Using Illuminative Technology in Creating Fashion Designs for Women Evening Wear Collections

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Abstract:

Fashion designers have always been using new technologies to design and submit their collections, the Light Emitting Diode (LED) became from the most popular technologies used nowadays, and they can be used as a decorative item besides beads and sequins or solely adding new aesthetic values. So the researcher overviewed this technology and it's usage in fashion in the past years also used this technology to create two women's wear collections for spring summer and executed four designs evaluated and judged as the best designs by experts in the fashion field though a designed questionnaire, in addition, the researcher clarified the methodology of how LEDs could be installed into the executed garments also measured the visible light transmission values of the fabrics used and tested the changes that LEDs could cause on the physical properties and colors of the fabrics used in the executed garments by performing bursting strength test, maximum force and elongation test, color reflectance and K,/S tests after exposing the fabrics to LED lights for 80, 110 and 140 hours. Research problem: 1- How do the LEDs affect the fabrics used in special occasion's women's wear? 2-What is the possibility of using LEDs to enrich the aesthetic and functional values of women's special occasions clothing designs? 3- What are the techniques of installing LEDs into women's clothing? **Research importance:** 1- Mentioning the usages of LEDs in fashion design. 2-Enlighten an important side of fashion design which is combining clothes with modern technological techniques by applying LEDs to performance garments and evening gowns as a decorative ornament along with beads, reflecting surfaces to create decorative shapes according to the LEDs arrangement. 3- Mentioning different techniques, tools, knowledge, styles and skills of designing and producing the light up garments. 4-Mentioning the effect of LED installation on certain fabrics used in fashion design.

Keywords:
- ***Illuminative Technology***
- ***Fashion Designs***
- ***Women Evening Wear***

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1. Introduction:-

1.1. Fashion and technology

Fashion designers used new technologies as an inspiration for their designs besides using it in the production processes to express novelty and development [(1)].

1.2. The historical relation between fashion design and lighting technology

1.2.1. Electric girl lighting company

Lighting technology was present in fashion since the 17th century, a company called the Electric girl lighting offered her clients the opportunity to hire girls wearing evening gowns with lights as a source of entertainment in parties and for ballet girls on stage, those girls used to wear lamps on their foreheads and these lamps were powered by batteries recessed in their clothes[(2)] as shown in fig(1).

Fig(1) Electric girl lighting company[(3)]

Fig(2) Atsuko Tanaka - Electric dress[(4)]

1.2.2 Atsuko Tanaka - Electric dress

She created the electric dress which she wore in a performance happening during the second Gutai art exhibition in October 1956 at O'Hara kaikan hall in Tokyo, the dress consisted of colored bulb lamps and colored neon tubes fixed all over the dress and connected by dozens of wires, this dress was a mix between the traditional kimono and industrial technology, the electric dress symbolized the massive urbanization and rapid development that happened to japan after war [(1)].as shown in fig (2)

1.2.3. Diana dew - Light up clothes

In 1967 Diana Dew presented mini dresses and pants with plastic lamps sewn in them expressing the pop culture vibes at this time, these lamps were powered by a rechargeable battery invented by her that lasts for five hours the dresses and pants pulsed to music in discotheques from one to twelve beats per minute, those garments weren't cheap they were priced at $150 as shown in fig (3).

Fig (3) Diana dew - Light up clothes[(5)]

Fig (4) Maggie Orth - Firefly dress[(6)]

1.3. Studying fashion designers' contribution in combining LED in fashion design

1.3.1. Maggie Orth - Firefly dress

From the applications of her textile products in 1997 was the firefly dress and necklace, as whenever the wearer moves they light up with changeable colors, the LED lamps are fixed in a layer of knitted nylon between two plies of conducting organza, the electric circuits connecting LEDs with each other were sewn by hand [(7)] as shown in fig (4).

1.3.2. Alexander McQueen - Futuristic collection

Alexander McQueen presented a new creative autumn collection for the French fashion house Givenchy he mixed between artistic innovation and electronic technology in a high quality glamorous way, the models in this show wore transparent bodice made of acrylic with variable colored LEDs powered by many batteries combined with a trousers printed with photo luminescent circuit board [(1)] as shown in fig (5).

Fig(5) Alexander McQueen - Futuristic collection[(8)]

Fig(6) Ingo Maurer and Janet Hansen - Light messages[(9)]

1.3.3. Ingo Maurer and Janet Hansen - Light messages.

Ingo Maurer collaborated with Janet Hansen innovated LED hats consisting of 400 light units each and later they created jackets and shirts having 1000 LEDs embedded in flexible panels they made also wedding gowns for brides and grooms where you can see a display of love messages on their garments[10] as shown in fig (6).

1.3.4. Studio 5050 - Love jackets

From their creations the love jackets which are pair of jackets programmed to give response to the one that sends the same message, when one of the two jackets find the other through infrared rays in a distance of minimum ten feet (as each jacket have an infrared LED receiver, transmitter and pic ship), they produce a sound and LEDs emit light with a certain pattern, this technology is very suitable for wearable practical clothes as all the electric components are fixed together to a circuit boards in a conductive fabric instead of using wires in the garments as shown in fig (7).

Fig (7) Studio 5050 - Love jackets[11]

Fig (8) Moritz Waldemeyer - Lighted jackets

1.3.5. Moritz Waldemeyer - Lighted jackets

Waldemeyer has dressed a band called (Take that) with five video jackets each jacket contains 400 different colored LEDs controlled by a mini video player these jackets were wearable and practical [12] as shown in fig (8).

1.4. LED lightened outfits that artists have worn on the red carpet and in live performances

By the rise of futuristic fashion trends, LED clothes were accepted and worn by artists in live performances as they added surprising, entertaining impacts on the audiences. Also they were present powerfully in popular fashion events such as the Met Gala to make a statement and express their individuality, from those artists, Rihanna when she wore LED gown designed by Alexandre Vauthier with help from Moritz Waldemeyer in her tour in Manchester, Katy Perry too have worn LED gown made by cute circuit at the Met Gala event shown in fig. (9), in 2008 Kanye West performed in the Grammys with a flashing LED jacket, scarf and an illuminated shade, Lady Gaga wore a Hussein Chalayan's inspired by animatronic clothing [13] [14] as shown in fig (10).

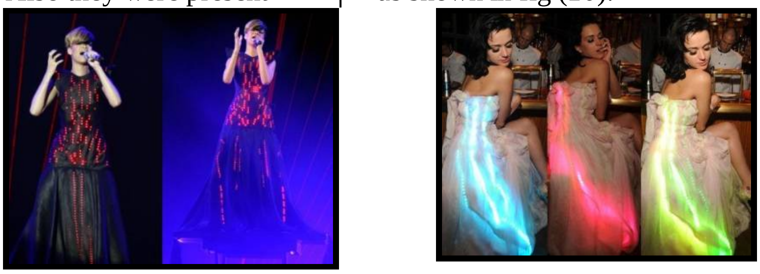

Fig. (9) Rihanna and katty perry wearing LED dress.

Fig. (10) Lady gaga and Kanye West wearing LED clothes[8].

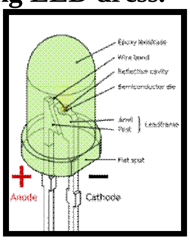

Fig (11) LED[15]

1.5. Light emitting diode (LED) definition

A light emitting p-n junction diode as shown in fig (11) emits light when a convenient electric current passes in the forward bias from anode to cathode the p-n junction diode is made of doped semiconductors. When electrons recombines with holes it releases photons, we can control the color of the released light of LEDs as the wave length of emitted photons depends on electroluminescence inorganic semi-conductor materials, for example Aluminum Gallium Arsenide (AlGaAs) for red, Aluminum Gallium phosphide (AlGaP) for green and Zinc Selenide (ZnSe) for blue [11].

1.6. History of LED development

The solid state lighting depending on sem-iconductors had been discovered and known recently.

-H.J Round (1907) discovered the electroluminescence while he was working on radios using diode technology when he applied 10-110V to a crystal of silicon carbide and a cat's-whisker detector, he observed a weak yellow shine emitted from the materials [16]

-Oleg Vladimirovich Losev (1920): discovered LED while working on radio recipients too, he passed current through zinc oxide and silicon carbide diode [17] . He then noticed cold (nonthermal) light emission [18]. In the years between 1924 and 1930 he published 16 paper in several countries scientific journals about his discovery, in those papers he studied closely LED and its applications, but unfortunately this invention wasn’t used or produced till the rise of semiconductors science in the 1940s and 1950s, and technologies for light emission became possible [16].

