Colors Systems and their effects on textile Designs

Lect. Azza Mohamed Mohamed El Halwany

Lecturer of Textile Department- Faculty of Applied Arts / Beni -Suef University

azzahalwany@apparts.bsu.edu.eg

Abstract

Colors are critical to the success of any functional design artwork designed to satisfy the consumer's satisfaction.

Color theory in choosing colors for applied designs has a great impact on the quality of this design and its applicability to obtaining a product with a competitive ability in the internal and external markets.

In the field of textile design, we find that appearance of color in textile fabrics requires many mathematical and engineering operations to obtain the color area appear in textile design.

This research aim to link the scientific systems used in the choice of colors for the design of the artwork, and the applied textile design with competitiveness, and to link them with the simple textile structures used in the implementation of these designs, in order to show colors areas of design on the surface of the woven fabric.

Using specialized textile programs (Ned Graphic software) to draw and define the surface appearance of the textile structures that achieve the proposed color scheme.

With the great development in computer programs, and the development of theories of colors using numerical computational methods that give ease in determining the degree of color and reach it easily.

Using different color threads for both warp and weft, to show how obtain the desired color effect according to the kind of textile structure, with installations

of all other variables (warp yarn number - weft yarn number - warp density in the unit of measurement - the density of the weft in the unit of measurement - the material of the warp - the material of the weft .....) that affected on the final shape of the textile design.

Key Words

Textile design, Colors theory, Colors systems, Simple weaves constructions, Simulation effect

1- Introduction

With the great development in computer programs, and the development of theories of colors using numerical computational methods that give ease in determining the degree of color and reach it easily.

There are some digital color theories that follow in many industrial fields, such as (paint colors - colors of computers - televisions - mobile phone ....).

In the field of textiles, to get a color in woven fabrics is represented by many factors Which is represented by the color of warp yarns - the color of weft yarns- the type of textile structure – No. count of warp and weft threads - the warp density - the weft density - the warp material - the weft material…..).[2]

Thus, in order to obtain woven fabrics of a certain color, it is necessary to consider and define the set of previous variables, and to find a correlation between these factors to obtain the required color degree.

DOI: 10.21608/mjaf.2020.32251.1651

It is possible to calculate the color values on different colored weaving with changing warp and weft color yarns, and can predict the final color of jacquard woven fabrics from these yarns. [6]

jacquard fabrics with different motifs, which are used in the field of (upholstery fabrics - curtain fabrics - floor mats ….), to express the color areas in the design, it requires identifying all these variables, and the most important of these variables is the type of textile structure that obtain the color area, since it is understood that each color area in the textile design has its own textile structure.

In order to obtain a successful textile design that is competitive in the internal and external markets, the textile designer needs to identify the color theories to determine colors, know how they are distributed in design area, and have a good knowledge of the different types of textile structures to obtain the color area that required in textile design.

2- Color in the textile design

Showing up the color in the textile design requires a good knowledge from textile designer with the variable factors in woven fabrics, and the extent of the impact of these factors on the quality of the product, and the quality of the appearance of woven fabric according to studied scientific theories.[9]

more than one hundred sets of 'color textile blocks' and their attributes have been integrated to form a 'color textile block database', which is available for the selection of most matched colors to the original image color.[2,3,8]

3- Theoretical study

Color is an element of the design that has a great impact on the success of the design and the extent of its satisfaction with the general taste.

For designers, color is an important component of design, as color highlights design details. The color has a cultural, aesthetic and psychological significance.

Therefore, the designer must know the target community that he wants to represent these designs to it, and achieve the desired success.[9-11]

3.1 Colors

Color is defined as the physiological effect generated in the retina of a light beam of a specific wavelength, whether it is caused by the pigment color or from colored light.

