Towards an Advanced Scientific Methodology for Designing Museum Exhibition Halls from the Perspective of Digital Technology Thinking

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Abstract:

The paper addresses the problem of architects in the absence of a clear understanding of the necessity of moving towards the use of digital technologies and relying on advanced software that relies on mathematics in designing and implementation and what it can offer of innovative solutions in general and in the exhibition halls in particular. The shortcomings of the current studies are discussed in a clear way to address an important aspect of architectural thought, which is the change in design methods as a result of the use of digital tools and the absence of a design methodology that includes the use of these digital tools.

Keywords: Digital architecture - algorithms - parametric architecture - digital fabrication

1. INTRODUCTION

Digital technology has changed the method used in design and with the growth of its influence in architecture it has become necessary to review the theories and methods of current architectural design and address the lack of clarity in the theoretical basis for architectural design using digital techniques.

1.1 The Main Objective Of The Research:

Finding a design methodology that aims to convert the components of the local Egyptian architecture, such as the ancient Egyptian civilization, analyzing it by mathematics and reusing it in design with a digital image by finding a design alternative to the exhibition halls that uses digital design in all its stages, starting from Digital Generation stage through Digital Representation to Digital Manufacturing and in the same time is proportional to the Egyptian environment. This achieves the user's functional and psychological performance.

2. DESIGN GENRATION

2.1 Forms In Digital Architecture

Digital forms can be considered those forms that depend on the use of digital language and computer as a basis for their design, followed by the spread of these forms in various engineering and technical fields, so they express the renewed experiences and theories of sculpture, architecture and industrial forms. (1)

3. DESIG COMPUTATION

3.1.The Digital Revolution And Software:

The digital revolution has created software for forecasting based on mathematical and statistical induction that facilitates even non-specialists to deal with directly, as it provides the specialist simulation software that enables him to represent reality and to choose the validity and accuracy of his perception of it. (2)
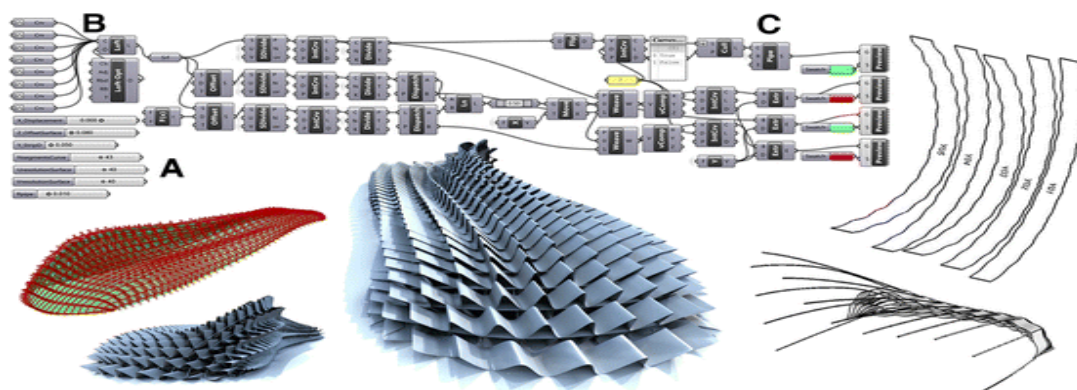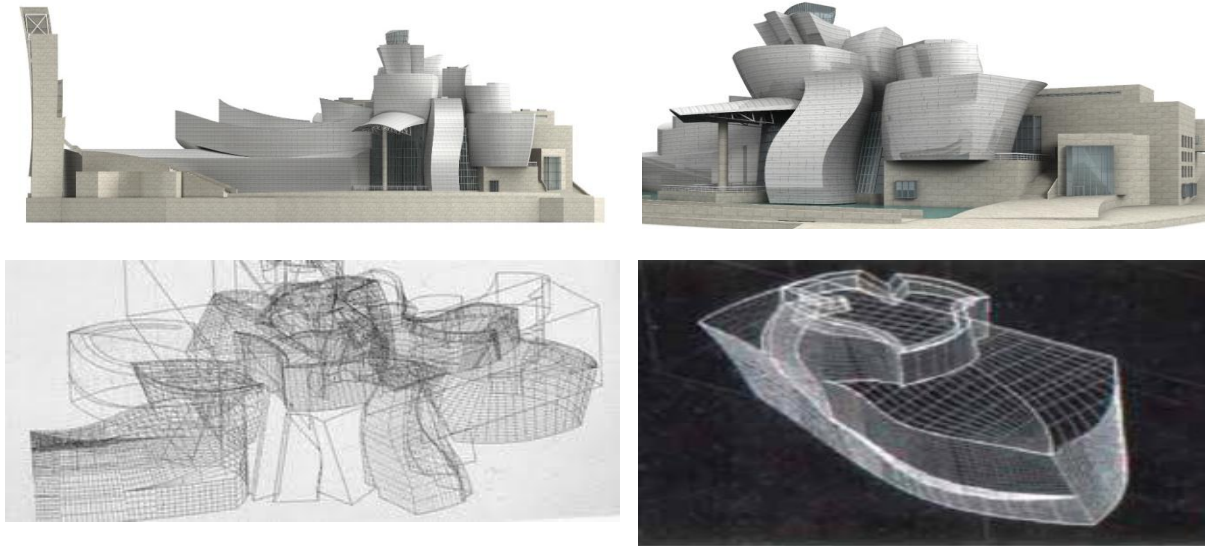


Fig .1. The form in digital architecture source (1)