-Biard and Pittman (1961- 1962): made experiments on GaAs substrate and found infra-red light emission [19] then they later filed a patent titled "Semiconductor Radiant Diode" based on their discoveries, this patent was about emitting light from a gallium arsenide semiconductor with a near infrared spectrum wave length [20]. In October 1962, Texas instruments announced the first initially LED commercial product (the SNX-100) which is based a pure GaAs crystal transmitting a 900nm light output [21] shown in fig. (1-40), Nick Holonyak also created the first visible red LED with GaAsP [22]

-George Craford (1972): Craford created the first yellow LED at Monsanto using GaAsP semiconductor.

-Herbert Maruska and Jacques Pankove (1972): introduced violet LED using Mg doped Gallium nitride films.

-Shuji Nakamura (1979): developed the first bright blue LED in the world using Gallium nitride [23].

-Akasaki (1992): introduced low cost commercially produced blue LED which was based on Akasaki and H. Amano material advances GaN [21].

The invention of LED colors continued and were used in many applications, shows LEDs with different colors, the blue's InGaN LED improvements additionally enhanced the possibility that white LED could be made using wavelength converting material to change short wavelength to long wavelength radiation [16].

1.7.LED advantages

1-LEDs make less energy consumption than other bulbs types so they can be battery powered [24] and used in clothes.

2-They are tiny, shock resistant, and hard to be damaged.

3-LEDs emits cool non thermal light which emits a small heat amount and gets rid of it by mounting phenomena in a direction opposite to light emission direction. [16]

4- LEDs produce brighter light comparing them to other types of bulbs so they save energy.

5-LEDs have a quick on and off cycling so they are perfect if the wearer want to switch off and on light frequently on his illuminated garment. [11]

6-LEDs are from the fastest devices to get full brightness when lighted.

7-Also it has a characterized long lifetime between 35,000 to 50,000 hours of life so time required for complete failure will be longer [25].

8- LEDs can emit light of any desired color without using color filters depending on the semiconductor type. [16]

9-LEDs are perfect for devices that need dimming as they don’t change their color tint when the current passing through them is lowered [26].

1.8. LED disadvantages

1-LEDs have relatively high prices more expensive than other types of bulbs however, the total ownership costs of LED is less than incandescent, halogen and fluorescent regarding energy consumption and lifetime [27].

2-LEDs will only light with the right electrical polarity not as incandescent light bulb that gives light regardless the electric polarity, if the voltage is of the wrong polarity, the device will be reverse biased, very small current flows, and no light is emitted [21].

3-To emit light, LEDs require certain electric current; the higher current applied the brighter is the light emission, but GaN based LED is an exception as above a certain current the light begins to degrade and produces inner heat which is

harmful to LEDs causing device failure.
4- LED efficiency largely relies on the temperature of the environment, operating the LED can completely fail in high ambient temperatures as a result in overheating [28].
5-LEDs (white and blue) may exceed safe limits causing blue hazard which affects eyes safety [29].
6-LEDs efficiency decreases when electric current increases [30].

1.9. Integrating LEDs into clothes.

1.9.1. Installing LED wired strands into garments

Wired light LED strand with battery holder and switch can be fixed through snaps into the garment so that it would be at the surface of it, another way and it is always associated with sheer fabrics is to fix the LEDs into the lining by perforating it and then placing the sheer fabric above it. And we will see both techniques later in the final garments.

2. Experimental work

The experimental work is concerned with preparing design sketches, mood boards and determining the specifications and tests carried out on fabrics used in evening wear and integrated with LEDs during this research.

2.1. Collection design

2.1.1. Fashion trend theme

Due the massive technological developments the trend setters are expecting a brighter technological future where electronics are embedded into clothes as a mean of decoration or to add technological enhancements to clothes from the upcoming trends a trend called illumination [31], see trend board fig.(12).

2.1.2. First collection (illuminative beauty)

This collection is an evening ready to wear collection that focusus on feminine silhouettes, exagurated ratios in hips, shoulders and sleeves also ruffles peplums and layers. This collection designs are decorated with LED tiny lamps the fabrics used are (tulle, satin , chiffon, sequins), it is inspired by some designers work as Versace, Marchesa, Givenchy, Ilja visser, Alexander mcqueen, Amaya Arzuaga, check the collection's mood board fig.(13).

Fig. (12) Trend board[31]

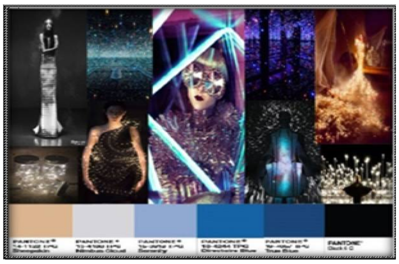

Fig: (13) Mood and color board for First collection

2.1.2.1. Design sketching

The figures from (14 to 23) shows the proposed designs for the first collection.

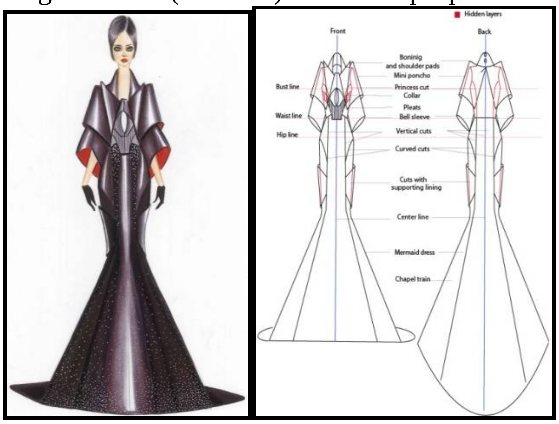

Fig: (14) Design.1 for the First collection

Design lines: Depends on straight lines and curved lines.
Decorative techniques: LED lamps attached to the skirt randomly, heavily scattered under the waist line and at the dress border.
Materials used: Alta moda satin.
Colors used on pantone pallet: pantone Black 6c, Nimbus Cloud 13-4108, lining tangerine tango 17-1463.
Structural analysis of the design
A mermaid three quarter bell sleeve dress with chapel train, and a mini poncho with a large collar, the poncho is attached to the dress from the neckline, the sleeves and the poncho back side is longer than the front one.
The sleeves and the poncho are lined with a red fabric.

Design lines: Depends on straight lines and curved lines.
Decorative techniques: LED lamps attached to the ruffles
Materials used: Alta moda satin.
Colors used on pantone pallet: pantone Black 6c.
Structural analysis of the design
A column fitted ankle length dress with over layered ruffles attached to the lower part of the dress and a circular skirt attached from one side to the corner of the waist line continuing with a sweep train to the back, the skirt is asymmetrical with draping on one side.


Fig: (15) Design.2 for the First collection

Design lines: Depends on straight lines and curved lines.
Decorative techniques: LED lamps attached to the center of the cape, and spreading through the skirts sides with glass beads.
Materials used: Alta moda satin, silk organza.
Colors used on pantone pallet: pantone Black 6c Nimbus Cloud 13-4108.
Structural analysis of the design
This outfit consists of two pieces
The first piece: blouse cape with two layered ruff collar with plisse accordion pleated silk organza.
The second piece: a pencil above calf length skirt containing two vertical cuts and two horizontal curved cuts, with a side wide slit opening.

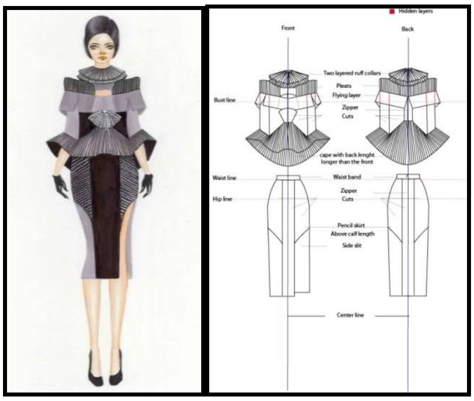
Fig: (16) Design.3 for the First collection

Design lines: Depends on straight lines and curved lines.
Decorative techniques: LED lamps placed under the chiffon cuts and grey metal snaps on the sleeves also glass transparent beads embroidery on the chiffon parts.
Materials used: satin, tulle, chiffon.
Colors used on pantone pallet: pantone Black 6c, Nimbus Cloud 13-4108.
Structural analysis of the design
A short sheath dress with three quarter bell sleeve and a halter neck, the dress is short and has a pencil cut; the central panel is divided into 10 pieces, the upper part of the dress consists of a halter neck collar and then tulle gatherings attached to a triangular cut, the bustier is heart shaped with a cup.

