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Benefiting from the Laws of Fractal Geometry in the Production of an Evening Top in a Manner that Achieves the Principle of Sustainability

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ABSTRACT

This research aims to present a design proposal that achieves the principle of zero loss, by producing an evening top made of lace material by using separate units of lace. Such top is used as an accessory that is matching more than one garment, which gives a different and new look to the clothes and helps to achieve sustainability. The design was produced by using Photoshop program to distribute the lace units in a manner inspired by the principle of self-similarity in fractal geometry to ensure compatibility as an aesthetic aspect of the product. As regards producing the clothing, the lace units were sewn by using the zigzag stitch.

Keywords: fractal geometry, evening top, sustainability, zero waste, sustainable design.

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Introduction:

The fashion industry is defined as the manufacturing of beauty. Nevertheless, there is a growing concern about the environmental pollution caused by the clothing industry. This type of pollution involves the whole process of clothing industry from its beginning to its end and even more extends to the post-consumption of the clothing itself. Furthermore, the remains of fabrics that result from the cutting process are considered among the most important sources of pollution . Therefore, some great measures have been taken by workers in the clothing industry to reduce fabric residues resulting from cutting. Some of these measures implement modern cutting systems such as the Gerber and Gemini systems and others to cut clothes with the least amount of waste possible. Consequently, clothing manufacturers have resorted to applying these systems not only for the sake of achieving sustainability and saving the environment, but also for some economic reasons related to reducing expenses. However, although the utilization of these modern systems helps in the reduction of shear waste away to a large extent, they cannot achieve the goal of zero waste. (Gelmetti et al., 2021)

Consequently, some other methods and design solutions have been recently applied to minimize and reduce the waste resulting in the clothing production. For example, shaping the fashion design on the mannequin by using folds, and forming a design by using the art of ergonomics. Furthermore, other optimal methods include applying the Japanese kimono style in designing peoples' clothes to reduce the wasted cloth during cutting. Significantly, these methods produce designs without cutting exhaust, yet some of them neither accomplish the required fit of the produced clothes, nor achieve the required aesthetic value. (ElShishtawy et al., 2022)

Many studies have dealt with the principle of producing clothes without exhausts.

For example, in a study entitled: "*Make/Use: A System for Open Source, User-Modifiable, Zero Waste Fashion Practice*", by (McQuillan et al., 2018) the researchers presented a model for a two-dimensional pattern, made up of one piece, and by following some simple steps, it is converted into a three-dimensional piece of clothing. The model included several proposals for the fabrication method. In addition to this, there is a possibility for printing various designs on the clothing, which gives the user the opportunity to turn from being a passive consumer and become an effective contributor to and a participant in the creative process of producing and modifying the clothing.

Another significantly important study was conducted by (Al-Shishtawy et al. 2022) and entitled "*A Comparative Review of Zero-Waste Fashion Design Thinking and Operational Research on Cutting and Packing Optimisation".* This study demonstrated a comparative presentation of the previous research concerned with the problem of reducing the loss of fabrics during the cutting process. In this sense, the study included research papers published in the period from 2010 to 2021. The main aim of the study was to track the problem in two prospects, namely,

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- Cutting and backing
- Zero waste fashion design

The study presented some of the technical and design solutions presented by the research papers included in the study in both tracks. Moreover, in the conclusion, it suggested that there is a possibility, over time, to combine the two tracks used to reduce losses by introducing the proposed methods in the track, namely, zero waste fashion design to technical software algorithms used in Cutting and backing.

Significantly, designers have been selecting and assigning proposals that achieve the aesthetic aspect of the design and proposing various design solutions. In fact, this shows that the clothing industry constantly needs new technologies in order to develop the designer's imagination and enhance their innovation to create modernized modified designs. Therefore, the design must achieve three basic aspects to be considered an innovative design: originality, versatility, and flexibility. Thus, if the same techniques are used constantly and repetitively, it will be difficult to obtain original ideas for different and variant designs.