**Fig .2.** Digital Representation Shows Guggenheim Museum source (2)

4. PARAMETRIC ARCHITECTURES

This trend is based on using the computer to create the shape using several equations with numerical variables so that the formation changes as the values change, and the term Parameter is a programmatic space that contains one or more mathematical algorithms and operations, and is based on engineering foundations and concepts with mathematical logic inspired by nature . (3)
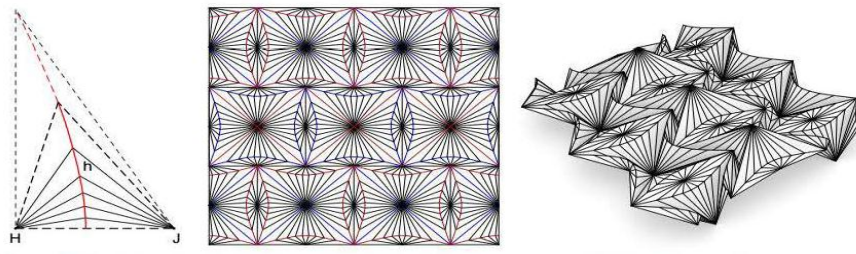
Fig.3. Sample of Parametric shapes (4)
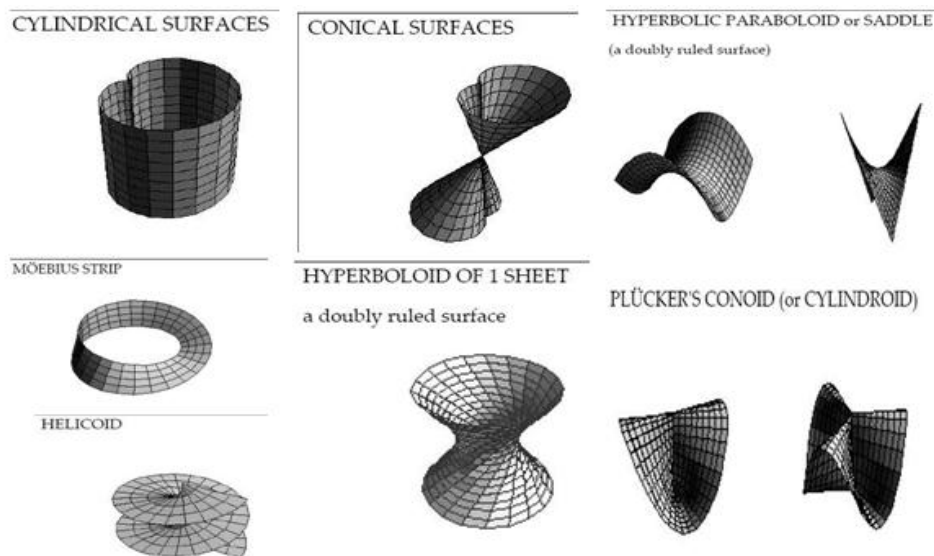
Fig.4. Sample of Parametric shapes (5)

4.1. Algorithms in architecture:

There is a close relationship between architecture and mathematics where it plays a role in finding unconventional architectural formations. Algorithm is one of the applications of mathematics that is used in architecture. In producing design alternatives to a specific design. (6)

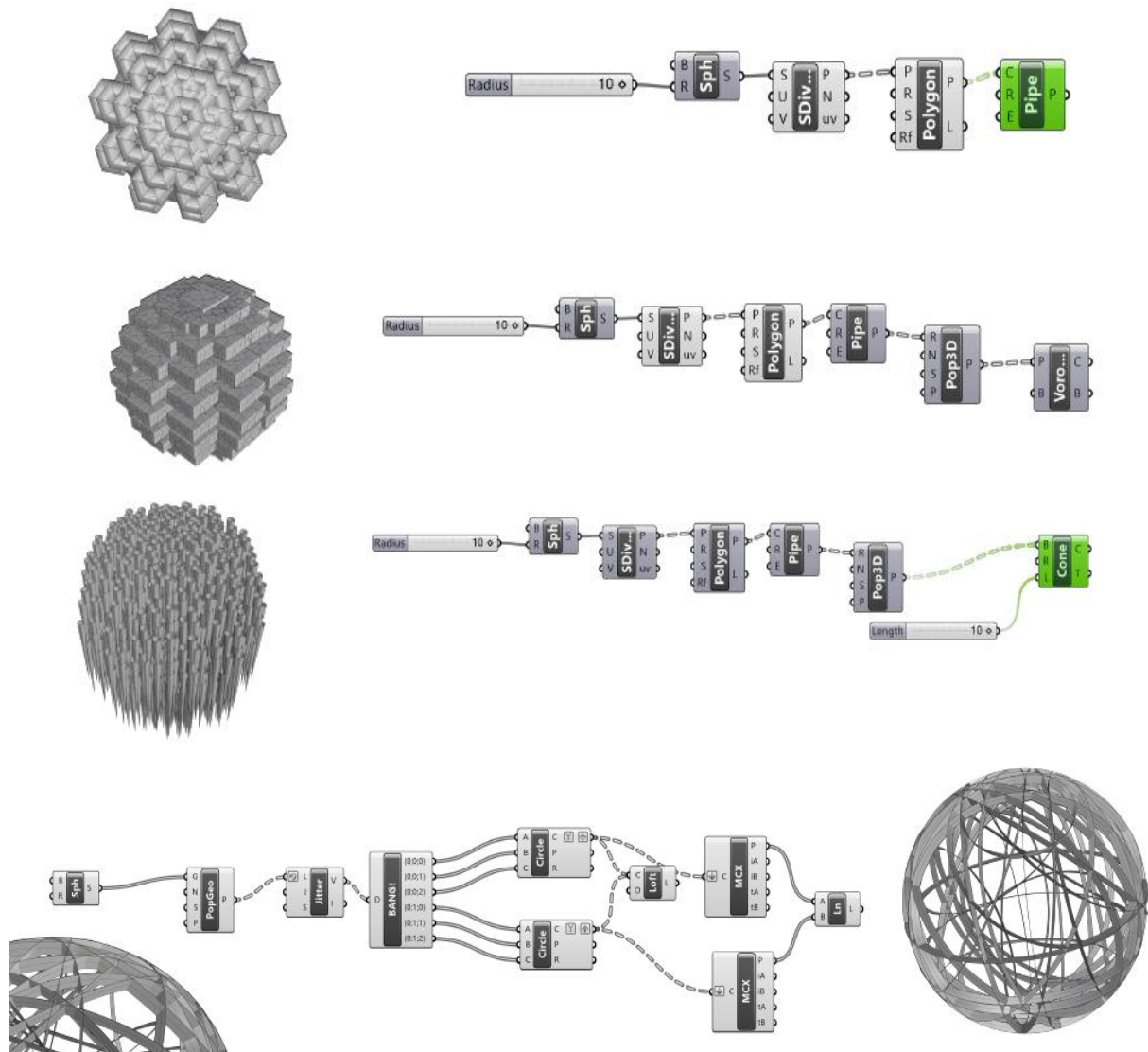## 4.2 Digital representation of algorithms using Grasshopper:

