

## Using digital modeling to simulate heritage furniture and manufacturing it digitally

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### Summary:

With the passing of time, the problems of preserving the archaeological heritage are increasing, so scientists have begun to search for new, unconventional methods of simulation, reproduction, and preservation of it, and furniture is one of the most important examples included in cultural heritage.

In recent years, interest in digital manufacturing has increased, which depends mainly on the presence of computers, and many digital mechanisms have been deployed that serve design in general and interior design in particular, and from here the idea of the research emerged that discusses the possibility of adopting design models that simulate heritage furniture through a computer. It is digitally produced and re-manufactured again. The research was conducted in three stages as follows:

First theoretical study in which an extensive theoretical study was conducted for scientific research and messages in the period from 2009 to 2019 within the constituent environments of the research elements, then a theoretical study of digital modeling was conducted as one of the axes of the research topic, then how to simulate the work of existing furniture, and also discuss simulation methods and choose the optimal method among them, and finally discussing digital manufacturing and knowing the digital technologies used in manufacturing, so we finally get a set of mechanisms and tools that can be used in preparing a standard model for use in analytical study.

Second: An analytical study in which a number of samples were selected for pieces of historical furniture in which the method of digital modeling was applied to them taking into account the diversity of those samples in terms of the historical period between the ancient and classic Egyptian, and also in terms of function, then researching the possibility of digital manufacturing of those samples that have been created as its model.

Third: The applied study and the results in which the researcher presents the most important results related to the effect of using digital modeling on simulating classic furniture and digitally recycling it.

### Key words:

Simulation - Modeling - Historic Furniture - Digital Manufacturing - 3D Printing.

### The research problem:

The scarcity of accurate digital copies of historical furniture that contain all the details and data related to it, and therefore the inability to use digital manufacturing methods to produce furniture with a historical nature, therefore, the research attempts to respond to the following inquiries:

1- How can digital modeling be used to simulate classic furniture?

2- To what extent is it possible to produce digital models that simulate the historical pieces of furniture to preserve them in full, and to display them in an appropriate manner that matches their value?

3- Is it possible to produce models that simulate traditional furniture using computer programs only, or is it necessary to make a digital scan of the furniture pieces that you want to model first?

### **The research importance:**

1- By generalizing the research experience, we can create a database of accurate numerical models containing all the data and details of the heritage furniture, which enables us to digitally reproduce it.

2- Demonstrate the importance of using digital modeling in simulating traditional furniture using digital 3D scanning with computer design programs.

### **The research aims:**

1- Adopting digital models that mimic the historical pieces of furniture to keep them complete, and displaying them in an appropriate manner that matches their value.

2- Study the possibility of recycling historical furniture using digital technologies through three-dimensional models that include all the details and their data.

### **The research assumes:**

The use of digital modeling in traditional furniture simulation can make a tangible positive change in digital manufacturing processes.

### **Research Methodology:**

The descriptive analytical method was used to study the furniture that was already simulated, then the applied approach to applying simulation to one of the traditional furniture pieces

### **The research contents**

**Theoretical study:** modeling - simulation - digital manufacturing.

**Analytical study:** Some seats (Louis 14- Louis 15 - Queen Hattep Horus).

**The applied study:** a simulation of the throne of Tutankhamun.

### **First; the theoretical study:**

#### **1- Modeling concept**

The process of discovering and coding features, skills, practices, and capabilities and building the ability to repeat, transfer or display them.

#### **The difference between modeling and reproduction:**

There is a clear difference between traditional modeling and cloning, as both can transfer attributes and possibilities, and the difference lies in the quality of the attributes, possibilities, or skills transferred. The traditional reproduction is the result of human skill or machinery that comes from theory and experience. Whereas in modeling skill and capabilities come from the ability to decode it may be unintelligible or emotional sometimes.

#### **Stages of digital modeling:**

1- 3D Scanners and Digitizers.

2- 3d modeling software.

3- Renderer.

