Work-in-Progress—Telecommunications History Escape Room Puzzle Game: Become a Phryctoria Archmaester

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Abstract. This study proposes an interactive mobile escape room game on ancient, coded telecommunications. The game's aim is to educate people about Phryctoriae, an ancient Greek long distance communication methodology by using fire to decode messages. The player is confined to a room with only a torch, the objective is to decipher encoded fire signals on the walls to secure an escape. The goal is to create an engaging and enjoyable experience for learning about the ancient Greek method of communication. The intended positive impact of the game involves players using problem solving, memorization, communication and critical thinking skills, hence it is aligned with United Nations' Sustainable Development Goal 4 on Quality Education. The museum where this game will be implemented first is the University of Patras' Science and Technology Museum which hosts a relevant permanent collection. The museum contributes to the preservation of the country's cultural heritage, mainly focusing on the history of telecommunications.

Keywords: Game-Based Learning, Escape Room Game, Phryctoriae, Museum Education.

1 Introduction

Telecommunications play a vital role in human societies with a strong impact on the economy and all aspects of everyday life. The exploration of telecommunications history can immerse children and young learners into the challenges humans faced in the past and the solutions they devised to overcome them. Phryctoria or pyrseia was an ancient Greek method of remote communication, invented by Kleoxenos and Dimokleitos in the 3 century BC, based on fire signals [1, 2]. This optical telegraph was a precursor to Mors code. The coding and decoding of messages were possible by two rows of five fires that corresponded to the location of a letter of the alphabet, its row and column respectively in a 5X5 table (Fig. 1). Based on a system of towers of beacons several kilometers away, coded messages were able to be transmitted sequentially from one place to another, from the periphery to the capital. This system was maintained in the East Roman (Byzantine) Empire.

Fig. 1. Carving depicting the 10 fires used to encode and send messages in Phryctoriae, namely, to signal the letter in the second row and fourth column of the commonly used alphabet table.

Immersive experiences and stories that can spark the interest to discover and explore science and technology (STEM) fields have been used extensively in museums. Immersive technologies such as virtual reality, augmented reality and the metaverse have become increasingly popular in museums as they offer a new way for people to learn [3]. Specifically, they allow visitors and students to travel back in time and visualize abstract concepts.

The University of Patras' Science and Technology Museum hosts a relevant permanent telecommunication collection. The museum contributes to the preservation of the country's cultural heritage, mainly focusing on the history of telecommunications and has a long track record of using educational technology and immersive technologies for engaging diverse audiences, even students with disabilities or special needs [4].

Escape rooms are examples of serious games, one popular method to organize learning in a structured, engaging and fun-inducing way around an epistemic topic [5]. Escape room games have been used in education to ignite interest and problem-solving towards the acquisition and practice of various skills in various levels of education [6]. Educational escape rooms usually challenge players to complete a mission, usually to decipher a mystery or break out from a confined space [7]. They are organized within a common theme and around a story that activates players to collect evidence to solve puzzles and riddles [8]. Immersive technologies have been used to provide innovative playful experiences based on the escape room paradigm in physical or virtual environments [9–11].

2 Purpose and Objectives

2.1 Purpose

The purpose of this project is to make museum visits more immersive and fun by incorporating an educational game that teaches students about telecommunications in Ancient Greece. While the game will be publicly available, its main target audience is primary and secondary school students who visit the museum regularly. The game will run on tablets stationed within the museum, allowing the public to have access. Moreover, the digital escape room game can be available from a distance to virtual museum visitors. As a result of playing, students will improve their knowledge on the subject and be exposed to a range of decoding puzzles. The implementation of escape rooms games would mean that visitors would become more familiar with museums as the rooms can be combined with the museum architecture.

2.2 Objectives

The objectives of the digital game are the following:
1. Create immersive learning experiences related to ancient Greek Phryctoriae telecommunication methodology.
2. Improve museum visits by creating an immersive educational game for tablet devices.
3. Distribute fun decoding escape room puzzles with a meaningful story.
4. Learning more about ancient Greek mythology.

3 Learning Experience Design

The Phryctoriae communication with fire project will bring together undergraduate students and researchers to develop a game to be used within museums.
- Stage 1 - Researching: ancient Greek methodology, existing educational games in museums, making a decoding system for letters e.g. different fire combinations for each letter in the English alphabet.
- Stage 2 – Content Creation: Writing narratives and dialogue to show the educational content, designing ancient paintings, ancient-themed characters, torches and sound effects/background music.
- Stage 3 – Development & Programming: Implementing game mechanics - drag & drop fire from inventory to light up torches on the wall, UI elements - main menu, pause menu, load next level, retry game, timer and interactive features.
- Stage 4 – Integration & Deployment: Conducting final testing and installing software onto tablet devices in museums.

A key advantage of our project is the appeal for children, it promotes learning whilst requiring them to concentrate on completing the task. For our game, we have taken inspiration from a 2D drag and drop game called Storyteller [12]. Similarly, our game will consist of a singular panel with ancient paintings, players will have a fire torch to drag and drop into different unlit torches trying to decipher the message they receive from an outside source. Each combination of lit torches will translate into a certain letter, players can make various letters to form

a word before clicking on a submit button. If a player manages to correctly decode a message within the time limit, they progress onto the next room.

3.1   Support of Sustainable Development Goals

The game concept supports the UN's Sustainable Development Goal 4, by providing an inclusive and educational puzzle experience that can be integrated into museum exhibits. Here's a brief breakdown of its alignment with specific SDG targets: Cultural appreciation and education (target 4.7): By exploring the Phryctoriae, the game serves as a bridge that connects players to historical insights and cultural heritage. It enriches the museum experience by fostering a deeper understanding and appreciation of the ingenuity of ancient civilizations and highlights the relevance of historical knowledge in contemporary education.