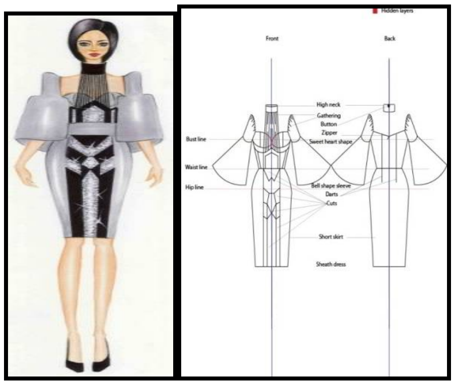
Fig: (17) Design.4 for the First collection

Design lines: Depends on straight lines and curved lines.
Decorative techniques: LED lamps placed on the skirt through snaps and under the chiffon pieces in the upper part of the dress.
Materials used: satin, chiffon.
Colors used on pantone pallet: Nimbus Cloud 13-4108, true blue 19-4067.
Structural analysis of the design
A floor length mermaid dress with short sleeve and a boat neck, with two puffed corners at the hip area this volumes is achieved by two pleats and boning also there is a side slit and a sweep train at the back, the front side of the dress consists of 17 pieces of satin and chiffon in the side corners, while the


Fig: (18) Design.5 for the First collection

back bodice part is 8 shaped with 4 pieces.
Design lines: Depends on straight lines and curved lines.
Decorative techniques: LED lamps placed on the bodice and the ruffles.
Materials used: satin, chiffon and sequins.
Colors used on pantone pallet: Nimbus Cloud 13-4108, pantone Black 6c
Structural analysis of the design
A floor maxi length dress with cap length sleeve and a sweetheart neckline, the lower part of the dress consists of three layers of ruffles; plisse accordion pleated maxi skirt and a pencil skirt underneath.

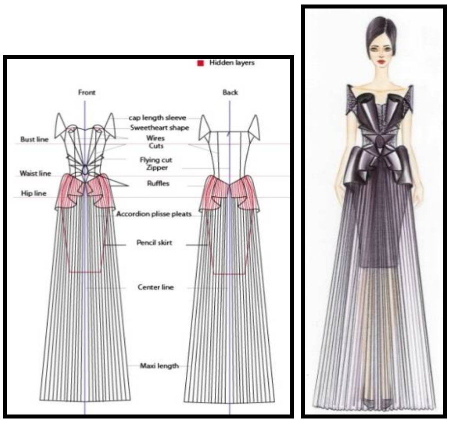

Fig: (19) Design.6 for the First collection

Design lines: Depends on straight lines and curved lines.
Decorative techniques: LED lamps placed on the dress's skirt.
Materials used: Alta moda satin.
Colors used on pantone pallet: Directoire blue18-4244, true blue 19-4067.
Structural analysis of the design
A floor ankle length column dress with six layers of peplum and short sleeve the upper part of the dress consists of several vertical cut lines the first and fourth panel have three constitutive layers each attached to the lining of the previous one.

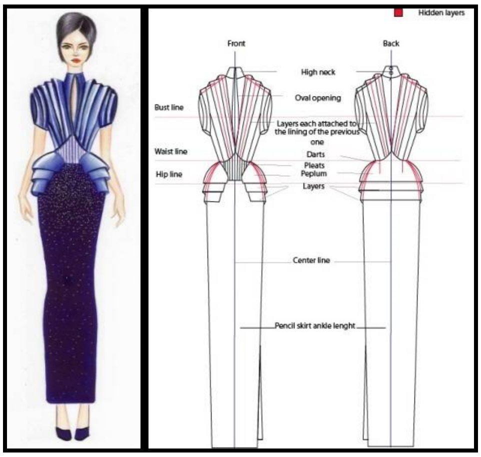

Fig: (20) Design.7 for the First collection

Design lines: Depends on straight lines and curved lines.
Decorative techniques: LED lamps spreaded randomly among the dress **Materials used:** Alta moda satin.
Colors used on pantone pallet: Directoire blue18-4244, True blue 19-4067, Nimbus Cloud 13-4108.
Structural analysis of the design
A micro sheath dress with above elbow sleeve and a sweetheart neckline there is a court train at the back continuing to the sides of the front, the micro skirt consists of four pieces one of them have accordion pleats and two folded ruffles with boning.

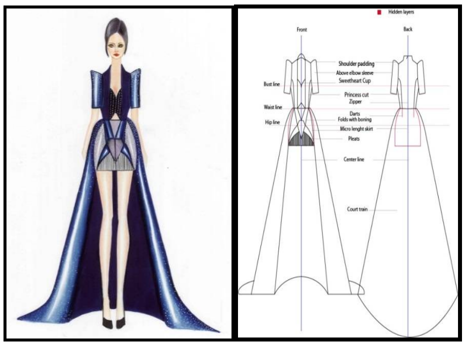
Fig: (21) Design.8 for First collection

Design lines: Depends on straight lines and curved lines.
Decorative techniques: LED lamps spreaded under the tulle, also flowers appliques above the tulle.
Materials used: Satin and tulle.
Colors used on pantone pallet: Nimbus Cloud 13-4108.
Structural analysis of the design
An A-line modified dress with a bustier of eight pieces and boning's the lower part consists of a tight short skirt with a curved edge, then a circular satin skirt followed by two wide pieces of tulle gathered from quarter front to the quarter back each on every side, while the last layer is a peplum on each side and a satin belt.

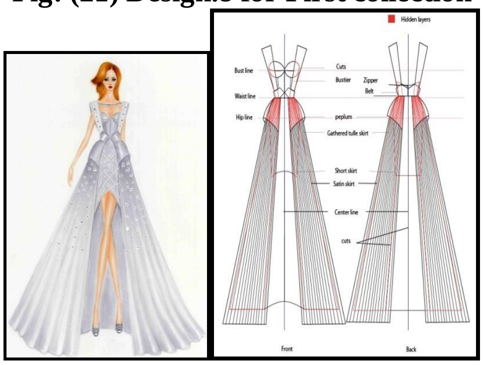

Fig: (22) Design.9 for the First collection

Design lines: Depends on straight lines and curved lines.
Decorative techniques: LED lamps spreaded on the skirt and on the cuts on the bodice.
Materials used: Alta moda, chiffon.
Colors used on pantone pallet: Serenity 15-3919, True blue 19-4067.

Structural analysis of the design

A short sleeveless sweetheart shaped dress with 21 front pieces and two oversized peplums on both sides a long layer of chiffon accordion plisse skirt extends from the back to the quarter front of both sides.

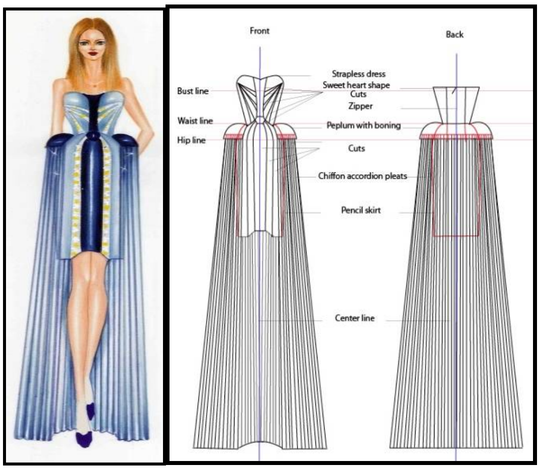

Fig: (23) Design.10 for the First collection

2.1.3. Second collection (Miss robot)

Humans have always been amused with the future, having all their daily duties done by artificial intelligence and actually many of these fantasies have been accomplished, as nowadays we can see actual robots talking, interacting with people and performing many duties so many fashion products have been inspired by robots whether from the electronic integration concept or from their appearance, we can see this in clothes that have hard edges, geometric cuts, oversized shapes complex silhouettes and unconventional materials see mood board fig (24).

2.1.3.1. Designs sketching

The figures from (25 to 34) shows the proposed designs for the second collection.

Fig: (24) Mood and color board for Second collection

Design lines: Depends on straight lines and curved lines.
Decorative techniques: LED lamps spreaded under the peplum layers and on the bodice.
Materials used: Satin and Alta moda.
Colors used on pantone pallet: Nimbus Cloud 13-4108, Black 6c

Structural analysis of the design

Illusion peplum sheath short dress with a horizontal flounce

The lower part of the dress consists of a pencil skirt with two peplums, twelve pieces and a long central panel extending from the upper part to the lower part, while the skirt's back consists of four pieces with one peplum

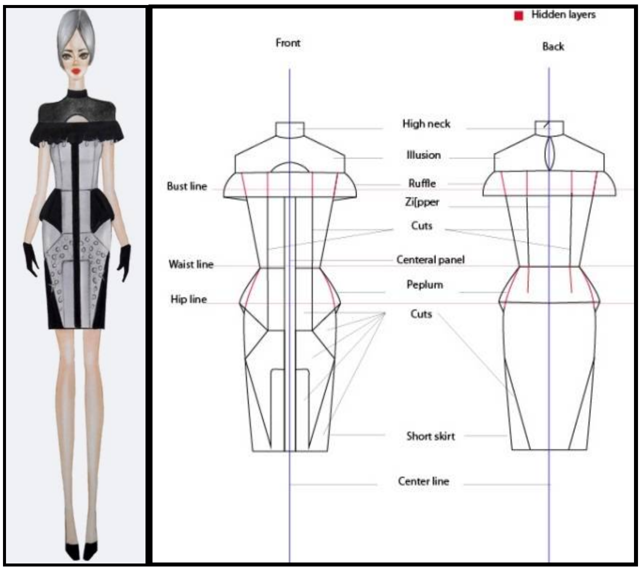

Fig (25): Design. 1 for the Second collection

Design lines: Depends on straight lines and curved lines.
Decorative techniques: LED lamps spreaded on the skirt
Materials used: Satin and Alta moda.
Colors used on pantone pallet: Nimbus Cloud 13-4108, Twilight purple 18-3820.
Structural analysis of the design
Short fitted sheath dress with high neck and 16 pieces bodice, the lower part of the dress consists of a pencil skirt with twelve pieces and three cut lines, it contains four peplum layers on both sides each layer is longer than the other all attached to the waist line, while the back consists of only 4 pieces and four peplums on each side.