In fact, the color is nothing but radiant energy that has a wavelength, which differs in its frequency, its vibrations from one color to another, and the photoreceptors in the retina receive them, and translates them into colors, where the retina contains conical cells that are divided into three types, The first is sensitive or more sensitive to lengths The long wavelength of light is therefore responsible for the sensation of red, the second group is more sensitive to the middle region of the wavelengths and is responsible for the sense of green, and the third is more sensitive to short wavelengths and senses to the blue color, as shown in Figure1.[11]

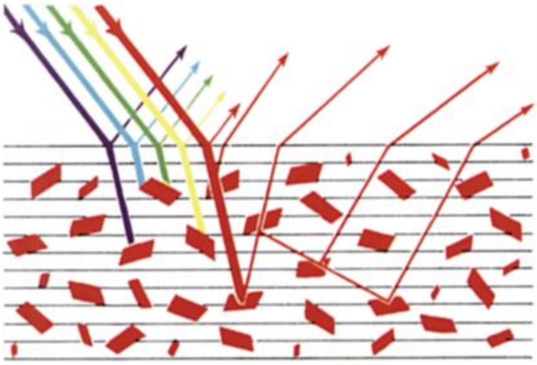


Figure1: the appearance of colors

Colors systems, as the human eye can distinguish between 10 million colors, it is clear that to describe color experiences by name is imprecise.
All the attempts to notate color can be traced back to the work of Sir Isaac Newton, In 1660 he re-created a spectrum by directing a narrow beam of white light through a prism; he went on to develop a color wheel by taking the two ends and bending the spectrum into a circle. This color wheel evolved and changed over the centuries,
In 1915 Williem Ostwald devised his double-cone color solid. Also in 1915, Albert Munsell developed another system of color notation that added steps to the constituent hues.
Munsell allowed his three-dimensional color solid to respond in shape to the different potential strengths between hues, creating an asymmetrical color solid.[9]

3.2 Evolution of colors systems and patterns:

There have been many attempts throughout history to understand the color, and as a result of these attempts many color schemes have emerged that have proven to be of great benefit in many technical fields that depend on color.
These different color schemes and systems have been based on different standard and sensory considerations, from the first attempts to understand color, to the complex color models present in the computer now that are based on mathematical and logical relationships that are made by highly complex electronic devices .

3.3 colors wheel

Colors theories have evolved to reach the circle of colors according to Munsell's arrangement. It is the arrangement of colors in a logical sequence to explain their properties in a geometrical form such as a circle or a triangle, or in a three-dimensional stereoscopic form, such as a cone, pyramid or sphere.
Several researchers such as (Oswald, Munsell) presented classifications that organize and arrange the color in a logical sequence to explain its properties according to the color distribution in the color circle (Figure 2) [2, 7, 8].

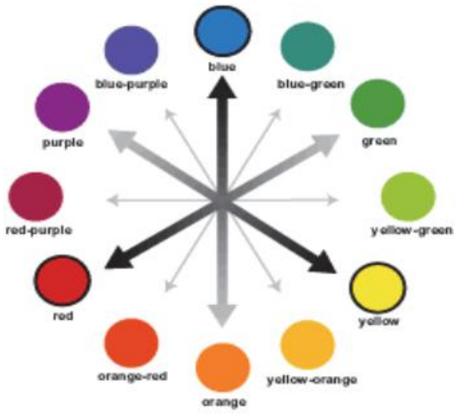


Figure 2: color wheel according to Munsell

3.4 colors systems

1- Achromatic system

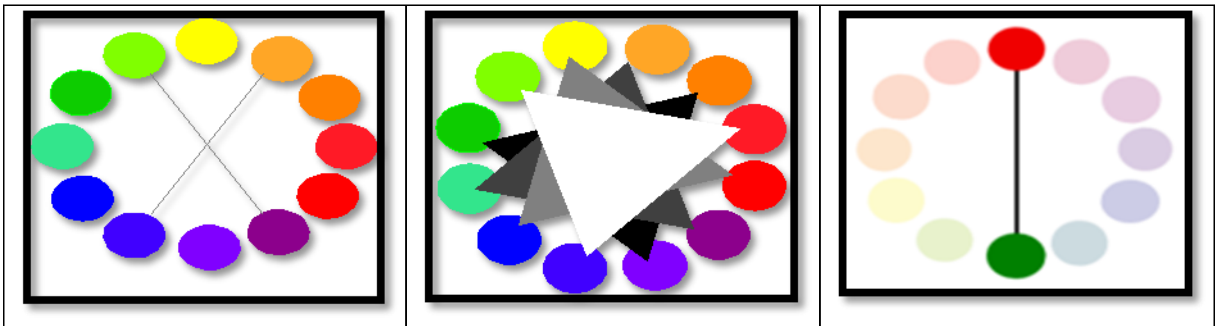
It includes white, black and gray tones, it is a colorless system (without dye), and it needs an interesting color movement like blue or red.