Currently, designers are facing greater challenges, as the design, in addition to achieving the functional and aesthetic aspects, must achieve further aspects related to preserving the environment and becoming eco-friendly.

From the foregoing presented study, the researcher found out that there are a lot of efforts which focused and concentrated on cutting the piece of clothing without wastes of cutting. This has been achieved through various design proposals, which called for addressing the current research that deals with the production of a top design that achieves the principle of sustainability without exhausts. The mechanism applied in the present study is using simple units of lace, which can be grouped and fabricated together to form and produce the required eco-friendly piece of clothing.

Herein, it is worthy of noting that the researcher believes that the utilization of the perfect characteristics of fractal geometry in the formation of a number of units, fashioned from a primary decorative unit, would ensure the production of a fashionable clothing with decorative design and creative style. Such fashionable style depends on the distribution of these units on the piece of clothing, whose design accordingly achieves the fundamentals of design, especially its compatibility and unity.

Purpose of the Study:

This research paper aims at presenting and proposing a design to produce a stylish and eco-friendly fashionable top inspired by the self-simulation characteristic in fractal geometry in the formation of several units from a primary decorative unit. These units are distributed on an evening top pattern, which fits size 42 and 44. The top is made of lace by using separate units of lace instead of using lace fabrics and cutting them to produce clothes. Thus, on one hand, this study contributes to the production of sustainable clothes. On the other hand, it emphasizes and enhances the importance of

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experimentation and application in the field of clothes- fashion-production. This goal is accomplished by inventing a product that can provide new design solutions and achieve the principle of zero loss. Furthermore, the designed top is not internally lined. Thus, it allows customers to use it as an accessory piece designed purposefully to match a quiet big range of clothing styles. In this way, it creates the effect of varied appearance and achieve sustainability.

Materials and methods

- Material: Lace units.
- Product (design): Women's top.
- Size: Size 42, 44
- Used seams: flat lapped seam using zigzag stitch
- The method used: self- simulation by action feature in fractal geometry using Adobe Photoshop version 24,1,1

Approach of Study:

This study follows the descriptive analytical approach.

procedures

Rhythm is generally considered among the essentials of designing, especially in fashion industry. This is because it gives the design a sense of movement and vitality. Rhythm is often achieved in design through repetition.

Fractal geometry is based on the idea that there are many shapes in nature. Such shapes could be observed in the form of repetitive and similar small pieces. Based on this presupposition, the idea of this research came as an attempt to get inspired by fractal geometry in designing the top.

The process involves a couple of steps which go as follows. First, the lace unit is photographed, then scaled to be used in small sample sized design. Next, the photo unit is entered in the photoshop program. Significantly, the action feature in this program has a great advantage as it allows recording several steps and repeating them for an unlimited number of times by pressing the “Play” button. Thus, the designer benefits from this feature in several ways. In fact, this characteristic is utilized by recording a copy and starting to move the unit according to fixed coordinates. Furthermore, the resulted two layers are then merged, thus, resulting in a novel unit. By repeating this process, we obtain new units that are increased in size and varied in shape with each reiteration. Eventually, those self-smeltery units are fabricated and organized together by applying Lapped seams with zigzag stitches forming the top.

The top fits sizes 42 and 44 because the stitching joints between the front and back at the shoulder and side seams are fixed using a flat elastic band that allows for elasticity.

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Procedures on photoshop are explained in detailed in Appendix.

Results:

- Producing a top without cutting loss using the previously explained method that achieves both functional and aesthetic aspects.
- Suggesting multiple uses of the proposed design to achieve the principle of sustainability.
- Suitable and matches size 42 and 44.

Discussion:

Through the presented findings, it is clear that the design of the produced top is capable of achieving the goal of its production, namely, the production of sustainable clothes without exhausts. This goal is a major principle in eco-friendly clothing industry and it is achieved by applying it to more than one garment. Hence, the variety in fashionable outlook is also accomplished and facilitated by the varied clothing appearance, which encourages women to use it instead of buying an evening gown every time she attends a new occasion. In addition, the suitability of the top for two sizes increases the chance of its continuous use in different occasions in case the woman either loses or gains weight and changes size.

