

Reviving and Preserving Cultural Heritage and Antiquities Using Three-dimensional Survey and Mixed Reality Technology

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Abstract:

Cultural heritage and antiques are of great importance and must be preserved and properly restored when damaged by the use of appropriate technology. Artifacts in Egypt are subjected to a lot of transport operations, which exposes them to damage as well as deterioration caused by environmental factors that are out of our control. For example, the statue of Ramses was severely damaged as a result of a number of transfers which could not be repaired or restored properly due to the lack of reference to its original form. Archaeological buildings are also constantly exposed to environmental factors and unexpected events such as the incident involving the Church of Notre Dame.

This research is proposing the creation of a complete archive of all the monuments and antiques in the form of three-dimensional graphic models to preserve the original state of these artifacts that can later be used as a reference. In the case of any damage, we can rely on these three-dimensional models to restore artifacts accurately. Furthermore, the 3D models of all the scanned artifacts can also be used to create 3D holograms that can be displayed in museums around the world. This minimizes or eliminates the need to transfer artifacts which can cause damage to these valuable pieces. The methods by which this can be achieved are to first use the technology of three-dimensional laser scanners to survey buildings and artifacts. Then, to save these units in the form of three-dimensional graphic models in archives that can be later used as a reference during the restoration process in case of any damage occurring to a piece or a historical building. The restoration process will also involve the use of three-dimensional printers to print the damaged parts and restore an artifact back to its original state. Additionally, the three-dimensional models will minimize the need to transfer artifacts, thus furthering their preservation, to be displayed in other locations because 3D models will allow us to create virtual exhibitions using Hologram models created by mixed reality technology, a technology that will allow users to experience and interact with the holograms as if they were a part of their physical world.

The traditional methods used to display and preserve our historical artifacts are ineffective and incompatible with the available technology as well as the great value of these monuments. Three-dimensional laser scanning technology and mixed reality technology will enable us to preserve their original state and display these thousand-year-old artifacts more interactively

which can result in a personalized display of data or information based on the viewer's selections or interactions. Moreover, the viewer can be fully immersed within the original environment of these artifacts for a more realistic experience.

Keywords

Mixed reality, Cultural heritage, Service design, Hologram

Objectives of this research paper:

The main objective of this research paper is to avoid the use of traditional methods used in preserving, restoring, or redisplaying monuments in museums. The use of ineffective, traditional methods is dangerous because it exposes valuable antiquities to unnecessary harm and damage caused by humans or during the transfer process from one place to another. The rest of the world has been investigating the use of newer, more efficient technologies, such as mixed reality and 3D scanning, to aid and improve the process of preserving, restoring, and displaying antiquities in a safer way that eliminates the risk of damage while avoiding the transfer process altogether. These technologies can allow any restoration to take place in the same place the antiquities are located and eliminates the need to move them for display in other museums (domestically or around the world) by creating holograms of the pieces using mixed reality technology instead. This further enhances their preservation and reduces the risk of damage.

The aim of this research:

The main purpose of this paper is to develop steps that enable us to preserve the ancient Egyptian artifacts and buildings through 3D scanning and revive them by displaying them in the forms of holograms in museums all over the world using mixed reality technology through the following steps:

1. Using three-dimensional surveys of the buildings and archaeological artifacts to create a complete archive that contains three-dimensional graphic models of all the antiques and archaeological buildings.
2. Using the three-dimensional models (that were created in the previous step) to restore archaeological artifacts via the use of three-dimensional programs to return them to their original state at the time of their construction.

3. The three-dimensional models can be beneficial in the following cases:

1. In the case of damage occurring to a piece of artifact, we can use the 3D models as a point of reference and apply the use of 3D printers to return the damaged artifact to its original state.
2. We can create external exhibitions (around the world) of the archaeological artifacts in the form of holograms using mixed reality technology without the need to transport these valuable pieces, which preserves them and keeps them from getting damaged, and it can be used as a great advertising tool for Egyptian tourism.

The importance of the research:

The importance of the study is apparent in the great need to preserve antiques and antiquities, which represent a national wealth and a basic source of income for the state, and to use appropriate technology to reach this goal. Additionally, it provides a creative solution to the

need to display these artifacts in the most possible places without the need to move them from one place to another in a way that harms them or exposes them to a number of dangers such as theft, human error, and others.

Methodology:

The methodology of this research study is based upon using the inductive approach to observe phenomena and gather data to conclude the general principles and holistic relationships.

The General scenario of the research:

The general goal on which the research is based is to find a method or a set of successive procedures to be relied upon in ensuring the preservation and restoration of archaeological objects and buildings or cultural heritage in general, whether the damage is a result of natural factors caused by environmental disasters, the factor of time, or the errors that occur as a result of the human factor represented in errors in transportation or cleaning and others.