2- Mono Chromatic System

It is a simple system that includes only one pigment with its gradations (fatigue and wiping), and color saturation for them.

3- Complementary system

It includes a corresponding color in the color wheel and takes several forms of letters that include the shape of (I-Y-X).
In this system, two or three colors or four colors can be used with the degrees of mixing between them, as shown in Figure (3).



Color system (X)	Color system (Y)	Color system (I)

Figure (3): kind of Complementary system

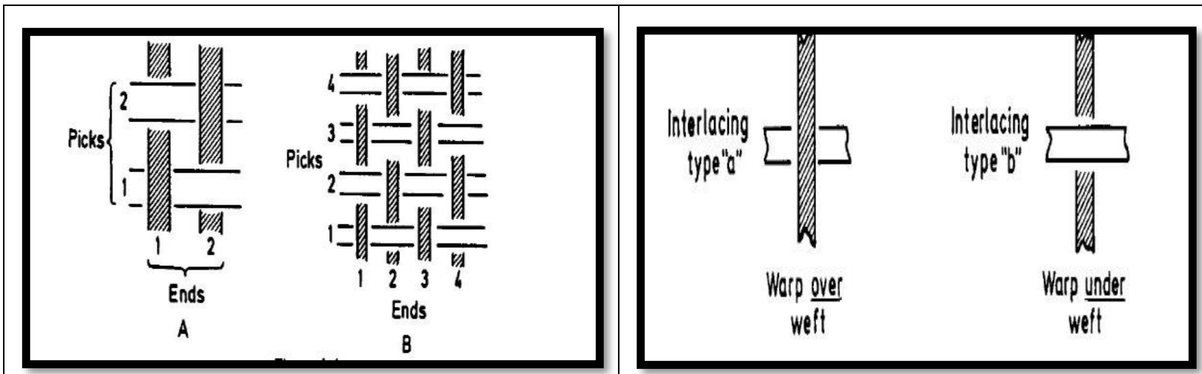
A- Chromaticity System (I)
It is a system based on choosing two opposite color grades in the color circle
B- Chromaticity System (Y)
It is a system that depends on choosing three contrasting tones in the color circle
C- Chromatic System (X)
It is a system based on the choice of four shades of color circle

4 The color system in woven fabrics

The woven fabric is produced from the intersection of warp and weft yarns using one of the types of textile structures.[6]

These warp yarns pass over the weft yarns giving this appearance to the color of the warp yarns, but if the weaving thread passes over the warp thread, this gives the appearance of the color of the weft yarns, as shown in the figure 3.

To obtain a chromatic effect on woven fabrics, the intersection between the warp and the weft dying yarns of similar colors or different colors (depending on the specification of the machine on which the design is applied) must be determined by selecting the appropriate textile structures to show the color space required in the textile design.[12]



B A

Figure 3: intersection between warp and weft yarns

4.1 textile structures

Textile structures express how the warp and weft dying yarns intersect according to specific scientific rules.

It is responsible for the appearance of design details and the different color effects of the design on the surface of the woven fabric.

Textile structures are divided into two types of structure (simple- complex), each one of both are consisting of several textile structures that can be used to achieve the required color theory.

10, 11

4.1.1 Simple weaves

One type of textile structure is used in one color area to show the specific color in this area in textile design. These simple weaves called simple backed structure that includes: [7]

- Plane weave and its kinds
- Twill weave and its kinds
- Sateen weave and its kinds

4.1.2 Complex weaves

It is combined with more than one textile composition for the same color space.[7-12]

Complex textile structures are used in the event that more than one color of warp or weft is used.

- Backed compound structure with two weft colors: two warp colors.

- Backed compound structure with three weft colors: three warp colors.
- Backed compound structure with more than three colors of weft / warp.
- Double weave.
- And other textiles structures.

The repetition of the motif unit in the textile design results from a number of warps and a number of wefts yarns in the unit of measurement, which are signed on the executive drawing sheet.