Fig.5. Representation of algorithms using Grasshopper (7)

5. DIGITAL FABRICTION

Manufacturing method is a new factor added by digital design, where the output varies according to the machine used and the material chosen, which affects the shape of the design in the latter. (8)

5.1 Robots and Architecture:

The idea of a robot is simply a direct (robotic) printing process. AutoCAD diagrams can be easily printed on the construction site directly on a scale of 1: 1 so that construction can be done directly without referring to the diagrams on the site. (9)
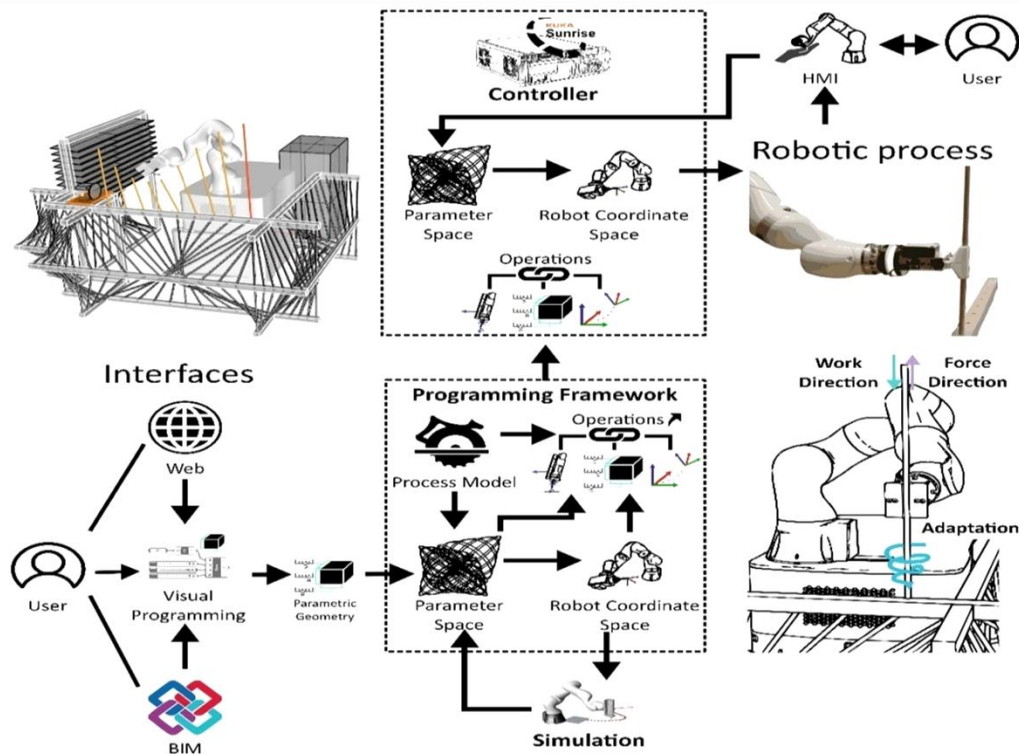
Fig.6. Robotics system source (9)

6. DIGITAL SHOWS

6.1 The Virtual Reality

The virtual reality means to create similar and true environments or may be fictional completely by computer , these environments can be integrated in them physically and they aim to create and design highly and efficient human environments also aims to control the life style to compose or recompose to satisfy person's psychological and sensual desires. (10)

6.1.1 The most important application – The cave room :

This technology aims to make the user entirely indulgences within the virtual environment. The cave is consisted of a system composed of a cube-shaped room   (3 * 3 * 3) meter, the aspects of this cube are side-view screens, also the ground of the cube is working as bottom display screen, the participant in such case locates inside the cube and the movement of the participant in this case is representing the interaction with the Virtual Reality (VR) . (10)
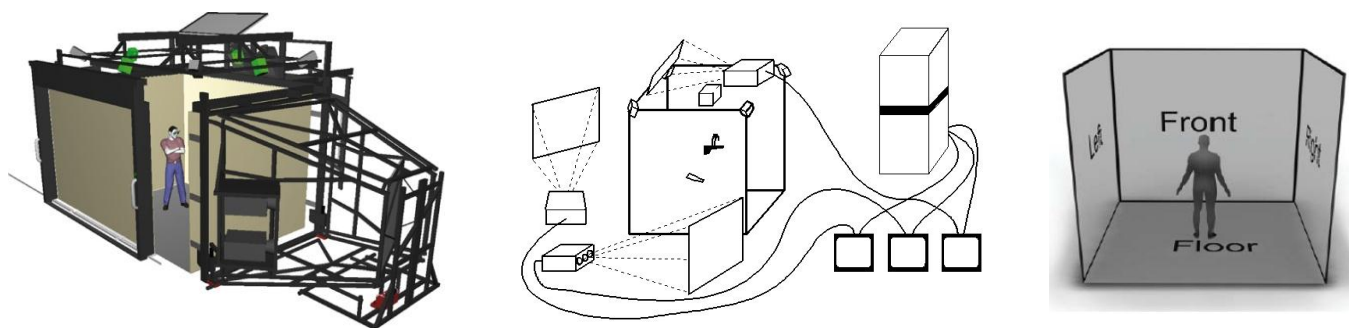

Fig.7. Idea of the cave room source (11)