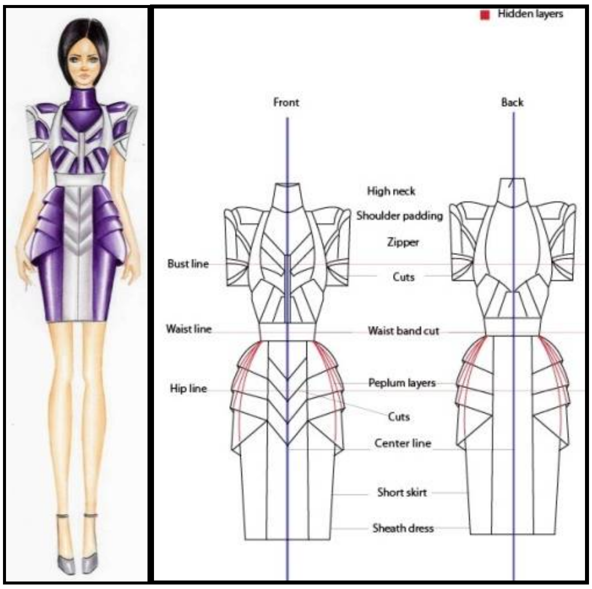

Fig (26): Design. 2 for the Second collection

Design lines: Depends on straight lines and curved lines. **Decorative techniques:** LED lamps spreaded on the skirt and the bodice under the chiffon layers.
Materials used: Satin and Alta moda, chiffon.
Colors used on pantone pallet: Nimbus Cloud 13-4108
Twilight purple 18-3820.
Structural analysis of the design
Mini dress with a cap sleeve and a separate long sleeve, the lower part is a mini pencil skirt with a flounce on each side, skirt front consists of 12 pieces while the back consists of 10 pieces with two flounces, the upper part of the dress consists a bodice made of 21 front pieces and 14in the back pieces.

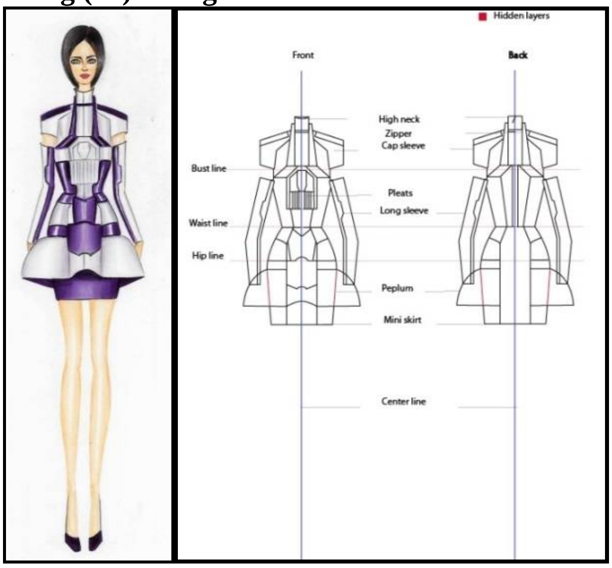

Fig (27): Design. 3 for the Second collection

Design lines: Depends on straight lines and curved lines.
Decorative techniques: LED lamps on the skirt and the bodice.
Materials used: Satin and chiffon.
Colors used on pantone pallet: Black 6c, Serenity 15-3919.
Structural analysis of the design
Micro length dress the lower part of the dress front consists of 6 pieces and a plisse flounce, while the back consists of 4 pieces and a flounces the upper part of the dress consists a high neck with pleated halter the dress is off shoulder and the sleeves are angled bell shape while the bodice made of 13pieces in the front and 5 at the back.

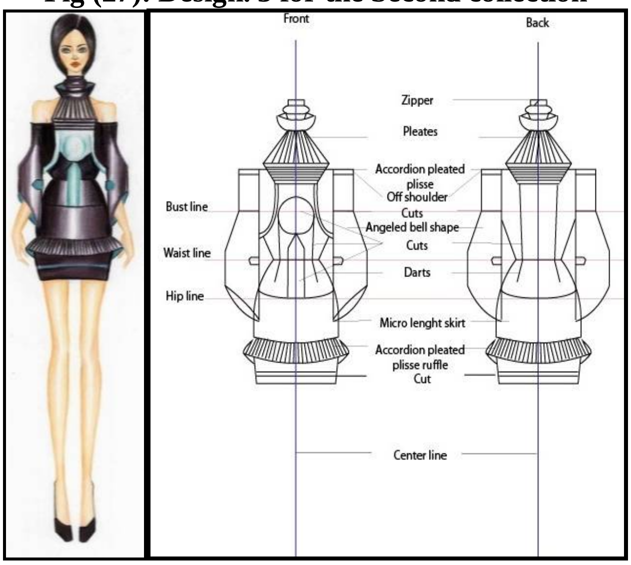

Fig (28): Design. 4 for the Second collection

Design lines: Depends on straight lines and curved lines.
Decorative techniques: LED lamps on the right side of the bodice.
Materials used: Satin.
Colors used on pantone pallet: Nimbus Cloud 13-4108.

Structural analysis of the design
Asymmetric column dress with high neck and pleats in the bodice and peplums, the lower part of the dress consists of a skirt with a layer of peplum on the left side sewn above it another pleated layer on the right side, while the bodice consists of pleated sweetheart shaped with a long sleeve while the other side consists of two pieces cap sleeve length.
Design lines: Depends on straight lines and curved lines.
Decorative techniques: LED lamps spreading on the skirt and on the bodice.
Materials used: Satin.
Colors used on pantone pallet: Serenity 15-3919, True blue 19- 4067, Nimbus Cloud 13-4108, Directoire blue18-4244.

Structural analysis of the design
Ankle length column dress with high neck and long sleeves, the front part consists of 12 pieces while the back consists of 2 pieces, the upper part is connected to the lower part by a waist band cut, the bodice consists of 6 front pieces and 6 back pieces for the sleeve it is a raglan sleeve that consists of 9 pieces in the front, 9 at the back.
Design lines: Depends on straight lines and curved lines.
Decorative techniques: LED lamps spreading on the skirt and bodice central panel.
Materials used: Satin and chiffon.
Colors used on pantone pallet: Serenity 15-3919, True blue 19-4067, Nimbus Cloud 13-4108, Ship skin 14-1122.

Structural analysis of the design
Ankle length column dress with Sabrina neckline and court train, the lower part of the dress consists 7 pieces with two ruffles and a waist band, while the he upper part front consists of six pieces and two ruffles, while the back consists of 6 pieces and two ruffles, and the sleeve consists of three pieces in the front and three pieces at the back.