## **2- The concept of simulation**

Simulation is the mimicking or simulation of a real system's work over a certain period of time. Whether we simulate manually or using a computer, it involves the generation of an artificial history of the system in order to infer the operational properties of the real system.

## **3- 3D laser digital scanner:**

It is considered the most accurate way to preserve and record the furniture heritage, as attempts to simulate the piece of furniture through computer programs only are considered inaccurate and subjected to human error as will be evident through an analytical and applied study.

## **The second axis: the analytical study**

In this section, three samples of experiments were carried out by designers then will be analyzed as an attempt to simulate and reproduce some pieces of traditional furniture through digital modeling.

### **Sampling objectives**



- 1- Helping to develop local design thought by re-introducing heritage furniture in a new way.
- 2- Increasing awareness among designers about the importance of digital design and its positive impact on heritage preservation.
- 3- Learn how to apply digital modeling intellect.
- 4- Learn how to link design technology with implementation technology in simulating heritage furniture.
- 5- Helping designers get valuable ideas and ideas in order to encourage reading and interest in this digital trend.

### **Criteria for selecting samples that can be subjected to analytical study**



- 1- That pieces of traditional furniture contain design ideas of an Egyptian or classical nature.
- 2- That historical and global models are known from each of the chosen ages.
- 3- To differentiate between the ancient Egyptian and French, with the aim of knowing that the methodology of digital modeling is the same in all of them.

### **The method of analysis used in the models under study**

- 1- Defining the model, its manufacture, and its location.
- 2- Knowing the description of the model, its dimensions, and the materials used in it.
- 3- Learn about the digital model and the role of the computer in obtaining it.
- 4- Knowing whether a design can be manufactured using digital manufacturing.
- 5- Knowing the advantages and disadvantages that exist in the final form.

<b>Louis XIV Paris chair</b>	
	
The chair after 3D modeling	the chair in real
<p><b>Model Description:</b> The chair was modeled using the 3Dmax program in an attempt to simulate the Louis XIV model, but the proportions of the basic chair were not meticulously meticulous, so the back was relatively high, and the designer did not transfer all the data and details of the legs during the simulation, which reduces the value of the model, which was the reason for the importance of having a three-dimensional digital scan of the piece before doing its model on the 3D design program</p>	<p><b>Furniture description:</b> armchair and a low base of natural gilded oak wood upholstered with fixed upholstery. The wood has been drilled in a smooth way for the back and hand restraints without upholstery. It has a tendency to palm rest that ends in scrolls.</p>

**Third, the applied study: simulating the chair of King Tutankhamun**

	
The chair after 3D modeling	the chair in real
<p><b>Recycling possibility:</b> It can be recycled through the use of 3D printing in the preparation of the first model, and the use of digital control machines in the manufacture of fine decorative details.</p>	<p>The gold-backed armrest is the best piece of furniture that can express its splendor and the luxury of Tutankhamun's furniture, due to its magnificence of the gold-covered parts .</p>

**Conclusion:**

We note through the application experience that it is possible to re-introduce the traditional furniture that already exists in digital form through the computer and digitally remanufacturing it, except that the researcher's reliance on scanning and photographic only and then modeling

through computer programs, showed the possibility of a human error in transportation and simulation.

### Results:

- 1- It is possible to take advantage of digital modeling to reintroduce historical furniture in a contemporary form using 3D scanners with computer programs in modeling and manufacturing processes.
- 2- Dependence in simulation on computer programs only without a digital laser scan showing the human error as it was shown in the analytical and applied study, and this is not true in heritage registration.
- 3- An accurate digital database can be created containing all data and details of heritage furniture, which enables us to research methods of digital recycling.
- 4- Heritage furniture can be recycled through 3D printing and CNC control machines.

### Recommendations:

- 1- Directing the competent authorities to work on using digital modeling techniques in simulating heritage furniture.
- 2- Providing computers and appropriate digital scanners to create an integrated project that provides a database that includes all the details of the ancient Egyptian pieces of furniture.
- 3- Non-reliance in simulation on computer programs only without a digital laser scan, in which the human factor error appears, and this is not true in heritage registration.

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