7. INTEGRATION BETWEEN ANCIENT EGYPTIAN CULTURE AND DIGITAL TECHNOLOGY

The integration and compatibility with vocabulary of Digital Programs , Which Generate new forms of global language with the vocabulary and ideas . using patterns and algorithmic methods To reuse the vocabulary of ancient Egyptian architecture to find a design alternative . (12)
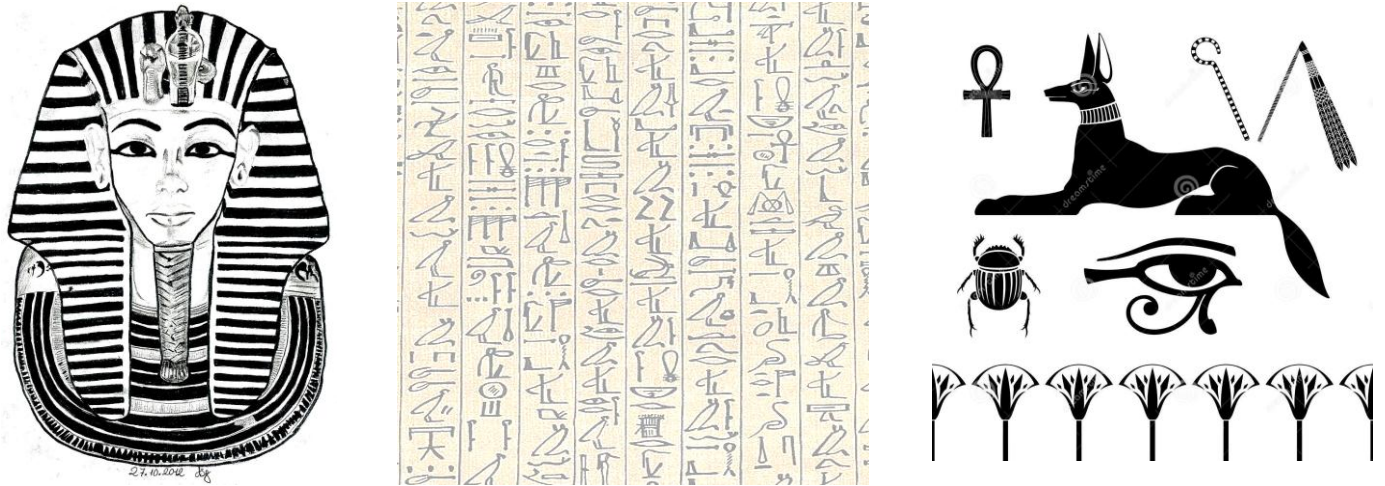
Fig.8. Symbols of ancient Egyptian civilization source (13)

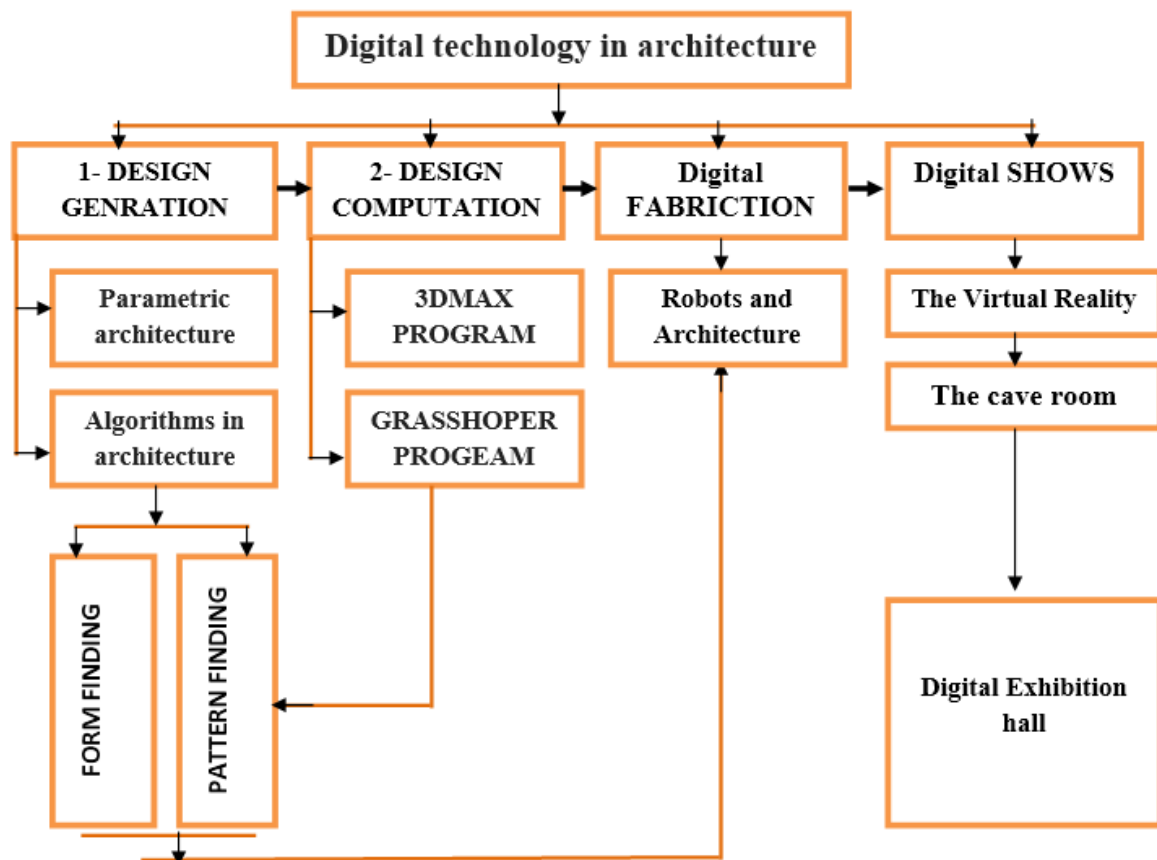## 8. METHODOLOGY FOR DESIGNING MUSEUM EXHIBITION HALLS FROM THE PERSPECTIVE OF DIGITAL TECHNOLOGY:

**Fig.9.** Methodology for designing from the perspective of digital technology source: researchers

9. EXPERIMENTAL METHODOLOGY

1- Alternative is based on applying the idea of digital architecture to the Egyptian environment and creating a design model for the digital exhibition halls.