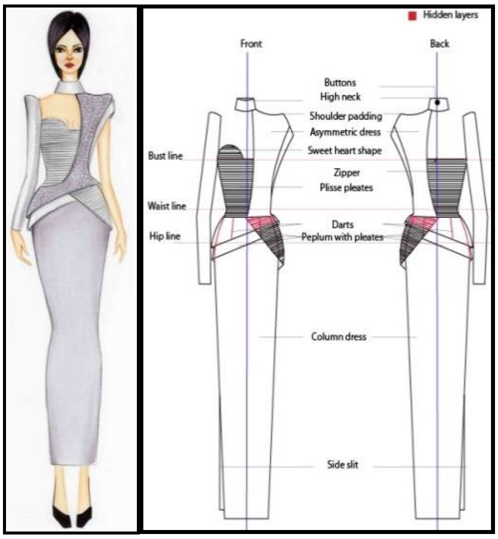

Fig (29): Design. 5 for the Second collection

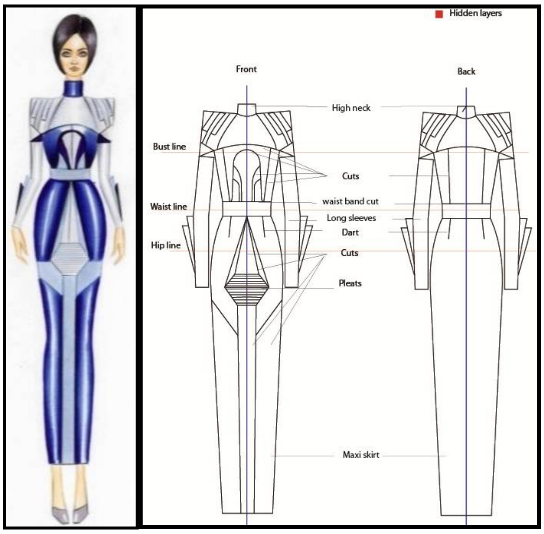

Fig (30): Design. 6 for the Second collection

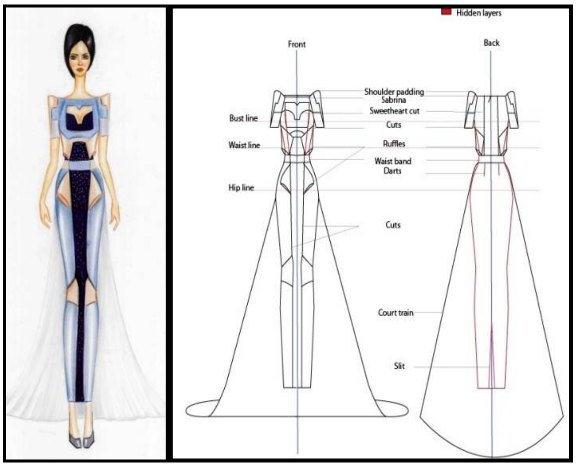

Fig (31): Design. 7 for the Second collection

Design lines: Depends on straight lines and curved lines.
Decorative techniques: LED lamps spreading on the skirt.
Materials used: Satin and crepe.
Colors used on pantone pallet: Serenity 15-3919, Nimbus Cloud 13-4108, Black 6c.

Structural analysis of the design

Midi length dress with high collar and along flying cap at the back.

It consists of a below knee length cap of eight pieces and the dress consists of ten pieces with two ruffles the dress cup has a sweetheart shape and there is a T shaped pleated cut, while the back consists of six pieces with two ruffles covered by 4 pieces cape with high neck

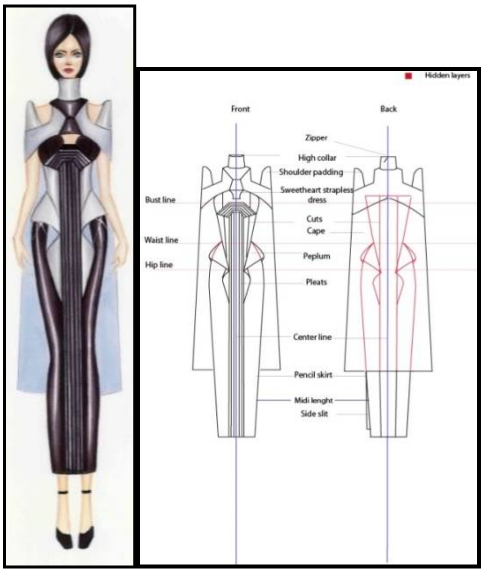

Fig (32): Design. 8 for the Second collection

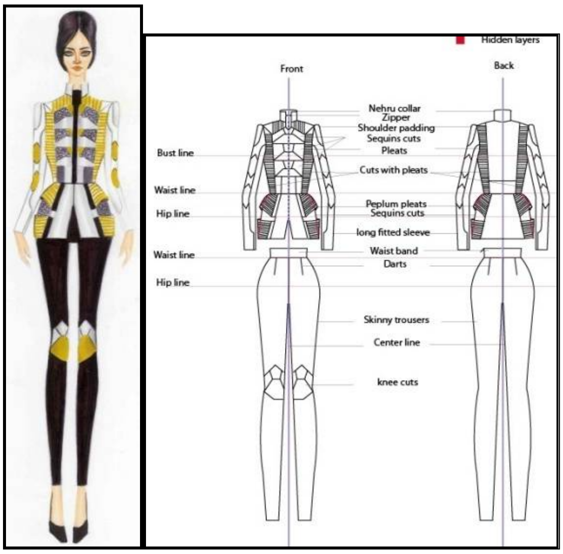

Fig (33): Design. 9 for the Second collection

Design lines: Depends on straight lines and curved lines.
Decorative techniques: LED lamps on the jacket.
Materials used: Alta moda.
Colors used on pantone pallet: Black 6c, Nimbus Cloud 13-4108, Sulphure 14-0755
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Structural analysis of the design

The first piece: is a peplum jacket consisting of 45 pieces some of them contains pleats with Nehru collar and a zipper in the center front, the back side of the jacket consists of 16 pieces some of them have pleats.

The second piece: is a slim fit trousers with a side zipper.

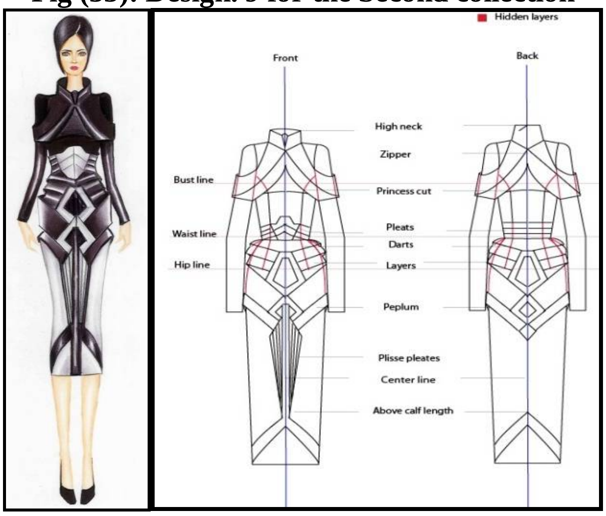


Fig (34): Design. 10 for the Second collection

Design lines: Depends on straight lines and curved lines.
Decorative techniques: LED lamps spreaded on the waist and the skirt
Materials used: Satin.
Colors used on pantone pallet: Nimbus Cloud 13-4108, Black 6c.

Structural analysis of the design

Above calf length peplum dress with high collar and long sleeves, the lower part of the dress consists of 23 front pieces, 6 layers of peplum, and 22 back pieces while the bodice consists of 17 front pieces, 12back pieces with a high neck collar and another layer of two pieces is attached to the neckline.

2.2. Evaluation of the designs

Shown in table (1)

Table (1): Evaluation scale for proposed designs form "questionnaire"

axes		Items	The proposed designs																								
			First					Second					Third					Fourth					Fifth				
			Degree					Degree					Degree					Degree					Degree				
The first		Design fundamentals	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	1	- Clarity of design compatibility.																									
	2	- The rhythm between the design details.																									
	3	-The balance between design details.																									
	4	- Bonding between the design fundamentals																									
The Second		Elements of design	Degree					Degree					Degree					Degree					Degree				
			1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	1	- The overall shape of the design lines.																									
	2	- Compatibility of design colors.																									
	3	- The proposed design elements has convenient ratios																									
	4	- Balancing the elements of the proposed design.																									
		Use of LEDs	Degree					Degree					Degree					Degree					Degree				
			1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
The Third: -	1	- The clarity of the decorative elements using LEDs																									
	2	- The compatibility of LEDs places in the design																									
	3	- The contrast between the design details using LEDs																									
	4	- The variation between the LED areas in the design																									
The Fourth:		The aesthetic values	Degree					Degree					Degree					Degree					Degree				
			1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	1	- Originality of the proposed design.																									
	2	- Creativity in the proposed design																									
	3	- Achievement of the aesthetic values in the proposed design																									
	4	- The design is following the global fashion trends.																									
		The Functional values	Degree					Degree					Degree					Degree					Degree				
			1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
The Fifth: -	1	- The suitability of the design to carry out high-end sewing.																									
	2	- Functional values of the proposed design.																									
	3	- The design fits the 20-30 age range for ladies.																									
	4	- Suitability of design for special occasion clothing.																									
		Modernity, creativity	Degree					Degree					Degree					Degree					Degree				
			1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
The Sixth	1	- The design is technologically contemporary.																									
	2	- Design creativity in the field of fashion design.																									
	3	- The proposed design is up to modern needs.																									
	4	- The novelty of the design technical details																									

2.3. Materials used:-

2.3.1. Fibers used:-

Polyester and Nylon, with different weaving structures commercial names (satin, chiffon satin, chiffon, chiffon crepe, tulle, sequins).

