

# **Mummification in VR: a serious game for an immersive experience in Ancient Egypt**

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This paper introduces a serious game developed in Virtual Reality (VR) that simulates the Ancient Egyptian mummification process. The primary aim of the project is to create an educational tool that offers a unique and interactive experience for users to learn about this fascinating ritual in an engaging and enjoyable way. By combining historical accuracy with gameplay, this VR game aims to enhance learning by allowing users to actively participate in the process.

Additional Key Words and Phrases: Virtual Reality, Serious Game, Interactive Learning Environments, Education, Ancient Egypt

## **1 INTRODUCTION**

Virtual Reality (VR) is an advanced immersive technology that allows the user to visualize and interact with a three-dimensional environment digitally created. Currently, standard VR systems require specific user-worn visors, through which the user can fully immerse themselves in the virtual environment. These devices are equipped with sensors that detect the movements of the user's body and head, allowing immediate and precise synchronization with the virtual space. This creates an immersive experience in which the user perceives the illusion of being physically inside the simulated world. Virtual Reality has a significant impact across a wide range of sectors, extending from video games to fields such as surgery, psychology, marketing, entertainment, tourism, professional training and education. The purpose of this project is to join the fields of interactive entertainment and learning, combining the pleasure and the fun of playing a game with its educational side.

Indeed, with technological advancements, the method of learning has changed over time evolving from traditional classrooms based only on textbooks to more interactive and enthralling lessons. One significant advancement in this field is the rise of Serious Games - games designed to blend entertainment and learning. These games combine educational content, problem-solving activities and real-world scenarios, making them powerful tools for educational purposes. Unlike conventional methods, serious games leverage the motivational aspects of gameplay to enhance cognitive abilities, improve retention, and foster a deeper understanding of complex concepts. Virtual Reality presents itself as an important medium capable of surrendering the user into a whole new environment, which allows us to bring back to a virtual life cultural heritage.

In this paper, we present a serious game that allows users to learn about the most famous ritual of the Egyptian culture, the mummification, in an amusing way where players take an active role in the game: in this way the learning process should be easier and long-lasting.

## **2 RELATED WORK**

Research in serious games has shown the effectiveness of immersive and interactive learning environments in teaching historical and cultural concepts [2, 3]. Some educational games have been developed to engage learners in exploring ancient civilizations. For example, Plechet et al. [5] developed a serious game where users learn Egyptian hieroglyphs. The game incorporates interactive elements that engage players in the learning process by immersing them in tasks and challenges related to deciphering hieroglyphic symbols and understanding their meanings in historical contexts. Another puzzle-type game is the one proposed by Zlatkov et al. [6], a serious

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game designed to entertain students with the exploration of an ancient archaeological site through a series of mini-games and puzzles. Deborah Game [4] stands out as a creative and effective approach to teaching accounting history through four different historical periods. Gaitatzes et al. [1] developed a series of games inspired by the Olympic Games in ancient Greece.

### 3 PROJECT OVERVIEW

The game is set within an ancient Egyptian temple, where users assume a first-person perspective and identify as a funerary priest for the mummification of Pharaoh Tutankhamun. Players are guided through a sequence of steps to complete the mummification process, with no time constraints, making it user-friendly for first-time players. This project was developed using Unity 3D<sup>1</sup> and the MRTK3<sup>2</sup> toolkit.

The game begins outside the temple with a series of interactable panels that introduce the user to the ancient technique of mummification, first with a brief introduction to the topic and then with an overview of its phases. Once inside the embalming room, the user can initiate the mummification process. The room is designed to optimize the user's experience, with the pharaoh's body positioned on a central table. To the left, a wooden table holds all the necessary tools for each step, while a bucket is placed on the floor. On the right side of the room, the canopic jars are neatly arranged for easy access. The game relies on different gestures and far or near interactions, between the user and the objects inside the room, made possible thanks to the hand-tracking system. Above the pharaoh's body, there are interactable panels that guide the user during the entire mummification experience, first with a brief description regarding the phase and then with instructions on how to solve it. After each phase, the last tool used will automatically return to its initial position.



Fig. 1. Overview of embalming room

The mummification procedure consists of five main phases:

- (1) body wash;
- (2) brain extraction;
- (3) organ extractions and preservation;
- (4) bandage with linen bands;
- (5) placement of the body inside the sarcophagus.

