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TEXTILE AND FASHION DESIGN WITH THE INTEGRATION OF SACRED SYMBOLS

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Abstract: *The textile and fashion industries face challenges in pattern diversity, innovation, and the integration of mathematical and symbolic design methods. This study aims to address these issues by improving the diversity, complexity, and adaptability of models while integrating mathematical principles and symbol-based techniques. Basically, research shows that using different mathematical models, like Hamiltonian or fractals, can make our models more diverse and effective. Improving the mathematical skills of designers is essential to overcome the complexities associated with mathematical design methods. The advancement of symbol-based design methodologies promotes cross-cultural adaptability and mitigates limitations in methodology dependency. A holistic approach involving research, education, and technological advancement is vital to driving innovation in textile and fashion design. Algorithms for sacred geometry figures offer new avenues for creating visually appealing designs with spiritual meaning. The fusion of mathematical precision and artistic expression in gold geometric ornaments embody harmony and beauty, tailored to contemporary aesthetics. Integrating sacred figures into clothing and home goods allows designers to offer unique, personalized products while embracing sustainability trends.*

Keywords: *Textile, Fashion, Mathematical integration, Symbolic design, Innovation, Pattern diversity*

1. INTRODUCTION

Sacred geometry offers a wealth of inspiration for fashion designers, allowing them to imbue garments with deeper meaning and aesthetic appeal. By incorporating sacred geometric patterns, shapes, and symbolism, designers can create visually stunning designs that resonate with spiritual and cultural meaning. This can be achieved through pattern design, silhouette and structural elements, embroidery and embellishments, accessories and jewelry, color symbolism, and cultural and spiritual references. By using sacred geometry in fashion design, designers can create garments that not only look beautiful but also carry deep messages and connections to the divine or the universe.

Liu [1] reviewed the advantages of quasi-regular patterns generated by the Hamiltonian for textile fabrics, highlighting their unique balanced symmetry. However, it acknowledges the limitations of a limited number of models. To address this, the paper introduces 110 functions derived from the Hamiltonian, improving the variety and quantity of models. These functions, implemented using Visual Basics, allow individual selection and modification of patterns and color conditions, effectively achieving the desired results.

Lu et al. [2] explored the benefits of incorporating fractal patterns into knitted fabric design, highlighting its unique and versatile characteristics. Fractal patterns offer complexity and irregularity, inspiring innovative designs. The study uses C++ programming to generate fractal models based on single pictures and time-avoidance algorithms. These patterns are then processed using computerized knitting software and applied to jacquard fabrics. The results demonstrate the adaptability of fractal patterns in knitted fabric design, demonstrating their potential to create complex and visually engaging textiles. However, the paper acknowledges that current knitted fabric patterns are mostly traditional, highlighting the need for further research and the integration of fractal designs into the textile industry.

According to Rani et al. [3], mathematics in fashion design ensures precision, efficiency, cost-effectiveness, and creativity. On the other hand, fashion designers depend heavily on mathematical principles, which can be complex and error-prone without sufficient skills or resources.

Jalalimanesh et al. [4] point out that mathematical ratios and sequences bring precision and innovation to textile design, improving usability and feasibility, as indicated by positive feedback from experts. The complexity of implementing precise mathematical models, the limited application outside of Fibonacci sequences and traditional motifs, and the technical dependence on programming skills can present challenges for designers.

The fashion model design method proposed by Cui et al. [5] is symbol-based and offers adaptability for cross-cultural design, innovation in pattern creativity, and potential for systematic application in fashion design. There is a dependence on Pierce's semiotic methodology [6], focusing primarily on geometric models, and a need for further refinement and development to expand its applicability.

The review of the available literature shows that the textile and fashion industry faces challenges related to pattern diversity, innovation, and the integration of mathematical and symbolic design methods. Specifically, there is a need to address limitations in model diversity, complexity, and the integration of mathematical and symbolic design techniques.