Table (2) Fabrics specifications

No	Commercial name and color	Fiber type	Structure	Warp /c.m	Weft /c.m	Mass g.m/m^2	Thickness (m.m)
1	satin	100% Nylon	Satin4	38	29	230	0.1
2	chiffon	100% polyester	Plain1/1	34	32	75	0.04
3	sequins	Plastic on 100% polyester tulle	Netting and sequins sewn above			315	0.66
4	Tulle	100% Nylon	Netting			34.89	0.016
5	Chiffon crepe	100% polyester	Plain1/1	20	36	143.8	0.01
6	Satin chiffon	100%Nylon	Satin4	105	39	105	0.01

2.3.2. Fabrics specifications:-

6 types of different synthetic fabrics were used in this research. The following tables illustrate the fabrics specifications as shown in table (2).

2.4. Experimental tests:-

All experimental tests were held in the national institute of standards in Egypt at the textile metrology laboratory and the photometry laboratory; all tests were done in conditioned atmosphere of 20 ºc and 60% RH.

2.4.1. Diffuse transmission % in visible region (380-780) of textile materials test

This test was held in the national institute of standards in Egypt at the photometry laboratory it was carried by spectrophotometer Cary 5000 model shimadzu 3101 pc; we measured the diffuse transmission of the following fabrics (satin, chiffon, chiffon crepe, satin chiffon, sequins and tulle).

2.4.2. Maximum force and elongation test

This test was held in the national institute of standards in Egypt at the textile metrology laboratory it was carried on maximum force and elongation tester strip method (QMat5.37/Q3214) model number H5KT/130 5000N according to EN ISO13934-1, 1999 [32], Load range 250N, extension range 150m.m, Gauge length 200m.m, speed 100mm/min, preload 1.0N, this test is performed be exposing a piece of fabric with certain dimensions to a gradual stress until reaching the tearing point. We measured the maximum force and elongation for the following fabrics (satin, chiffon) after LED exposure for 80, 110 and 140 hours.

2.4.3. Bursting strength of textile materials test

This test was held in the national institute of standards in Egypt at the textile metrology laboratory Bursting Strength of textiles test was measured by Ball Burst Test according to ASTM D 3787 [(33)] on tulle fabric, we performed this test on tulle after LED exposure for 80, 110 and 140 hours.

2.4.4. Color measurement test

This test was held in the national institute of standards in Egypt at the textile metrology laboratory color measurement was measured by spectrophotometer these tests were performed on satin, chiffon and tulle with two colors light grey and dark blue after LED exposure for 80, 110 and 140 hours.

3. Results and discussion

This research results have followed what we have discussed in the literature review to execute selective fashion designs integrated with LEDs, also to statistically analyze the results by Anova statistical calculations.

Table (3) diffuse spectral transmission percent in visible region

samples	color	tulle	Chiffon	sequins	chiffon crepe	chiffon satin	satin
Transmission percent	light grey	81.43%	48.07%	43.00%	35.72%	22.50%	5.68%
	dark blue	71.39%	29.49%	15.05%	1.87%	1.09%	0.01%

3.1. Diffuse spectral transmission percent in visible light of different fabrics (six fabrics 2 colors each) in the visible region (380-780nm)

3.1.1. Light grey fabrics

Transmission values of light grey fabric are shown in table (3) Hypothesis: there are a statically significant difference between (tulle, chiffon, sequins, chiffon crepe, chiffon satin, satin) in light grey in the diffuse transmission percent test in visible region and to investigate this hypothesis we calculated the analysis of variance for the mean diffuse transmission percent in visible region of the previous fabrics of light grey color first.

3.1.2. Dark blue fabrics

Table (3) shows that the F value was (22.922) which is the statically significant value on (0.01) level that refers to the difference in diffuse transmission percent between tulle, chiffon, sequins, chiffon crepe, chiffon satin, satin in the dark blue color.

Table (4) Analysis of variance for the mean diffuse transmission percent of the tested fabrics

Light Grey color	**Sum of squares**	**Mean of squares**	**Degrees of freedom**	**F**	**Significance**
Between groups	1628.671	325.734	5	35.204	0.01
Within groups	111.033	9.253	12		
Total	1739.704		17		
Dark blue color					
Between groups	1135.338	227.068	5	22.922	0.01
Within groups	118.873	9.906	12		
Total	1254.211		17		

This table (4) shows that the F value was (35.204) which is the statically significant value on (0.01) level that refers to the difference in diffuse transmission values between tulle, chiffon, sequins, chiffon crepe, chiffon satin, satin in the light grey color while in dark blue color the F value was (22.922) which is the statically significant value on (0.01) level that refers to the difference in diffuse transmission values between the previous fabrics. To determine significance direction we performed the LSD test for multiple comparisons as shown in table (5), (6).

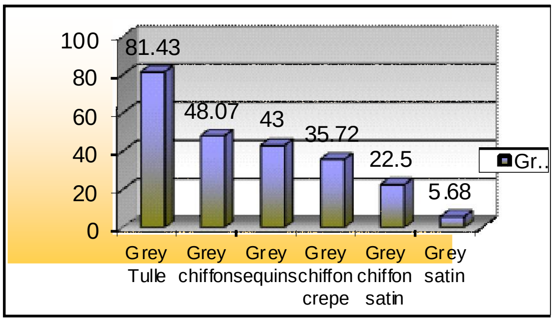
Table (5) LSD test for multiple comparisons

Light grey color diffuse transmission %	**Tulle 81.43%**	**chiffon 48.07%**	**Sequins 43%**	**chiffon crepe 35.72%**	**chiffon satin 22.5%**	**satin 5.68%**

Tulle	-					
Chiffon	**33.36	-				
Sequins	**38.43	**5.07	-			
Chiffon crepe	**45.71	**12.35	**7.28	-		
Chiffon satin	**58.93	**25.57	**20.5	**13.22	-	
satin	**75.75	**42.39	**37.32	**30.04	**16.82	-

Table (6) LSD test for multiple comparisons

Dark blue color diffuse transmission %	**Tulle 71.39%**	**chiffon 29.49%**	**Sequins 15.05%**	**chiffon crepe 1.87%**	**chiffon satin 1.09%**	**satin 0.01%**
Tulle	-					
Chiffon	**41.9	-				
Sequins	**56.34	**14.44	-			
Chiffon crepe	**69.52	**27.62	**13.18	-		
Chiffon satin	**70.3	**28.4	**13.96	0.78	-	
Satin	**71.38	**29.48	**15.04	1.86	1.08	-



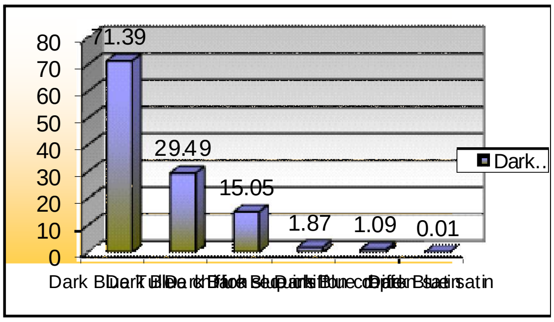


fig (35) diffuse spectral transmission percent in visible region percent of the materials used

-Therefor there is a statically significant difference between (tulle, chiffon, sequins, chiffon crepe, chiffon satin, satin) in light grey in the diffuse transmission percent test in visible region.
-There is a statically significant difference between (tulle, chiffon, sequins, chiffon crepe, chiffon satin, satin) in dark blue in the diffuse transmission percent test in visible region.

3.2. Bursting strength, maximum force and elongation, color reflectance and K/S

These tests were performed on light grey tulle, light grey and dark blue satin and chiffon.