2- Return to vocabulary, forms and Sentence visual message in the minds of society . 3- using (3D max & Rhino & Grasshopper software) to create a form and pattern .
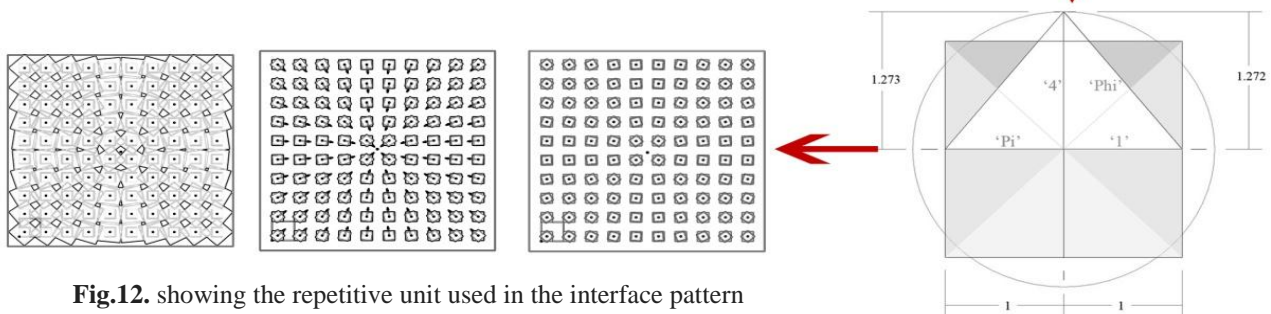
9.1 Case study digital museum in Egypt:

Design Idea: Using components from ancient Egyptian architecture by studying an analysis of the pyramids and concluding the golden proportions in design.
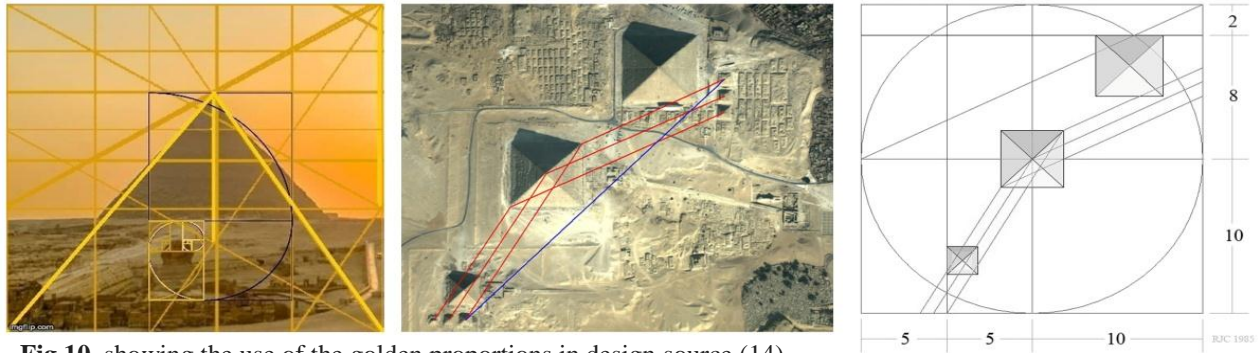
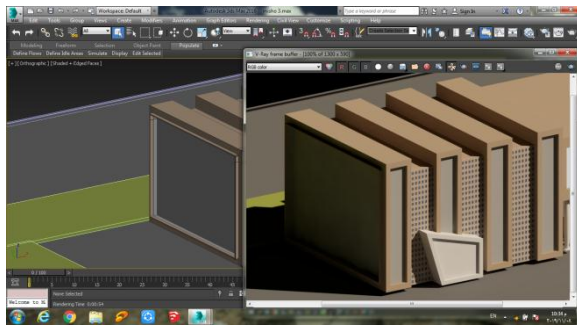**Fig.10.** showing the use of the golden proportions in design source (14)
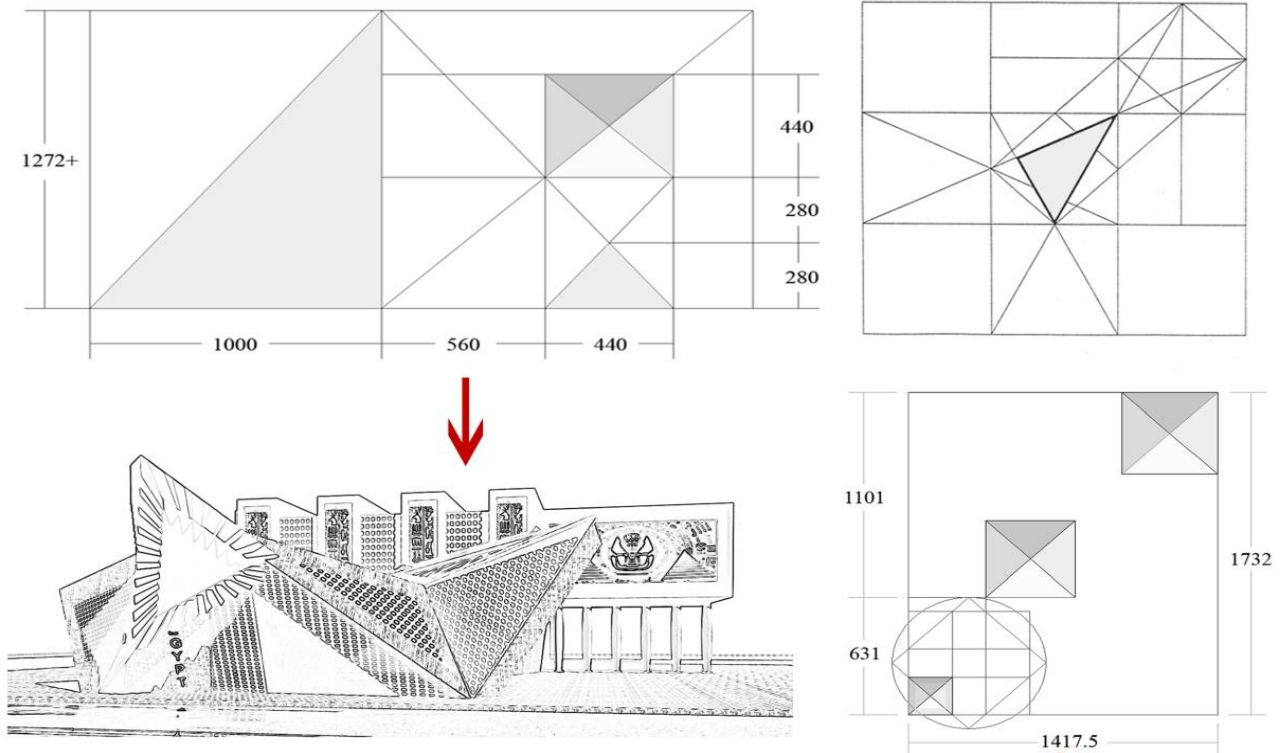
Fig.11. showing the shape of the proposed model source: researchers
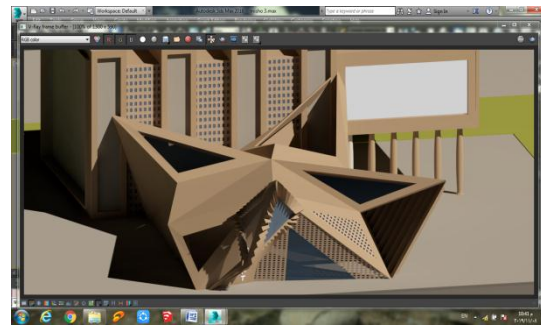