Conclusion:

The resulting design has successfully achieved the desired goal. In one sense, the design has accomplished the aspect of sustainability which has been facilitated by the possibility of using it as an accessory. Hence, it ensures and allows a variety of clothing appearance that women can easily obtain by owning and using it. Moreover, it achieves a high quality of production without loss, as the design is produced by distributing units to match the prepared design and then, the units are reassembled by using flat lapped seam using zigzag stitch without going through the cutting process.

Although the implementation of the proposed design will be carried out in haute couture style, and not in a mass production style, the nature of the lace material that was used is often utilized in fashion houses that adopt the haute couture style and not the mass production method.

The proposed method in this research is fixed to producing only one piece of clothing. However, researchers in the fashion industry will not be able to propose solutions that can be generalized to all factories due to the wide variety of types of pieces of clothing and the times and occasions for wearing them. Nevertheless, it is useful to recommend and present new ideas that would contribute to finding solutions regardless to questioning and considering the possibilities of extended application.

The researcher also recommends the use of units that are manufactured in the crochet style, which will give two advantages. The first benefit is that the designer will be able to model the decorative unit that he intends to use. The other benefit is the

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possibility of implementing these units in different sizes, which will give greater enrichment to the design that implements them.

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Appendix: Research Procedures on photoshop in detailed

- **Preparing and photographing the lace unit used in the design in question. Then entering the image of the lace unit into the Photoshop program and reducing it to a scale to be used in making a miniature sample for the design of the top**
- **Remove the background from used unit image using photoshop as follows:**
  - File
  - ↓
  - Open then choose the image from the device
  - ↓
  - Select object (or) quick selection tool
  - ↓
  - add layer musk
  - ↓
  - File
  - ↓
  - Save a copy, Change the type to an image instead of Photoshop and name the file: image 1".
- **Using the action feature in Photoshop, which allows and facilitates the recording of several steps and then repeating them for an unlimited number of times by pressing the "Play" button as follows:**
  - Create new file from file menu:
  - File
  - ↓
  - New
- Open the file of the unit which will be used from file menu:
  - File
  - ↓
  - Open
- Move the unit from the opened file to the created file using move tool. Figure (1)

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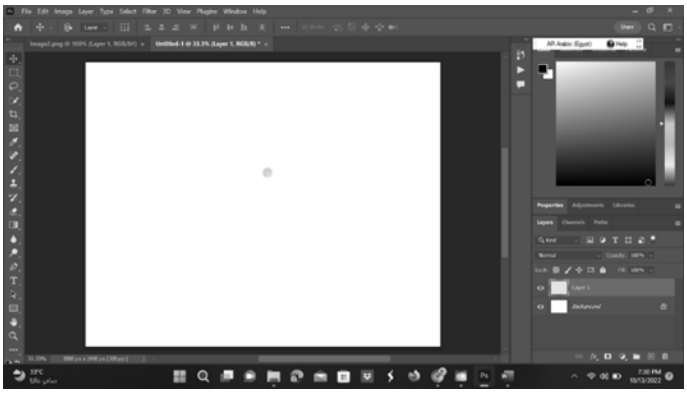

Figure (1)

Open a new file and move the unit.