Table (7) shows the statically significant differences between the materials used for Bursting strength, maximum force and elongation tests, K/S and color reflectance tests before /after exposure to LEDs light for 80 hours

Groups		**Mean**	**t**	**Sig.**
Bursting strength Tulle	Not exposed to LED light	174.70	12.05	0.00
	80 hours of exposure to LED	179.10		
Maximum force Satin	Not exposed to LED light	1237.00	0.71	0.49
	80 hours of exposure to LED	1207.00		
Elongation % Satin	Not exposed to LED light	19.92	3.29	0.01
	80 hours of exposure to LED	19.07		
Maximum force Chiffon	Not exposed to LED light	223.30	8.31	0.00
	80 hours of exposure to LED	228.10		
Elongation % Chiffon	Not exposed to LED light	26.76	0.66	0.53
	80 hours of exposure to LED	27.00		
Color reflectance Tulle	Not exposed to LED light	37.96	0.14	0.89

light grey	80 hours of exposure to LED	37.91		
K/S Tulle light grey	Not exposed to LED light	0.51	0.04	0.97
	80 hours of exposure to LED	0.51		
Color reflectance satin light grey	Not exposed to LED light	29.69	2.90	0.02
	80 hours of exposure to LED	29.42		
K/S satin light grey	Not exposed to LED light	0.83	0.39	0.71
	80 hours of exposure to LED	0.85		
Color reflectance Chiffon light grey	Not exposed to LED light	28.39	1.15	0.28
	80 hours of exposure to LED	28.81		
K/S Chiffon light grey	Not exposed to LED light	0.90	9.06	0.00
	80 hours of exposure to LED	0.88		
Color reflectance satin dark blue	Not exposed to LED light	6.14	0.08	0.94
	80 hours of exposure to LED	6.11		
K/S satin dark blue	Not exposed to LED light	7.17	0.11	0.92
	80 hours of exposure to LED	7.21		
Color reflectance Chiffon dark blue	Not exposed to LED light	4.27	0.36	0.73
	80 hours of exposure to LED	4.40		
K/S Chiffon dark blue	Not exposed to LED light	10.74	0.95	0.37
	80 hours of exposure to LED	10.39		

Table (8) shows the statically significant differences between the materials used for Bursting strength, maximum force and elongation tests, K/S and color reflectance tests before /after exposure to LEDs light for 110 hours

Groups		Mean	t	Sig.
Bursting strength Tulle	Not exposed to LED light	174.70	56.69	0.00
	110 hours of exposure to LED	195.40		
Maximum force Satin	Not exposed to LED light	1237.00	2.63	0.03
	110 hours of exposure to LED	1175.00		
Elongation % Satin	Not exposed to LED light	19.92	7.56	0.00
	110 hours of exposure to LED	17.97		
Maximum force Chiffon	Not exposed to LED light	223.30	6.64	0.00
	110 hours of exposure to LED	228.15		
Elongation % Chiffon	Not exposed to LED light	26.76	2.82	0.02
	110 hours of exposure to LED	27.79		
Color reflectance Tulle light grey	Not exposed to LED light	37.96	11.60	0.00
	110 hours of exposure to LED	44.66		
K/S Tulle light grey	Not exposed to LED light	0.51	6.32	0.00
	110 hours of exposure to LED	0.34		
Color reflectance satin light grey	Not exposed to LED light	29.69	10.22	0.00
	110 hours of exposure to LED	30.28		
K/S satin light grey	Not exposed to LED light	0.83	0.82	0.43
	110 hours of exposure to LED	0.80		
Color reflectance Chiffon light grey	Not exposed to LED light	28.39	1.26	0.24
	110 hours of exposure to LED	28.85		
K/S Chiffon light grey	Not exposed to LED light	0.90	9.90	0.00
	110 hours of exposure to LED	0.88		
Color reflectance satin dark blue	Not exposed to LED light	6.14	0.44	0.67
	110 hours of exposure to LED	6.30		
K/S satin dark blue	Not exposed to LED light	7.17	0.56	0.59
	110 hours of exposure to LED	6.97		
Color reflectance Chiffon dark blue	Not exposed to LED light	4.27	0.08	0.94
	110 hours of exposure to LED	4.30		
K/S Chiffon dark blue	Not exposed to LED light	10.74	0.22	0.83

	110 hours of exposure to LED	10.66		

Table (9) shows the statically significant differences between the materials used for Bursting strength, maximum force and elongation tests, K/S and color reflectance tests before /after exposure to LEDs light for 140 hours

Groups		Mean	t	Sig.
Bursting strength Tulle	Not exposed to LED light	174.70	3.56	0.01
	140 hours of exposure to LED	173.40		
Maximum force Satin	Not exposed to LED light	1237.00	1.83	0.10
	140 hours of exposure to LED	1249.00		
Elongation % Satin	Not exposed to LED light	19.92	36.46	0.00
	140 hours of exposure to LED	20.88		
Maximum force Chiffon	Not exposed to LED light	223.30	22.00	0.00
	140 hours of exposure to LED	236.00		
Elongation % Chiffon	Not exposed to LED light	26.76	8.93	0.00
	140 hours of exposure to LED	30.02		
Color reflectance Tulle light grey	Not exposed to LED light	37.96	16.38	0.00
	140 hours of exposure to LED	43.94		
K/S Tulle light grey	Not exposed to LED light	0.51	5.76	0.00
	140 hours of exposure to LED	0.36		
Color reflectance satin light grey	Not exposed to LED light	29.69	3.42	0.01
	140 hours of exposure to LED	30.59		
K/S satin light grey	Not exposed to LED light	0.83	1.23	0.25
	140 hours of exposure to LED	0.79		
Color reflectance Chiffon light grey	Not exposed to LED light	28.39	0.88	0.40
	140 hours of exposure to LED	28.71		
K/S Chiffon light grey	Not exposed to LED light	0.90	49.30	0.00
	140 hours of exposure to LED	0.89		
Color reflectance satin dark blue	Not exposed to LED light	6.14	0.25	0.81
	140 hours of exposure to LED	6.23		
K/S satin dark blue	Not exposed to LED light	7.17	0.32	0.75
	140 hours of exposure to LED	7.06		
Color reflectance Chiffon dark blue	Not exposed to LED light	4.27	0.25	0.81
	140 hours of exposure to LED	4.18		
K/S Chiffon dark blue	Not exposed to LED light	10.74	0.64	0.54
	140 hours of exposure to LED	10.97		

We can conclude from the previous tables (7, 8, 9) that there were differences between the different fabrics properties before and after LED exposure.

3.3. Analyzing the statical differences between the proposed designs of the first and second collection

Hypothesis there are statically significant differences between the proposed designs of the first and second collection.

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Table (10) Analysis of variance for the mean diffuse between collections

collections	Sum of squares		Degrees of freedom (df)	Mean of squares	F	Significance
First collection	Between groups	1367.588	9	151.954	10.474	0.000
	Within groups	3336.708	230	14.507		
	Total	**4704.296**	**239**			

Second collection	Between groups	1355.650	9	150.628	4.740	0.000
	Within groups	7309.000	230	31.778		
	Total	**8664.650**	**239**			

This table shows that the F value was (10.474) which is the statically significant value on (0.000) level that refers to the difference between the proposed designs of the first and the F value was (4.740) which is the statically significant value on (0.000) level that refers to the difference between the proposed designs of the second collection.

Table (11) Significant differences between collection one and two

collections	**N**	**Mean**	**Std. Deviation**	**T.TEST**	**Degrees of freedom "df"**	**Significance Sig.**
First	10	952.30	60.39	0.761	18	0.457
Second	10	931.80	60.13			

This table shows that there is no statically significant differences between collection one and two according to questionnaire elements.

Table (12) the arrangement of First collection designs, percentages and Axis's arrangement according to each design individually.

Second collection Miss Robot	Percentage %	Ranking	Ranking of the axes											
			first		Second		Third		Fourth		Fifth		Sixth	
			%	Ranking	%	Ranking	%	Ranking	%	Ranking	%	Ranking	%	Ranking
Des.1	73.17	8	40.00	6	69.50	5	78.50	4	79.50	3	89.00	1	82.50	2
Des.2	74.83	7	40.00	6	78.00	4	77.50	5	84.50	1	84.50	1	84.50	1
Des.3	84.08	2	97.00	1	77.50	5	77.50	5	83.50	4	84.50	2	84.50	2
Des.4	72.50	9	72.50	1	72.50	1	72.50	1	72.50	1	72.50	1	72.50	1
Des.5	71.42	10	75.50	2	75.50	2	66.00	4	64.50	5	82.50	1	64.50	5
Des.6	77.00	6	82.50	3	74.50	4	66.50	6	76.50	5	85.50	1	85.50	1
Des.7	77.25	5	84.50	3	73.00	4	85.50	1	76.50	5	85.50	1	67.50	5
Des.8	85.83	1	84.50	6	85.50	2	85.50	2	88.50	1	85.50	2	85.50	2
Des.9	82.50	3	82.50	1	82.50	1	82.50	1	82.50	1	82.50	1	82.50	1
Des.10	77.92	4	64.50	6	82.50	1	82.50	1	82.50	1	75.00	5	80.50	4

This table shows the designs percent ranking according to the judges' evaluation also according to the questionnaire axis order, the percent of each axis and its order in every design of the first collection individually

Table (13) the arrangement of Second collection designs, percentages and Axis's arrangement according to each design individually.