The purpose of this research is to address various challenges and constraints in textile and fashion design, including pattern diversity, innovation, and the integration of mathematical and symbolic design methods. There is a need to improve model diversity, complexity, and adaptability for cross-cultural design while advancing the integration of mathematical principles and symbol-based design methodologies. This will promote creativity, precision, efficiency, and cost-effectiveness in textile and fashion design processes.

2. MATERIAL AND METHODS

Six algorithms have been developed that realize sacred geometry figures. These algorithms are presented in Appendix A. Some of the algorithms use the “circles” function available in the Matlab help page.

Figure 1 shows the results of the implementation of the proposed algorithms.

The “Egg of Life” algorithm draws two types of circles in different colors. The first circle is centered at coordinates (200, 200) with a radius of 60 and is colored red, while the second set of circles is offset relative to the first and is colored green. Positioning angles for circles are calculated in radians.

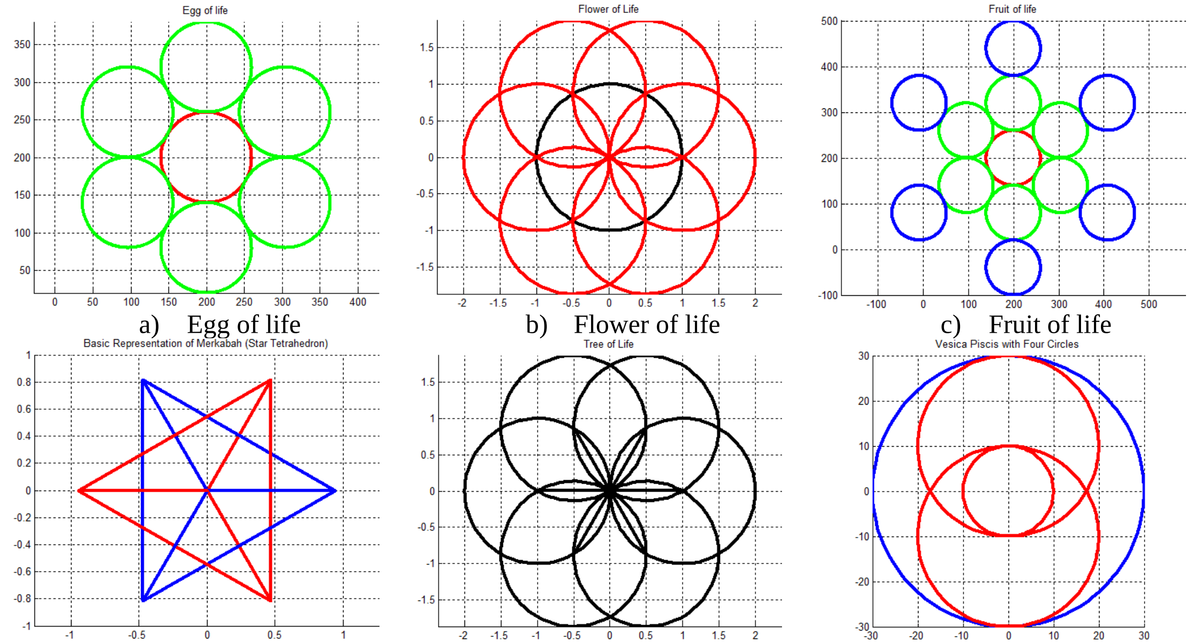
The algorithm "Flower of Life" draws a central circle and surrounds it with additional circles based on sacred geometry. It defines parameters such as the radius of the circles and their number. It then creates a shape, draws the center circle, and goes through drawing additional circles based on certain angles.

The “Fruit of Life” algorithm draws circles arranged in a specific geometric pattern. First, define parameters for the center circle and surrounding circles. It then draws three sets of circles with different radii and colors.

The "Merkaba" algorithm generates a basic representation of the Merkabah, also known as the star tetrahedron, by defining the vertices and edges of two tetrahedra. The first tetrahedron is shown in blue, and the second in red. The graphics are three-dimensional. The Merkaba is a sacred geometric shape believed to have spiritual significance in various mystical traditions.