The number of warps and wefts yarns per unit may be equal or different, and in both cases we obtain a square-shaped geometry for the executive drawing of the textile design. [11]

Therefore, the textile design integration rule must be followed from the four corners of the square shape, so that the design does not break in the case of the repeated motif unit along the length and width of the resulting woven fabric. [10, 11]

Once the weave databases were set up, it is time saving for designer, that he do not need to design weave-databases every times, but he can use these databases in every design production.

The color mixing is realized by Interweaving warp and weft, and the color proportion of yarn is decided by float length, which is to say, the color appearance of yarn is depending on weave structure. [1, 7]

5. Practical study

In this paper, strands of different colors were used for both warp and weft according to the color theory required to achieve, and the link between color theory and the type of textural structures used to show the color effect that can be obtained within the design in different color area in the textile design, with stability of all other variables from (Warp thread number - weft thread number - warp density in the unit of measurement - the density of the weft in the unit of measurement - warp material - weft material - and other data related to the specification of the produced fabric).

Simple textile structures based on one color of warp and one color of weft were used to show the color appearance in the textile design.

And the use of color systems that is compatible with simple textile structures, and presented a set of design ideas that express each color scheme of the systems being discussed.

5.1 Achromatic System in Textile Design:

As previously defined, the color scheme is the system that depends on white and black and the degrees of mixing between them.

And the effect of the two colors (white - black - degrees of mixture between them) can be obtained in the textile design using the simple backed structure or the double weave structures as shown in Table (1).

5.2 Mono Chromatic System in Textile Design:

It is a simple system that depending on only one color with its degradation (shading and lightening), and saturation grades for this color used in each color space to obtain the desired color degree in the final design.

This is by using one color of warp or weft, a white color (to lightening the color) or a black color (for the shade) in the other direction of the weave.

The change in the percentage of color appearance on the surface of the fabric is obtained by changing the textile structure according to what is shown in Table (2).

5.3 Complementary color scheme in textile design:

To apply this theory in the field of weaving design, the color arrangement of both warp and weft is determined, with the type of weaving structure used to show this color in the weaving design area according to the specification of the loom machine being implemented, and by using simple textile structures that serve this theory and achieve the required degree of appearance To color inside the textile design.

The color system (I) can be obtained in textile design using simple textile structures, as this system can be applied using one color for warp yarns, and one color for weft yarns.

As for both the color system (Y) and the color system (X), they requires more than one color of warp yarns, and more than one color of weft yarns, according to the proposed color arrangement for both warp and weft yarns.

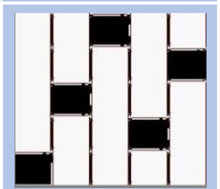
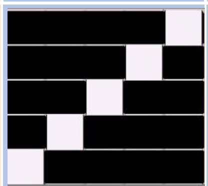
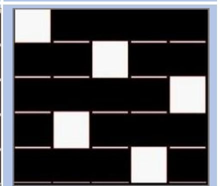
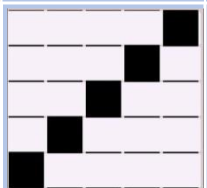
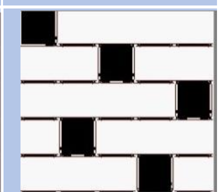
That require complex textile structures, to have colors appearance for each of warp and weft separately, and that is not covered in this research.

5.3.1 Color system (I)

It is a system that depends on choosing two opposite color grades in the color wheel.

When applying the color system (I) in the field of textile design, a color of warp and a color of weft or two colors for warp and weft can be used, along with the degrees of mixing between them, using simple textile structures, to obtain the required color area as shown in the table (3).

Table 1: Achromatic System for Textile Design

Achromatic System for Textile Design						
Code No.	**Warp Color Yarn**	**Weft Color Yarn**	**Color Appearance**	**Textile Structure**	**Simulation effect**	
					Twill	**Sateen**
1-1	White	Black	White	Warp Sateen (Sateen 5 Warp for Ex.) Twill with one Weft intersection (for Ex.4/1 Twill)		
1-2	White	Black	Black	Weft Sateen (Sateen 5 Weft for Ex) Twill with one Warp intersection (for Ex.4/1 Twill)		
1-3	Black	White	White	Weft Sateen (Sateen 5 Weft for Ex) Twill with one Warp intersection (for Ex.4/1 Twill)		