- From window menu but √ next to action order to view it
  - Window
  - ↓
  - Actions
  - Put √ sign
- Press action order then choose create new set. Figure (2)
  - Actions
  - ↓
  - Create new set

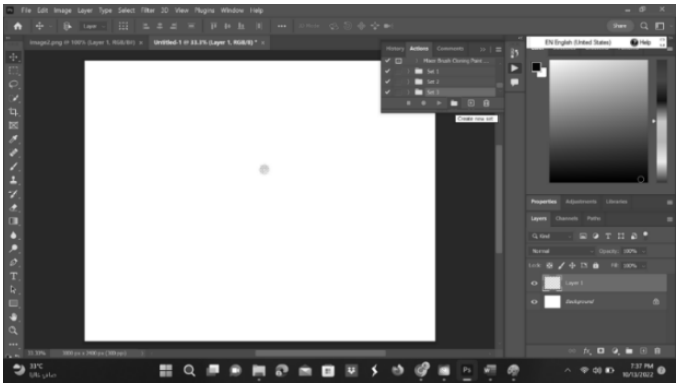

Figure (2)

Create a new action group.

- Name the set then press ok, Figure (3)

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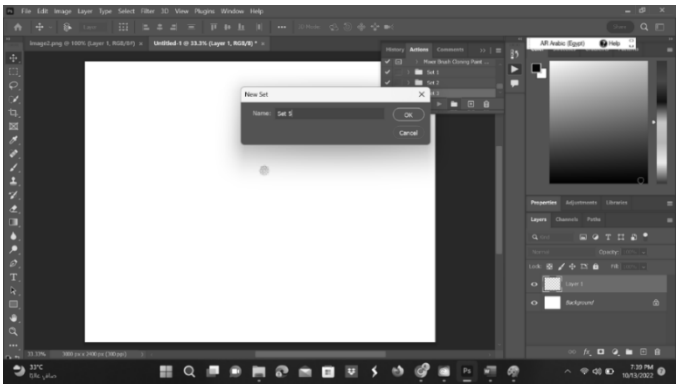

Figure (3)

Name the action group.

- Below the new set choose to create new action name it then press record. Figure (4)
  - Actions
  - ↓
  - Create new action
  - ↓
  - Record, Figure (4)

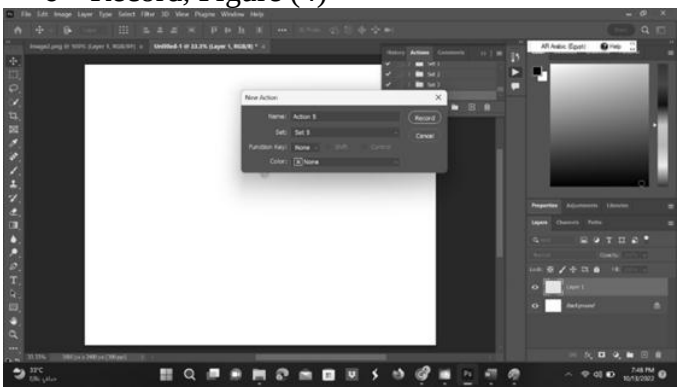

Figure (4)

Create a new action.

- From Keyboard press Ctrl +Alt +T
- This order puts frame around the unit and create copy of it at same time, we can change the unit center and rotate it as desired, then press Enter from Keyboard. Figure (5)

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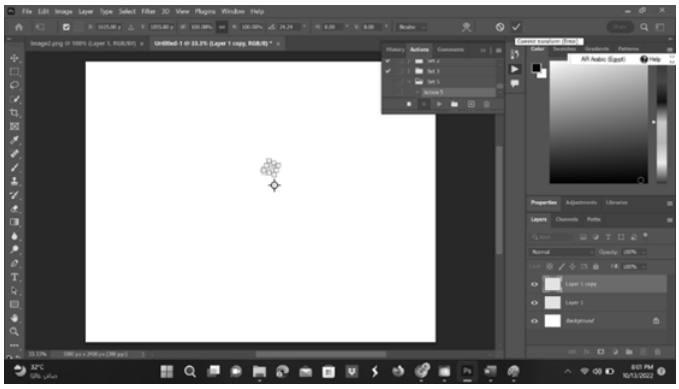

Figure (5)

press Ctrl +Alt +T.