The Tree of Life algorithm draws circles and lines connecting in a certain pattern. Parameters such as the radius of the circles, the number of circles, and the number of lines are defined. The circles are located at right angles around a central point, and lines are drawn to connect them.

The algorithm "Vesica Piscis" generates an image with four circles by drawing them in different sizes and positions. The preceding shapes are calculated, parameters such as radii for the circles are defined, and a shape is created. A large circle is then drawn in blue and smaller circles in red, with the two positioned above and below the larger circle.



a) Egg of life b) Flower of life c) Fruit of life
d) Merkaba e) Tree of life f) Vesica Piscis

Fig. 1. *Figures generated by the proposed algorithms*

A color range borrowed from the latest color trends for the years 2023–24 has been used to shape the designs. The color of the year 2024 can be described as gentle, warm, and cozy (PANTONE 13-1023 Peach Fuzz). This can be reflected in warm shades as well as pastel soft tones. These colors create a sense of calm and comfort, which can be important for the harmony and well-being of people in 2024.

3. RESULTS

Golden geometry ornaments are extremely suitable for use in textile design due to their elegance and sophistication. These ornaments are characterized by their precise and symmetrical shapes that complement each other in harmony and balance.

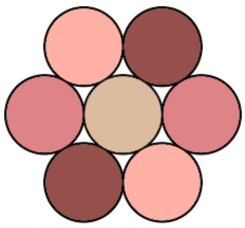
In textile design, golden geometry ornaments can be used for fabric decoration, embroidery design, stamps, and prints. They can also be incorporated into various types of textile accessories, such as cushions, curtains, tablecloths, etc.

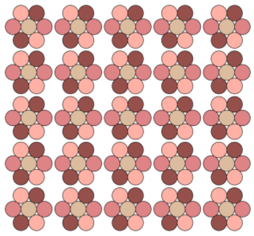
Golden geometry is based on the principles of the golden ratio and Fibonacci numbers, which are considered the basis of harmony and beauty in nature. These mathematical proportions are used to create a variety of geometric ornaments that give a unique and sophisticated look to the textile design.

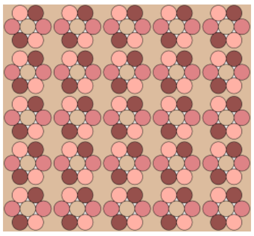
In the present work, various patterns are formed using ornaments obtained on the basis of golden geometry in combination with colors relevant for the last few seasons. Various clothes, accessories, and household goods are customized on their basis, which shows the many possibilities for creativity in line with the current sustainability trends.

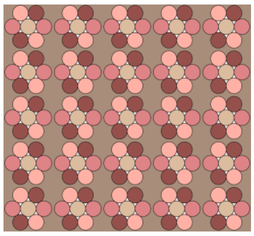
The sacral figures that were generated with the proposed algorithms were used.

Figure 2 features a variety of designs and accessories, including bags, throw pillows, and curtains. These designs include patterns derived from four colors and are adaptable to be placed on a white or colored background. Specific items listed include women's handbags, including a sack and large handbag, as well as women's shoes, decorative pillows, paper bags, and curtains.


Ornament 1 obtained from 4 colors


Pattern in white background


Pattern in colored background


Pattern in colored background


Handbag


Sack


A paper bag


Decorative pillow


A voluminous handbag


Women's shoes


Decorative pillow

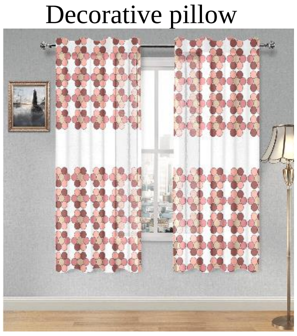

Curtains

Fig. 2. *Ornamental designs and accessories*

Figure 3 shows objects that consist of a colored ornament obtained from three colors, which can be positioned on a white or colored background. These decorative designs are complemented by a variety of women's clothing, including handbags, sneakers, t-shirts, dresses, tunics and sleeveless dresses. The collection also includes household items such as wall and wrist clocks.