<sup>1</sup><https://unity.com/>

<sup>2</sup><https://learn.microsoft.com/it-it/windows/mixed-reality/mrtk-unity/mrtk3-overview/>



Fig. 2



Fig. 3



Fig. 4



Fig. 5



Fig. 6

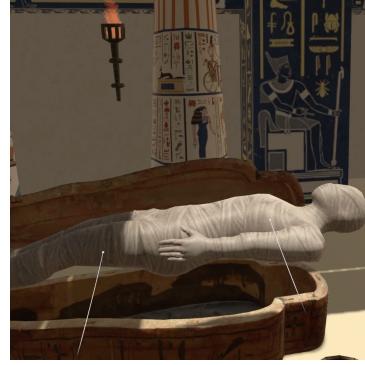


Fig. 7

The process begins with the body wash which is performed with a bar of soap, which must be rubbed on the body. The user, after interacting with the soap, will see a loading bar in front of him which marks the level of completion of the washing phase. Once completed, the loading bar will disappear, a sound effect will play, and the body texture will automatically change to appear visually cleaner [Figure 2].

Next, it's time to extract the brain from the nose. For this step, the user needs to take the metal hook, also positioned above the wooden table, and bring it closer to the pharaoh's nose. Once the nose and hook collision is performed, a 3D prefab of a brain will spawn above the head [Figure 3]. At this point, the user must place the brain inside the bucket on the ground. Again, once positioned correctly, a sound effect will play to provide auditory feedback to the user.

The third phase consists of the extraction of four internal organs: lungs, liver, stomach and intestines. To complete this stage, the player must first pick up the knife on the table. By interacting with two green little cubes that will appear on the pharaoh's chest [Figure 4], the organs will spawn above the body [Figure 5]. User must then follow the instructions on the panel in front of him to correctly place the organs in the respective open canopic jars on the ground. As the organ is brought close to the correct jar, it will disappear, the jar will close, and a sound effect will play to indicate the closure.

After completing this step, the process continues with wrapping the body. A roll of bandages is located on the table to the left, the user must grab it. Green little cubes will then appear above the body [Figure 6]. By interacting with each of these cubes using the bandage roll, the body will be transformed into a mummy.

In conclusion, the mummy needs to be placed inside the sarcophagus, which will appear on the left, replacing the wooden table. The player must grab the mummy with both hands and rotate it until it is correctly positioned. Once aligned, the mummy will be secured and the sarcophagus lid will close with an accompanying sound effect [Figure 7].

When the mummification process is finished, the player is teleported to the external area of the temple, where he can exit the game via an interactable button placed on a panel in front of him.

#### 4 CONCLUSION

In this paper we have discussed the design and implementation of a serious game that supports users in learning the main steps of an ancient ritual of Egyptian history. We chose to use Virtual Reality to create a fully immersive experience that transports the user back to Egypt in 1323 B.C., allowing him to witness and even participate firsthand in the mummification of one the most famous pharaohs: Tutankhamun. The game requires a virtual reality headset that, by realistically simulating spaces, events, and sounds, makes learning more engaging and effective by turning simple observation into a hands-on experience. Our game was designed to be exploited in different situations, especially in educational, cultural and training contexts, such as schools, museums and exhibitions.

#### 5 FUTURE WORK

The project aims to enthuse users by immersing them in the world of Ancient Egypt and teaching them techniques related to one of the most fascinating funerary rituals in history.

In a future phase of game optimization, adding some features to the game could be considered. For example, to enhance the game's use in educational contexts, such as in school lessons, it would be useful to add a user evaluation section to the project. A quiz, for instance, could test users' understanding of the topic and provide immediate feedback on their learning progress.

Another important aspect that could be better analyzed in the future is the quantitative and qualitative evaluation of this serious game, which is necessary to identify the strengths and any potential issues of the system. To do this it is important to run user tests that involve participants from outside the project. These tests allow for the assessment of the effectiveness of the application in delivering historical content interactively and engagingly, while also identifying potential issues related to user experience, interactions, and game functionality. At least 12 people should be selected for the test, preferably between 13 and 25, as the game is intended for an educational setting.

An initial test could be done using the Think Aloud method, which allows for a qualitative assessment and aims to gather detailed information on users' thinking and decision-making as they interact with the application. During the test, users are asked to verbally express their thoughts, emotions, and actions as they complete specific tasks, allowing researchers to understand better what difficulties they encounter, what they think while using the application and what expectations they have about the system's functionality.

It's also necessary to carry out quantitative testing to perform a usability analysis that can be numerically evaluated. A good way to do this might be to give each of the 12 or more users mentioned above a post-test questionnaire, such as a SUS. After providing the questionnaires and collecting all data, it is necessary to analyze them. The data analysis cannot be absolute, but results should be compared with those of a SUS questionnaire from a similar serious game.

One of the main objectives of this serious game, besides being pleasantly usable, is to impart knowledge to the users. To check this aspect it could give a quiz about the topics covered in the game immediately after playing, and re-propose it after 6 months to verify that the knowledge has been assimilated by the user.

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