Fig.12. showing the repetitive unit used in the interface pattern
source: researchers

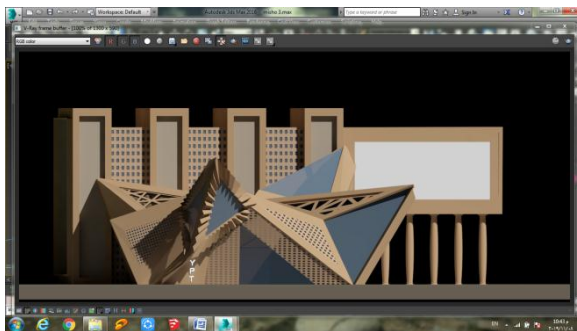**Steps to design model using 3dsmax :**

Table .1. Showing 3d max was used to draw the model source researchers
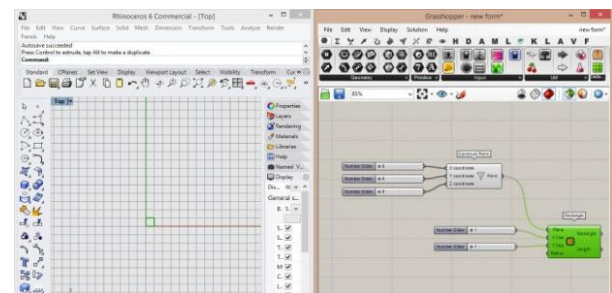

Step 1

Step 2

Step 3

Step 4

Steps for pattern making using grasshopper
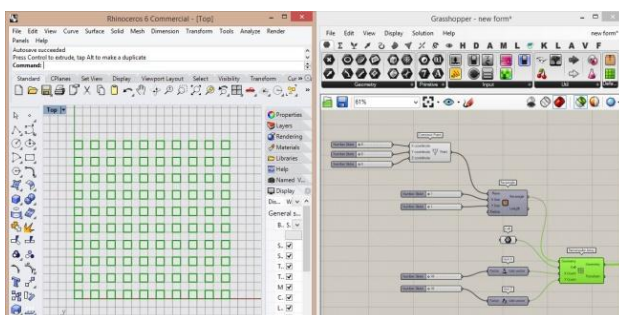
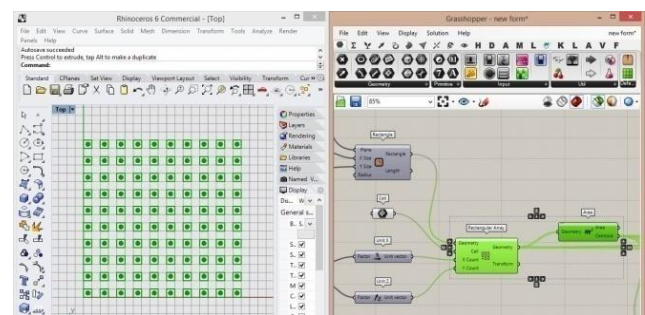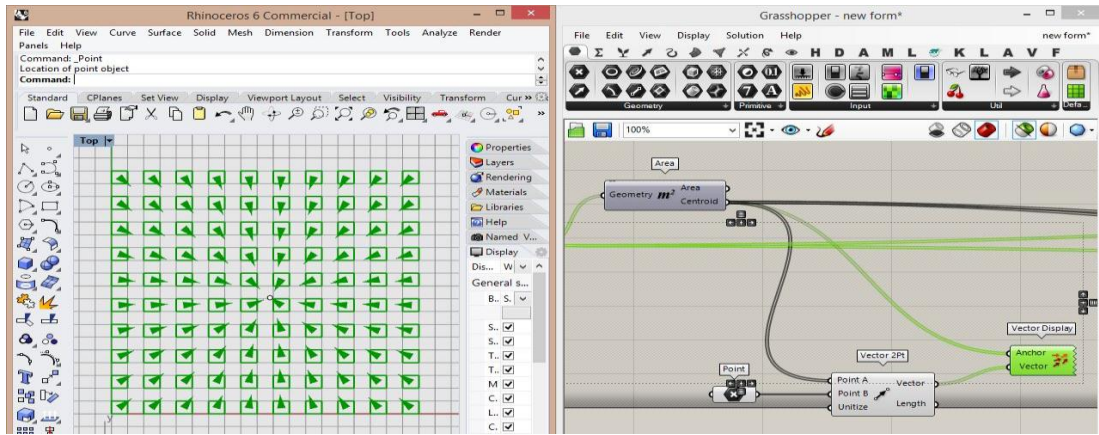**Table 2.** Showing grasshopper was used to draw the pattern source researchers