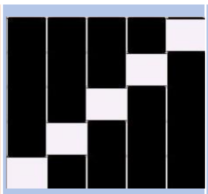
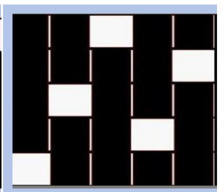
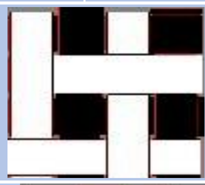
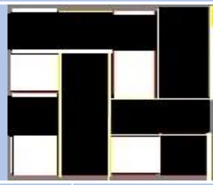
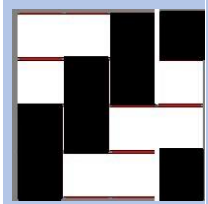
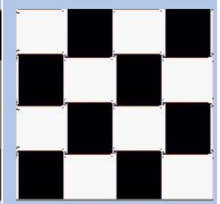
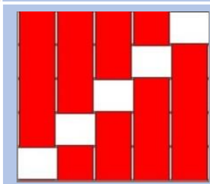
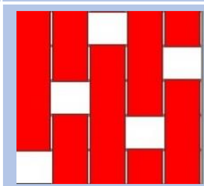
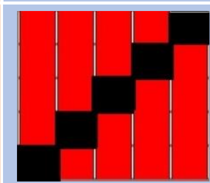
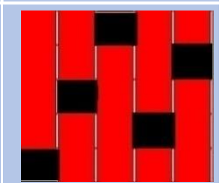
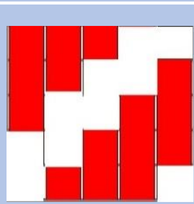
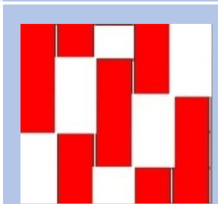
1-4	Black	White	Black	Warp Sateen (Sateen 5 Warp for Ex.) Twill with one Weft intersection (for Ex.4/1 Twill)		
1-5	White Weft: Black weft	White Warp: Black Warp	White	Double plane 1/1 White Warp and weft yarns at face Black Warp and Weft yarns at back		
1-6	White Weft: Black weft	White Warp : Black Warp	Black	Double plane 1/1 White Warp and weft yarns at face Black Warp and Weft yarns at back		
1-7	White/ Black	White/ Black	Half blend between Red and White	Plane1/1 Balance twill 2/2 Sateen by adding or deleting marks to give equal appearance to the number of warp and weft yarns		
Or any other textile structure which achieve this color system						

Table 2: Mono Chromatic System in Textile Design

Mono Chromatic System in Textile Design						
Code No.	**Warp Color Yarn**	**Weft Color Yarn**	**Color Appearance**	**Textile Structure**	**Simulation effect**	
					Twill	**Sateen**
2-1	Red	White	Red	Warp Sateen (Sateen 5 Warp for Ex.) Twill with one Weft intersection (for Ex.4/1 Twill)		
2-2	Red	Black	Red	Warp Sateen (Sateen 5 Warp for Ex.) Twill with one Weft intersection (for Ex.4/1 Twill)		
2-3	Red	White	Light Red	Warp Sateen with More than one Weft intersection Twill with more than one Weft intersection (3/2)		