- Then press the sign (Stop playing / recording) from Action window, a new unit formed. Figure (6)

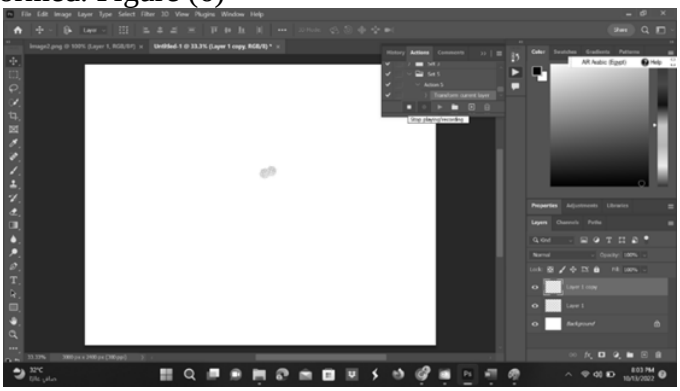

Figure (6)

Operating action.

- To merge the two layers, we press Shift from Keyboard to choose both layers. Figure (7)

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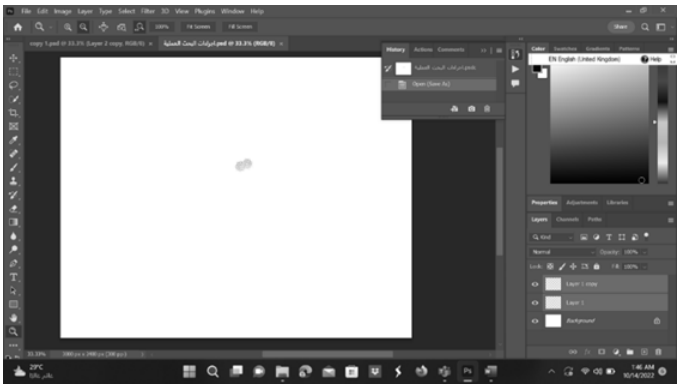

Figure (7)

Select and merge the two layers .

- Then press Ctrl +E from Keyboard so the two layers get merged. Figure (8)

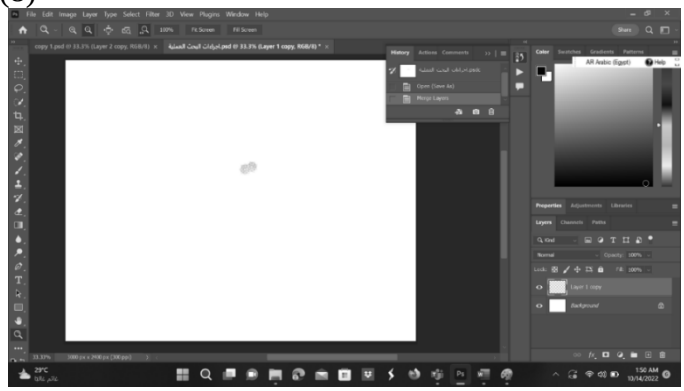

Figure (8)

Execute the command to merge the two layers.

- To run the Action, click on it then press Play sign, The result is in next shape. Figure (9)

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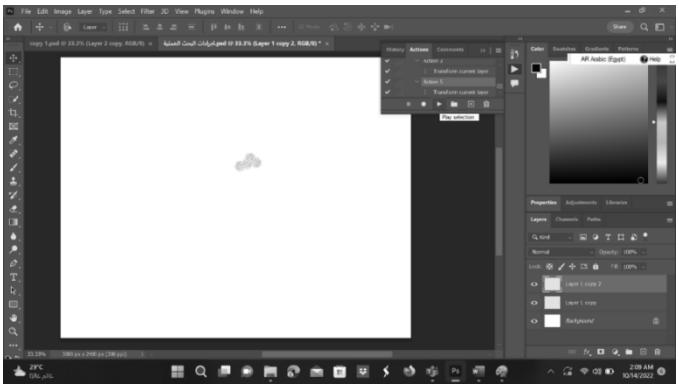

Figure (9)

Re-execute the action for the resulting new unit.

