densities in samples

Yarn density (yarn/cm)		**Sample 1**	**Sample 2**	**Sample 3**
Woven part	**Warp/weft /cm**	2.6/2.5	3/3	5/3.5
Knitted part	**Stitch/row /cm**	2/3	2/3	2/3

IV. DISCUSSION

Weaving technique and knitting technique were combined within non-seam process. This combination can present more stable and comfort behaviors in garment design. Each technique has its own advantages and disadvantages. In garment design, woven fabric can be used as base parts and knitted fabrics can be used in moving parts of body like sleeves, legs etc. In knitting process, the fabric dimensions can be arranged by stitch increasing/decreasing. It can help designer to create optimal shapes around moving parts of body.

V. CONCLUSION

In this study, it is aimed at combining two techniques (knitting and weaving) to suspend the disadvantages and create an optimal surface highlighting the advantages. This study can give new ideas for creating textile surfaces for textile applications. The surfaces can be diversified by using different weaving and knitting patterns. It can present aesthetic and functional surface design applications.

In next parts of this study, the whole garment will be produced within this combination of two techniques. Different patterns will be selected according to the body parts to allow user better movement and clothing comfort.

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