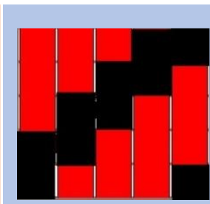
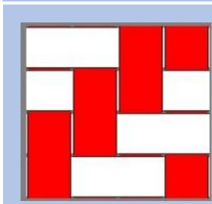
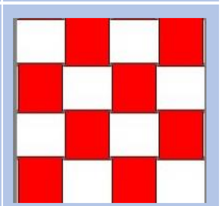
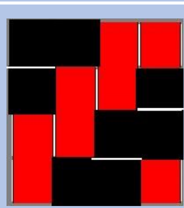
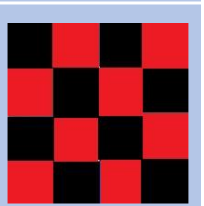
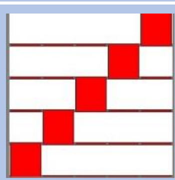
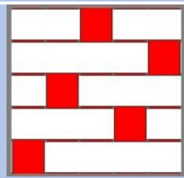
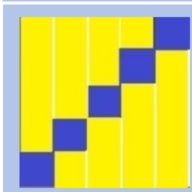
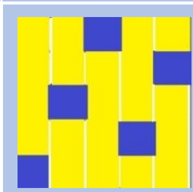
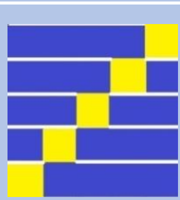
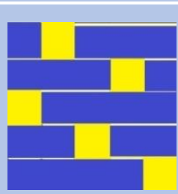
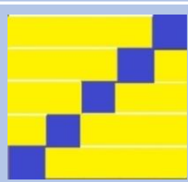
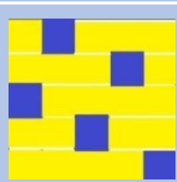
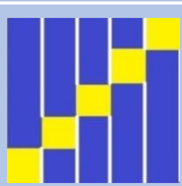
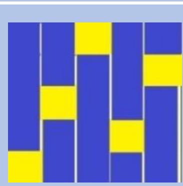
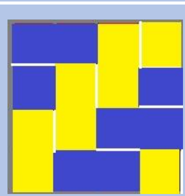
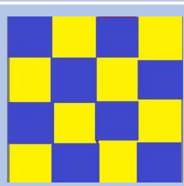
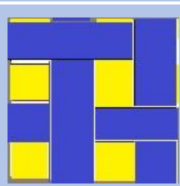
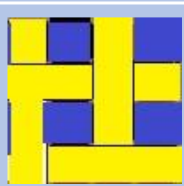
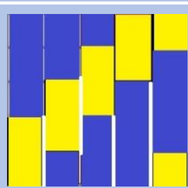
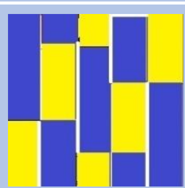
2-4	Red	Black	Dark red	Warp Sateen with More than one Weft intersection Twill with more than one Weft intersection Or reverse(3/2)		
2-5	Red	White	Half blend between Red and White	Plane1/1 Balance twill 2/2 Sateen by adding or deleting marks to give equal appearance to the number of warp and weft yarns		
2-6	Red	Black	Half blend between Red and Black	Plane1/1 Balance twill 2/2 Sateen by adding or deleting marks to give equal appearance to the number of warp and weft yarns		
2-7	Red	Whit/ Black	White/ Black	Weft Sateen Sateen 5 Weft for Ex)(Twill with one Warp intersection)for Ex.4/1 Twill (		
Or any other textile structure which achieve this color system						

Table 3: Complementary color scheme in textile design, color system (I)

Complementary color scheme in textile design, color system (I)						
Code No.	**Warp Color Yarn**	**Weft Color Yarn**	**Color Appearance**	**Textile Structure**	**Simulation effect**	
					Twill	**Sateen**
3-1	Yellow	Blue	Yellow	Warp Sateen (Sateen 5 Warp for Ex.) Twill with one Weft intersection (for Ex.4/1 Twill)		
3-2	Yellow	Blue	Blue	Weft Sateen (Sateen 5 Weft for Ex) Twill with one Warp intersection (for Ex.4/1 Twill)		
3-3	Blue	Yellow	Yellow	Weft Sateen (Sateen 5 Weft for Ex) Twill with one Warp intersection (for Ex.4/1 Twill)		
3-4	Blue	Yellow	Blue	Warp Sateen (Sateen 5 Warp for Ex.) Twill with one Weft intersection (for Ex.4/1 Twill)		
3-5	Yellow or Blue	Yellow or Blue	Half blend between yellow and blue	Plane1/1 Balance twill 2/2 Sateen by adding or deleting marks to give equal appearance to the number of warp and weft yarns		
3-6	Yellow Warp : Blue Warp	Yellow Weft : Blue Weft	Half blend between yellow and blue	Double plane 1/1 Yellow Warp and weft yarns at face Blue Warp and Weft yarns at back, or reverse		
2-4	Yellow or Blue	Yellow or Blue	Shaded yellow Shaded blue	Warp Sateen with More than one Weft intersection Twill with more than one Weft intersection Or reverse(3/2)		
Or any other textile structure which achieve this color system						

5.4 code number

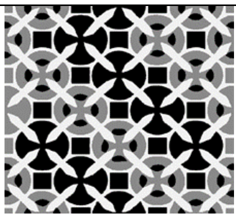
Giving code number for each textile structure makes it easy to descript the color appearance in textile design.