Step 1

Step 2
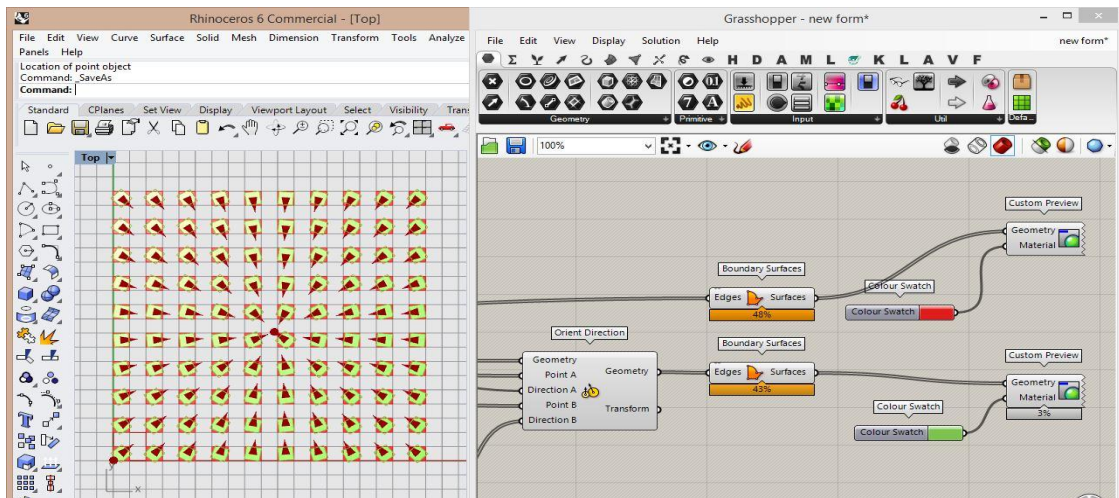

Step 3

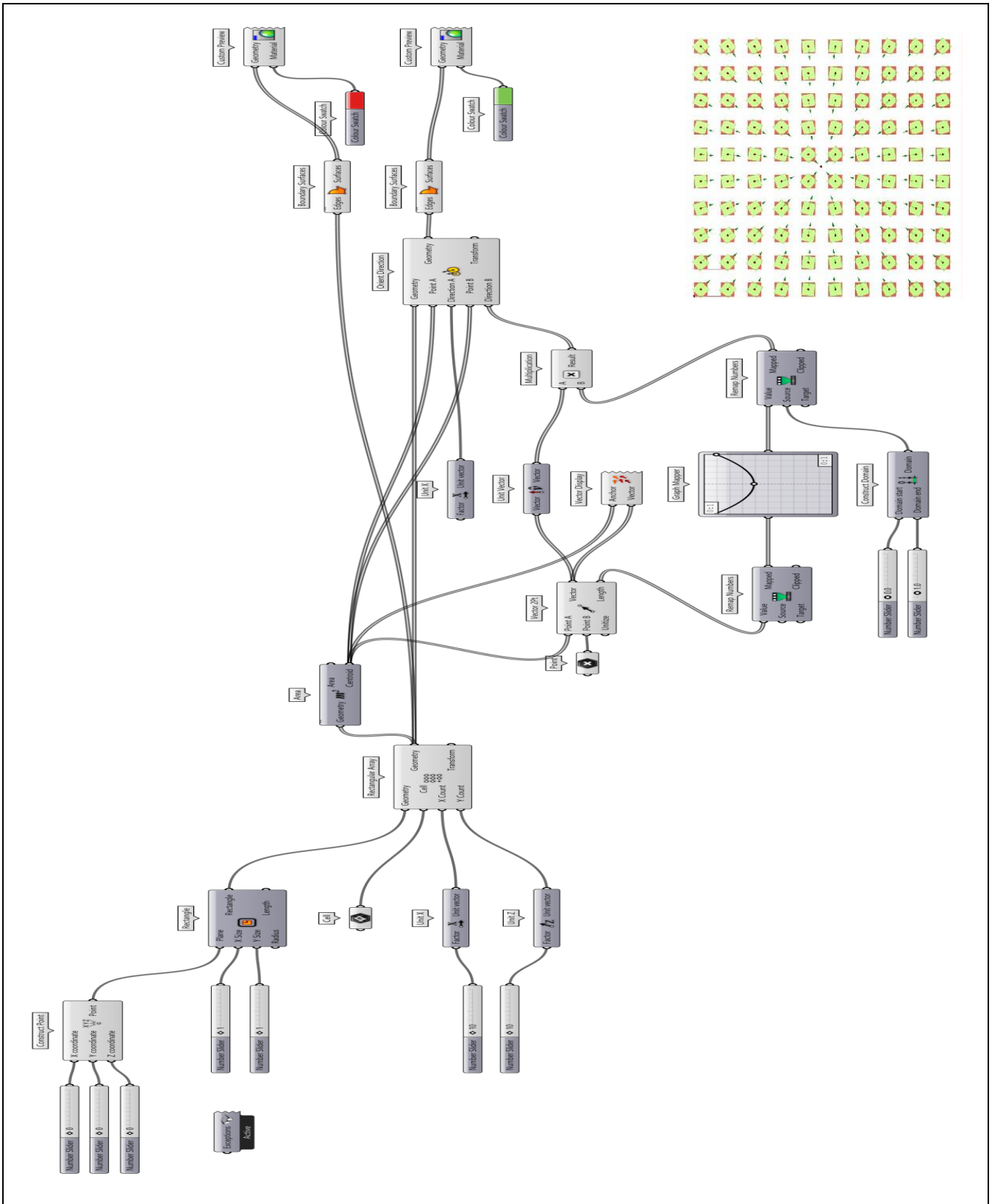**Step 4**

Step 5
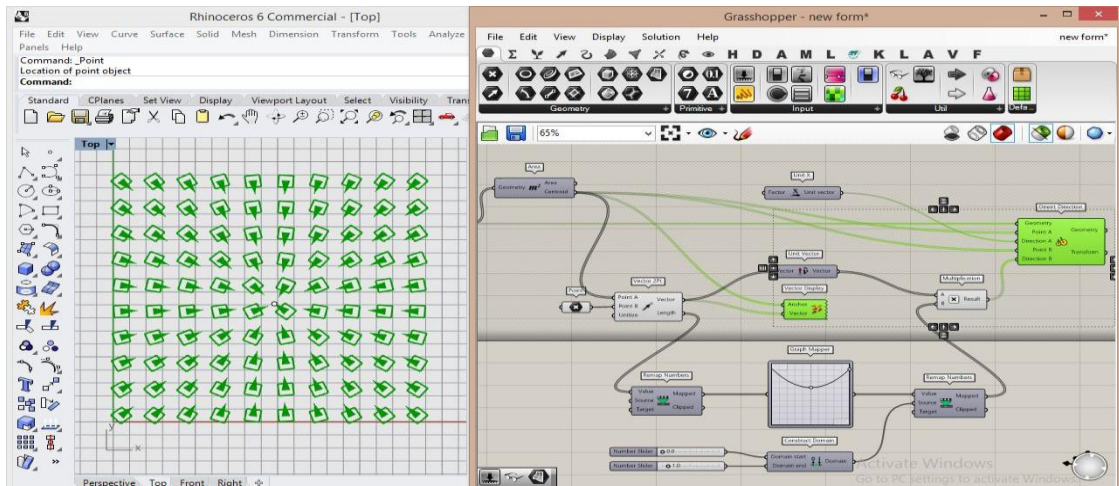
Step 6
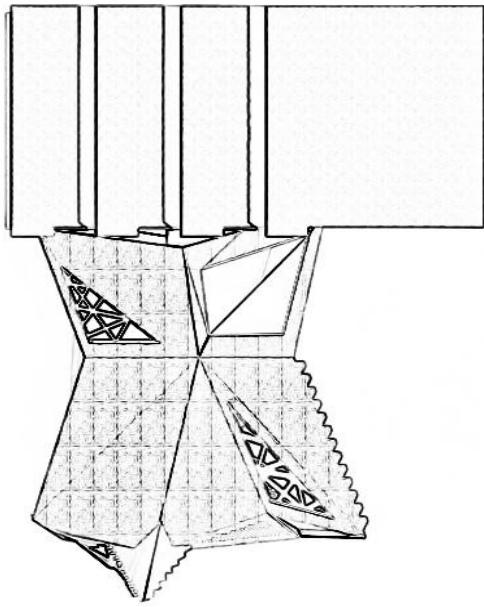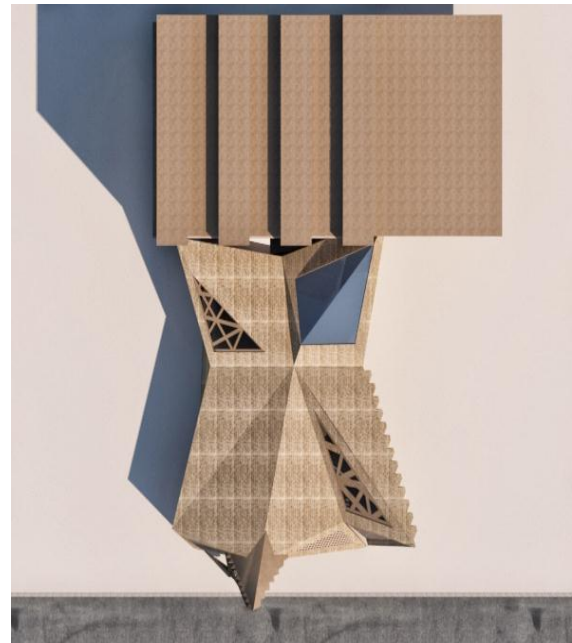

Step 7

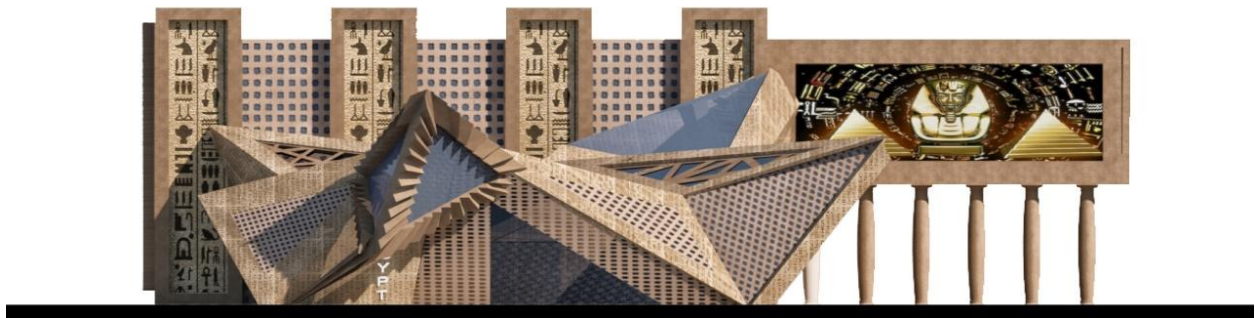**Fig .13.** The final Definition for the pattern using grasshopper source researchers

Final model :

Plan

Layout

Main Elevation

3d shots

Fig .14. showing final model and pattern source researchers

10. CONCLUSION & RESULT

The architect should not be separated from keeping up with the new developments and changes of the times in the use of advanced technology in architectural design, especially digital technology and what it can offer design solutions such as the use of Parametric and algorithm to find sentences with a local identity and to recognize the impact of the Design computation on architectural forms and help in finding non-traditional forms, which led to increased creativity and recognition of the importance of digital manufacturing such as the use of robots and what they can offer solutions for implementation and the identification of the concept of digital display and the use of virtual reality techniques and access to a design methodology For digital exhibition halls.

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