The scenario is based on several stages or procedures, some of which are precautionary in all cases for all archaeological pieces and buildings, and others take place when damage occurs. These procedures begin first with a three-dimensional laser scanning process of all artifacts or archaeological buildings, as in Figure 1. There is a large number of 3D scanners that can be used, each is dedicated to a specific type of object based on its size, raw materials which it is made up of, and whether it is shiny or not. After selecting the appropriate 3D scanner that uses appropriate technology that doesn't affect the valuable pieces at hand, a three-dimensional scan of each artifact is performed that translates its physical shape into a 3D model on a computer. The accuracy of the 3D laser scanning ranges according to the technology used in the scan, the lighting surrounding the artifact, and the material of the artifact.

Then, those three-dimensional models are dealt with by specialists, 3D Artists, who can amend the defects that occurred in the scanning stage, as well as rebuild previously damaged parts and recolor it in the event of color damage due to the time factor to see how the artifact was when manufactured.

As for the third procedure, it is resorted of any damage occurring to the artifact/s previously scanned. The 3D models prove useful as a point of reference to find out how the damaged artifact/s looked precisely before the damage taking place, and then we can separate the damaged part into a separate graphic model and rebuild it through 3D printers. With the great development in 3D printers, we will be able to rebuild the damaged pieces with the required accuracy that is completely identical to the damaged part, with the same materials, and the same colors and without human factor intervention except in the process of installing the printed model again to the original artifact/s.

The fourth stage or procedure, here, is a preventive step to reduce the occurrence of accidents or to reduce the chances of damage to the antiques, which is one of the most important problems we face in Egypt that leads to damage to those pieces or parts of them and thus the need to restore them, which requires a certain type of treatment and leads to high costs.

In this step, we will convert the 3D models on computers to holograms that are displayed in museums around the world. Those holograms can be seen and dealt with either by using a medium such as mixed reality glasses, mobile phones, or direct projection devices without the presence of an intermediary in dark rooms and environmental conditions that can be controlled.

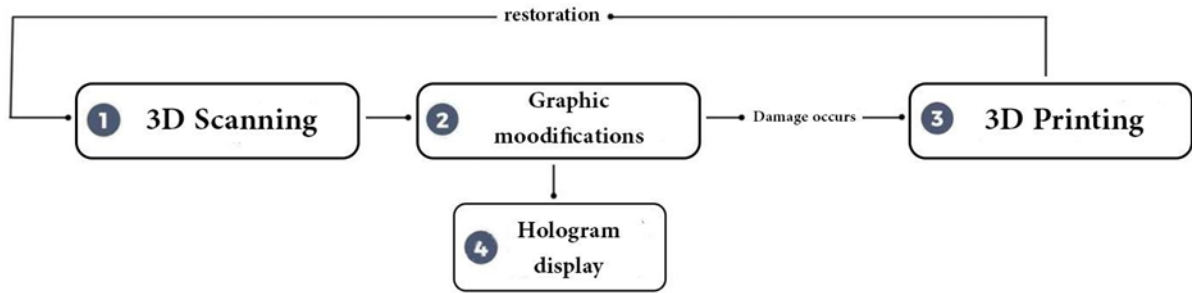


Figure (1) General scenario of research

Holograms will enable us, first, to preserve the artifacts by reducing the need to transport them and to instead use hologram technology to display the original pieces at an unlimited number of locations. Secondly, it will enable us to see those pieces in the context of the environment in which they were located when they were made, as we will be able to enhance the surrounding environment and not only the hologram itself, and also it will enable us to create interactive holograms where the audience will see it move and interact with it directly.

There is no doubt that these procedures (Figure 1) will enable us to preserve our heritage by carefully restoring it in case of damage, by minimizing its transfer to a minimum, and by keeping the three-dimensional models of our heritage that we can display anywhere in the world. Additionally, these models can be used to train personnel on the cleaning and restoration processes or even used in educational settings to convey the image/s of our heritage with extreme accuracy.

Findings and Recommendations:

1. It is necessary to take proactive steps and measures using modern technologies that enable us to ensure the preservation of our heritage and to ensure more accurate restoration in the event of an environmental or human error.
2. Preserving and restoring archaeological objects and buildings is a complex and intertwined process that needs a lot of development and modernization with the help of modern technologies available now in a more widespread way.
3. Mixed reality technology will enable us to display antiquities in an easier, more enjoyable, and safer manner than the actual transferring/transportation of the real antiquities which is costly, difficult, and very risky.
4. Creating virtual exhibitions in other countries in the form of interactive holograms will be a great promotional tool for Egyptian tourism and will allow us a greater ability in preserving antiquities from the costly and cumbersome transport operation.
5. A complete archive of archaeological objects and buildings should be made in the form of three-dimensional models using 3D laser scanning technology.

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