Both color system and textile structure achieve the color appearance on fabric surface, with different warp and weft color yarns according to one of color system (Achromatic, Mono Chromatic and (I) Color System).

Table (4, 5 and 6) shows some designs ideas, which achieve each color systems that mentioned at this research.

Table 4: Textile Designs achieve Achromatic Color System

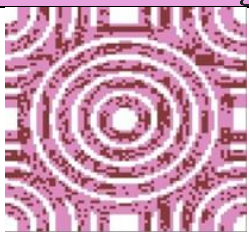
Code No.	Color Appearance
1-1	
1-2	
1-7	



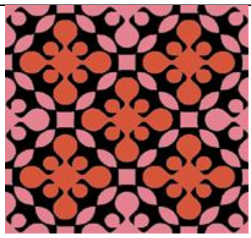
Code No.	Color Appearance
1-1	
1-2	
1-7	

Code No.	Color Appearance
1-1	
1-2	
1-7	

Table 5: Textile Designs achieve Mono Chromatic Color System



Code No.	Color Appearance
2-7	
2-1	
2-3	



Code No.	Color Appearance
2-1	
2-7	
2-6	

Code No.	Color Appearance
2-1	
2-7	
2-6	
2-4	
2-4	

Table 6: Textile Designs achieve (I) Color System

	Code No.	Color Appearance
	3-1	
	3-2	
	3-5	
	3-7	
	3-1	
	3-2	
	3-5	
	3-7	
	3-1	
	3-2	
	3-5	
	3-7	

6. Results

Determining the textile structure in the upholstery fabrics has a great impact on the success of the textile design:

- Classification the details of the textile design.
- Appearance quality of woven fabric.
- Obtaining color balance within the textile design.
- Obtaining color gradients from mixing warp and weft dying yarns.

The degree of color that appears on the surface of the fabric can be determined using specialized textile design programs, to help the textile designer in determining the chromatic effect of the design appearance on the surface of the fabric, as they are identical to the colors in the paper design.

7. References

1- Kavita Mathur and Abdel-Fattah M. Seyam, Color and Weave Relationship in Woven Fabrics, Advances in Modern Woven Fabrics Technology- 2011, chapter 7- pp 129-150.

2- Keiji Osaki, Evaluation of Colour Components Reproduced on Mon-Ori Fabrics by Combination of Texture and Weft's Colour, November 2000, pp.117-120.

3- Keiji Osaki, Reproduction of various colours on Jacquard textiles by only eight kinds of colour wefts, Proceedings of SPIE, Vol. 4421, April 2002, pp.740 – 744.

4- Grundler, D. & Rolich, T., "Matching Weave and Color with the help of Evolution Algorithm", Textile Research Journal, 2003, vol. 73, no. 12, pp. 1033-1040.

5- Kim S and Lee J S, New production method for a plain weave figured fabric Fibers and Polymers, 2011, pp 137.
6- Mathur K, Hinks D, Seyam A F M and Donaldson R A, Towards automation of colour/weave selection in jacquard design: Model verification Colour Research & Application 2009, pp 225.
7- Meng Zhang and Jiu Zhou, Compound Half-Backed Weave Design for Digital Jacquard, Fabric Materials Science and Engineering 280, 2017.
8- Osaki K, High quality colour reproduction on jacquard silk textile from digital colour Images, AUTEX Research Journal, 2003, pp 173
9- Wilson, J., Handbook of Textile Design: Principles, Processes and Practice, 2001.
10- Woodhead Publishing Limited, Colourless and colourful digital design of jacquard textiles, 2013, chapter 5, pp 80- 109.
11- Z. J. GROSICKI, Watson's Textile Design and Color, Elementary Weaves and Figured Fabrics, Department of Fiber Science, 2004.
12- ZHOU J and JIANG Y J, Innovative design of jacquard fabrics based on digital technology, Journal of Textile Research, 2009, pp 53.