- We repeat these steps the result is figure (10)

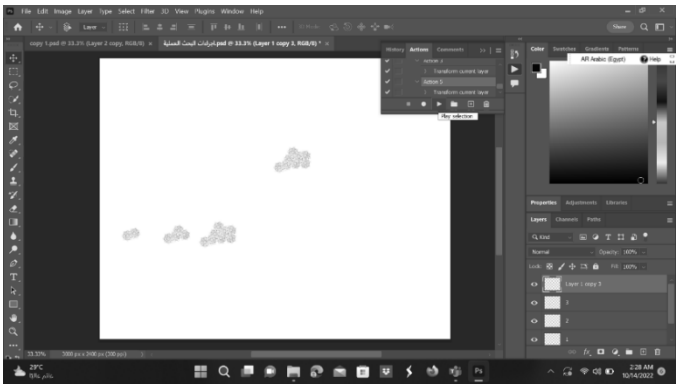

Figure (10)

Units resulting from the repetition of the implementation of the action order to be used in the implementation of the top design.

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Figure (11)

The final outlook of the design in Photoshop.

- In the end, the design of the top, which was prepared in Photoshop, was implemented using the lace units on the mannequin, then the units were sewn together with flat knitting links using the zigzag stitch.

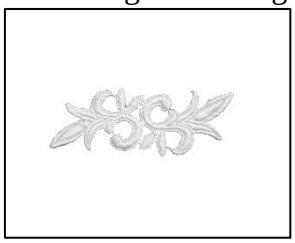

Figure (12)

The lace unit used in producing the top

Figure (13)

The lace unit scaled and iterations

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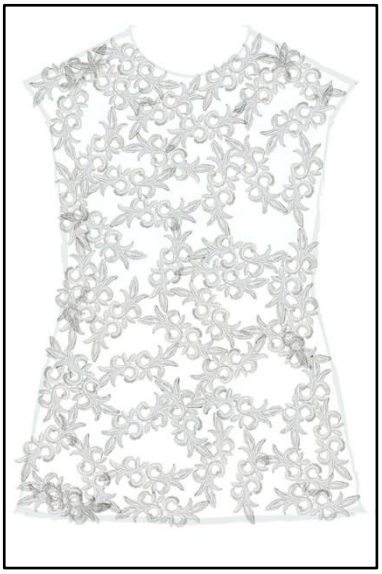

Figure (14)

The design of the top in photoshop

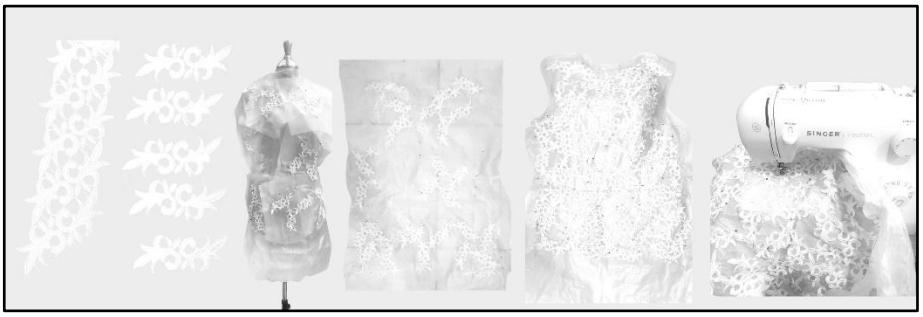

Figure (15)

Product implementation stages

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Figure (16)

The final form of the product after its implementation

Figure (17)

Putting the top on a size 42/44 mannequin front and back

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Figure (18)

Matching the product with different clothes to give a variety of outlook.

Figure (19)

Matching the product with different clothes to give a variety of outlook.

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Figure (20)

Matching the product with different clothes to give a variety of outlook.

Figure (21)

Matching the product with different clothes to give a variety of outlook.

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Figure (22)

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