***Fig. 3**. Objects of floral ornament obtained from three colors*

4. DISCUSSION

From the analyses made and the results obtained, it can be summarized that increasing the variety of models should include the development and application of methods, such as the introduction of additional functions derived from mathematical principles such as Hamiltonian [2] or fractal models [1], to improve the variety and quantity of designs.

There is a need to improve pattern complexity and innovation by exploring and integrating fractal patterns into fabric design processes using programming languages such as C++, Matlab, etc. to generate complex and visually engaging designs.

The integration of mathematical principles consists of improving the mathematical skills and resources of designers to overcome the complexities and errors associated with mathematical design methods [4, 6].

Extending symbol-based design approaches by further developing and refining symbol-based design methodologies to promote adaptability for cross-cultural design while addressing limitations in methodology dependency and the scope of designs being developed.

The integration of mathematical principles and sacred symbols in textile and fashion design holds promise for stimulating innovation, improving product diversity, and increasing market competitiveness [8].

It can be summarized that a comprehensive approach involving research, education, and technological advancement is needed to address these challenges and drive innovation in textile and fashion design.

5. CONCLUSION

The development of algorithms for realizing sacred geometry figures offers a new approach to creating complex and aesthetically pleasing designs. Applying these algorithms produces visually stunning results.

Each algorithm, from the Egg of Life to the Vesica Piscis, offers a unique method for generating sacred geometric shapes ranging from simple arrangements of circles to complex three-dimensional images. These shapes have spiritual significance in various traditions and add depth and meaning to the design.

The use of gold geometric ornaments in textile design represents a fusion of mathematical precision and artistic expression. By incorporating the principles of the golden ratio and Fibonacci numbers, these designs embody harmony and beauty, resonating with the elegance and sophistication sought in contemporary textile aesthetics. The adaptability of these designs to a variety of textile applications, including fabric decoration, embroidery, stamps, and prints, highlights their versatility and potential for creative expression. By integrating these sacred figures into clothing, accessories, and home goods, designers can tap into current sustainability trends while offering consumers unique and personalized products.

APPENDIX A

Listings of algorithms used in this study

```
clc, clear all, close all
fi1=30:360/6:380
a=200; b=200
r=60
circles(a,b,r,'facecolor','none','edgecolor','r','linewidth',3)
t=pi/180
x1=a+2*r*cos(fi1*t)
y1=b+2*r*sin(fi1*t)
circles(x1,y1,r,'facecolor','none','edgecolor','g','linewidth',3)
title('Egg of life');
grid on
axis equal
```

```
clc, clear all, close all
% Define parameters
radius = 1;        % Radius of the circles
numCircles = 6;    % Number of circles in the Flower of Life
% Create a figure
figure;
hold on;
axis equal;
% Draw the central circle
theta = linspace(0, 2*pi, 100);
xc = radius * cos(theta);
yc = radius * sin(theta);
plot(xc, yc, 'k','linewidth',3);
% Draw additional circles based on sacred geometry
for i = 1:numCircles
   angle = (i-1) * 60; % Angle between circles
   x = radius * cosd(angle);
   y = radius * sind(angle);
   xc = x + radius * cos(theta);
   yc = y + radius * sin(theta);
   plot(xc, yc, 'r','linewidth',3);
end
grid on
```