Second collection Miss Robot	Percentage %	Ranking	Ranking of the axes											
			first		Second		Third		Fourth		Fifth		Sixth	
			%	Ranking	%	Ranking	%	Ranking	%	Ranking	%	Ranking	%	Ranking
Des.1	73.17	8	40.00	6	69.50	5	78.50	4	79.50	3	89.00	1	82.50	2
Des.2	74.83	7	40.00	6	78.00	4	77.50	5	84.50	1	84.50	1	84.50	1
Des.3	84.08	2	97.00	1	77.50	5	77.50	5	83.50	4	84.50	2	84.50	2
Des.4	72.50	9	72.50	1	72.50	1	72.50	1	72.50	1	72.50	1	72.50	1
Des.5	71.42	10	75.50	2	75.50	2	66.00	4	64.50	5	82.50	1	64.50	5
Des.6	77.00	6	82.50	3	74.50	4	66.50	6	76.50	5	85.50	1	85.50	1
Des.7	77.25	5	84.50	3	73.00	4	85.50	1	76.50	5	85.50	1	67.50	5
Des.8	85.83	1	84.50	6	85.50	2	85.50	2	88.50	1	85.50	2	85.50	2
Des.9	82.50	3	82.50	1	82.50	1	82.50	1	82.50	1	82.50	1	82.50	1
Des.10	77.92	4	64.50	6	82.50	1	82.50	1	82.50	1	75.00	5	80.50	4

This table shows the designs percent ranking according to the judges' evaluation also according to the questionnaire axis order, the percent of each axis and its order in every design of the second collection individually

Table (14) LSD test for multiple comparisons between questionnaire axis for the first collection designs

	First collection	Design fundamentals	Elements of design	Use of LEDs	The aesthetic values	The Functional values	creativity and Modernity
1	**Design fundamentals.**	1					
2	**Elements of design**	.706**	1				
3	**Use of LEDs**	0.231	.455**	1			
4	**The aesthetic values**	0.374*	.583**	.426**	1		
5	**The Functional values**	0.040	0.202	0.185	.535**	1	
6	**Creativity and modernity**	0.184	.342*	.319*	.643**	.832	1

This table shows the comparisons between questionnaire axis for the first collection designs

Table (15) LSD test for multiple comparisons between questionnaire axis for the second collection designs

	Second collection	Design fundamentals	Elements of design	Use of LEDs	The aesthetic values	The Functional values	creativity and Modernity
1	**Design fundamentals.**	1					
2	**Elements of design**	.304	1				
3	**Use of LEDs**	0.187	.519**	1			
4	**The aesthetic values**	-0.125	.204*	.433**	1		
5	**The Functional values**	-0.021	-0.076	0.126	0.303	1	
6	**Creativity and modernity**	-0.102	.253	0.177	.711**	.526**	1

This table shows the comparisons between questionnaire axis for the Second collection designs

3.4. Final executed designs

3.4.1. Design one

As shown in fig (36)

Fig. (36) dress from all sides

3.4.1.1. Techniques used

This dress contains 60 LEDs of warm white color the LED strands are installed in the satin part of the dress by putting metal grommets on the fabrics front side and passing the LEDs through them to the surface while the LEDs are fixed under the chiffon fabric by passing the LED heads through holes in the lining and then placing the chiffon fabric above it as shown in Adding LED wires strands as shown in fig (37) with batteries, is the most suitable way for the researcher to install LED into the garments as it is the most durable safe technique as shown in fig from (37 to 40).

Fig. (37) LEDs on the satin fabric passing Through grommets.

Fig. (38) LED wires in the lining

Fig. (39) LED under chiffon

Fig. (40) LED passing through holes in the satin lining

3.4.2. Design two

As shown in fig (41)

Fig. (41) dress from all sides

3.4.2.1. Techniques used

It has 48 warm white LEDs, the LED strands are installed in the satin part of the dress by putting metal grommets on the fabrics front side and passing the LEDs through them to the surface, while in the upper ruffle the LEDs are attached through sewing the wires in the ruffles lining and letting the LEDs heads free see fig (42), (43).

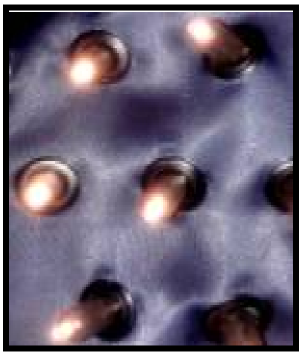

Fig. (42) LEDs passing to the surface through metal grommets

Fig. (43) LED wires in the lining

3.4.3. Design three

As shown in fig (44),(45)

Fig. (44) dress from all sides

Fig. (45) dress from all sides

3.4.3.1. Techniques used

It has 60warm white LEDs, the LED strands are installed by stitching between the two tulle layers while the other LED strand it fixed around the belt fig (46).

3.4.4. Design four

As shown in fig (47)

Fig. (46) LEDs under tulle layer

Fig. (47) dress from all sides

3.4.4.1. Techniques used

This dress contains 36 LEDs of warm white color are fixed under the chiffon fabric by passing the LED heads through holes in the lining and then placing the chiffon fabric above so the Light transmits through the sheer fabric it as shown in technique, as shown in fig.(48), (49).

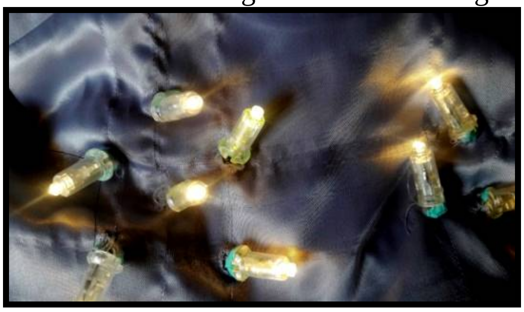

Fig. (48) LED passing through holes in lining

Fig. (49) LED under chiffon

We can summarize the results in the following points:-

1-By experimenting several techniques the researcher found a suitable way to install LEDs to each type of fabric according to the fabric's properties.

2-The easiest and most good looking way to install the LEDs was through applying snaps to the surface of the dress and passing LEDs through them to the outside but this way was only applicable to the satin fabric due to its thickness and weight.

3-The other two methods of applying LEDs in tulle and chiffon were more difficult, hard and caused several defects to the inner lining of the dress as in the chiffon the LED heads passed through holes that were made in the lining by an pointed ironer the LEDs were fixed with a double face stitching tape so that they don't move and then we placed the chiffon fabric above this holes while under the tulle dress we had to stitch 6 LED cords on the satin lining which was a bit difficult as the weight of the LED cords was relatively heavy so we needed to fix them with many stitches unless they fall, the look of the two other methods on the lining isn't not polished and good but it doesn't appear to the wearer or two the public as it is covered by another layer of lining.

4- The LED light appeared very strong when fixed on the satin fabric as the LED heads weren't just placed directly on the fabrics' surface but also the satin surface reflected most of the light emitted from the LEDs while under the tulle the light appeared less strong as it was transmitted through a sheer fabric, moreover the light transmission was the least in the case of the chiffon as it is thicker and heavier than the tulle so it absorbed some of the light transmitted from the LEDs.

5- All ways of LED light transmission wether being diffused under a sheer fabric such as tulle and chiffon or transmitted directly to the viewer were both appealing as they were convenient to the designs styles a faded out soft light in case of tulle and chiffon for a soft feminine look and strong light transmission for a strong powerful look.

6-By this research we knew the fabrics with high transmission values and the fabrics with low transmission values, (tulle and chiffon were the highest while satin was the lowest)

7-140 hours in the bursting strength test is the best interval of time that tulle was exposed to LED without changing its value too much.

8-80 hours in elongation test is the best interval of time that satin was exposed to LED without changing its value too much and 140 hours for the maximum force value, 80 hours for the chiffon fabric in both maximum force and elongation.

5-In K/S 80 hours is the best interval of time that tulle was exposed to LED without changing too much its value, while in light grey satin the best interval of time is 80 hours, 140 hours for light grey chiffon, 80 hours in dark blue satin and 110 hours for dark blue chiffon.

9-In reflectance test 80 hours is the best interval of time that light grey tulle was exposed to LED without changing too much its value, while 80 hours in light grey satin, 110 hours for light grey chiffon, 80 hours for dark blue satin, 140 hours for dark blue chiffon.

10-when we measured the color difference between the standard samples of fabrics (which weren't exposed to LED) and samples exposed 80, 110, 140 hours to LED we found that the best interval of time light grey tulle exposed to LED without changing much its value is 80 hours, while in light grey satin is both 80 hours and 110 hours, for light grey chiffon is 140 hours, in dark blue satin exposed to LED without changing much its value is 80 hours, while in dark blue chiffon the best interval of time to LED exposure without changing much its value is 110 hours,

11-Getting the practical knowledge of executing and designing LED clothes.

Recommendations

The researcher recommends the following:-

1- More researches should be done on wearable technologies.

2- Undergoing more tests to know the effect of LEDs on different fabrics properties natural and synthetic.

3- Researches should be done on the usage of LEDs in other fields of fashion rather that fashion design for example the effect of using LEDs on visual merchandising.

4- Encouraging university fashion design students to use LEDs and other wearable technologies in their designs.

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