<table>
<tr><td></td><td><pre>% Display the result
title('Flower of Life');
hold off;</pre></td></tr>
<tr><td><pre>clc, clear all, close all
fi1=30:360/6:380
a=200; b=200
r=60
circles(a,b,r,'facecolor','none','edgecolor','r','linewidth',3)
t=pi/180
x1=a+2*r*cos(fi1*t)
y1=b+2*r*sin(fi1*t)
circles(x1,y1,r,'facecolor','none','edgecolor','g','linewidth',3)
x2=a+4*r*cos(fi1*t)
y2=b+4*r*sin(fi1*t)
circles(x2,y2,r,'facecolor','none','edgecolor','b','linewidth',3)
title('Fruit of life');
grid on
axis equal</pre></td><td><pre>clc, clear all, close all
% MATLAB Code to plot a basic representation of Merkabah
(Star Tetrahedron)
% Define the vertices of the tetrahedrons
vertices_up = [
   sqrt(8/9), 0, -1/3;
   -sqrt(2/9), sqrt(2/3), -1/3;
   -sqrt(2/9), -sqrt(2/3), -1/3;
   0, 0, 1
];
vertices_down = -vertices_up;
% Define the edges of the tetrahedrons
edges = [
   1 2;
   2 3;
   3 1;
   1 4;
   2 4;
   3 4;
];
% Plot the first tetrahedron
figure;
hold on;
for i = 1:size(edges, 1)
plot3(vertices_up(edges(i,:), 1), vertices_up(edges(i,:), 2),
vertices_up(edges(i,:), 3), 'b','linewidth',3);
end
% Plot the second tetrahedron
for i = 1:size(edges, 1) plot3(vertices_down(edges(i,:), 1),
vertices_down(edges(i,:), 2), vertices_down(edges(i,:), 3),
'r','linewidth',3);
end
axis equal;
grid on;
xlabel('X');
ylabel('Y');
zlabel('Z');
title('Basic Representation of Merkabah (Star Tetrahedron)');
hold off;</pre></td></tr>
<tr><td><pre>clc, clear all, close all
% Define parameters
radius = 1;   % Radius of the circles
numCircles = 7;   % Number of circles
numLines = 6;   % Number of lines
% Create a figure
figure;
hold on;
axis equal;
% Draw circles
for i = 1:numCircles
   angle = (i-1) * 60; % Angle between circles
   x = radius * cosd(angle);
   y = radius * sind(angle);
   theta = linspace(0, 2*pi, 100);
   xc = x + radius * cos(theta);
   yc = y + radius * sin(theta);
   plot(xc, yc, 'k','linewidth',3);
end
% Draw lines connecting circles
for i = 1:numLines
   angle = (i-1) * 60; % Angle between lines
   x1 = radius * cosd(angle);
   y1 = radius * sind(angle);</pre></td><td><pre>clc, clear all, close all
% Clear previous figure
clf;
% Define parameters
r = 10;
radius_big = 3 * r;
radius_small = r;
radius_small_2 = 2 * r;
% Create figure
hold on;
% Draw big circle
theta_big = linspace(0, 2*pi, 100);
x_big = radius_big * cos(theta_big);
y_big = radius_big * sin(theta_big);
plot(x_big, y_big, 'b','linewidth',3);
% Draw smallest circle
theta_small = linspace(0, 2*pi, 100); % Full circle
x_small = radius_small * cos(theta_small);
y_small = radius_small * sin(theta_small);
plot(x_small, y_small, 'r','linewidth',3);
% Calculate centers of the other two circles
center_top = [0, radius_small];
center_bottom = [0, -radius_small];
% Draw the other two circles</pre></td></tr>
</table>

```
    x2 = radius * cosd(angle+180);
    y2 = radius * sind(angle+180);
    line([x1 x2], [y1 y2], 'Color', 'k','linewidth',3);
end
% Display the result
title('Tree of Life');
grid on
hold off;
```

```
theta_other = linspace(0, 2*pi, 100);
x_top = center_top(1) + radius_small_2 * cos(theta_other);
y_top = center_top(2) + radius_small_2 * sin(theta_other);
plot(x_top, y_top, 'r','linewidth',3);
x_bottom = center_bottom(1) + radius_small_2 * cos(theta_other);
y_bottom = center_bottom(2) + radius_small_2 * sin(theta_other);
plot(x_bottom, y_bottom, 'r','linewidth',3);
% Set axis limits
axis equal;
xlim([-radius_big, radius_big]);
ylim([-radius_big, radius_big]);
title('Vesica Piscis with Four Circles');
% Show grid
grid on;
hold off;
```

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