Inclusivity in education (Objective 4.a): The game is designed to be accessible, with user-friendly mechanics that cater for different learning needs and abilities. Its aesthetic paintings complements the museum's artefacts, creating a cohesive educational atmosphere. Customizable settings ensure that people with disabilities can fully engage with the content, making it a universally designed learning tool in line with the ethos of creating safe and inclusive learning environments.

4   Development Plan

4.1   Visual Development

The entire visual design we are planning is based on ancient paintings depicting the scenes of the game. This will be achieved by hand drawing each scene in this style. A point of reference for this style is the "Storyteller", as this game uses stylistic elements of paintings on scrolls and emulating a traditional medium. Adapting the concept to fit our game we were inspired by real stone carvings that depict those communication methods.

Since the wall paintings will be somewhat monochromatic by nature, we plan to bring contrast and visual interest by making the fire to send and receive the coded messages as realistic as possible. The stone slab visuals allow us to distinguish between distinct locations by using different types of stone with different texture and color, all accurate and in reference to the materials used in the times our game is set in.

We have designed a diagram to show the visual development process of our different categories of elements.
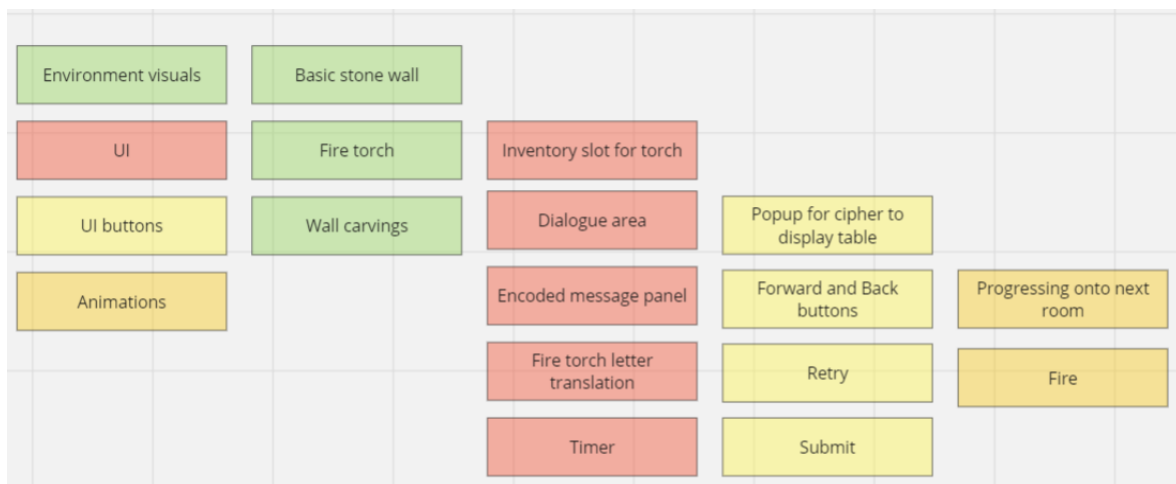

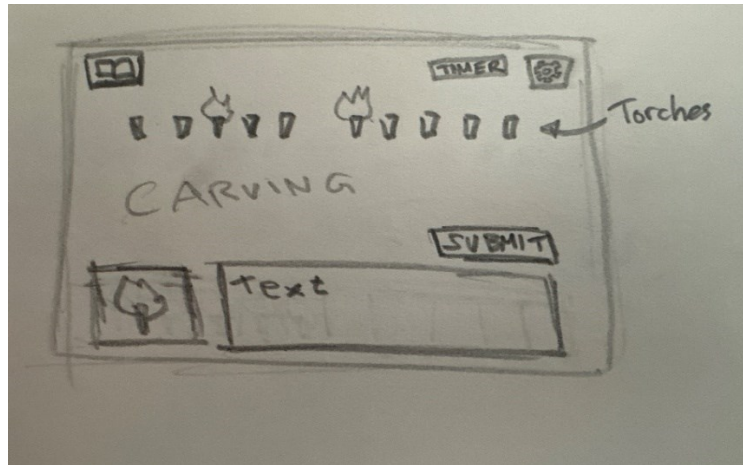**Fig. 2** Visual development process diagram.

Fig. 3 Basic UI design.

This drawing is to demonstrate a basic UI design for our game. This is how the screen will look for the player. Users will operate a virtual torch which they can move to light up the unlit signaling torches. Corresponding letters will display, the player will have access to the Polybius square to help with the decoding by clicking the book icon [13].

4.2 Gameplay Mechanics

We envision each Level as a new room with a wall depicting a mythological scene. The scenes will provide hints to the players about the word they have to cipher and decipher.

Players will have an assistant that is trapped as well in another room. Depending on if they play it as Single player or Multiplayer it will either be an artificial intelligence (AI) agent helping them or a friend or comrade. Both players will have the same scene depicted.

At the beginning of a level, players will see a new mythological scene depicted in an ancient wall some torches already lit up (either first or last syllable of the word), these are the ones their assistant already lit up for them. Now the player has to light up the rest of the torches, by placing the torch in the inventory to the unlit torches, in the right order to finish the word and submit it. If it is the correct word the wall opens and progresses to the next level. Players will have three attempts, if they get it wrong then a sound is played, and a hint will appear.

For example, the wall carvings can depict the mythological scene of Aphrodite's birth. The right word is Aphrodite.

The Assistant could for example already lit up the torches for the syllable "Aph" or "te", now the player would have to light up the torches for "Aphrodi" or "rodite".

In multiplayer we are planning to have players help each other by having each player take turns trying to decipher the word.

Fig. 4 In-game intro dialogue.
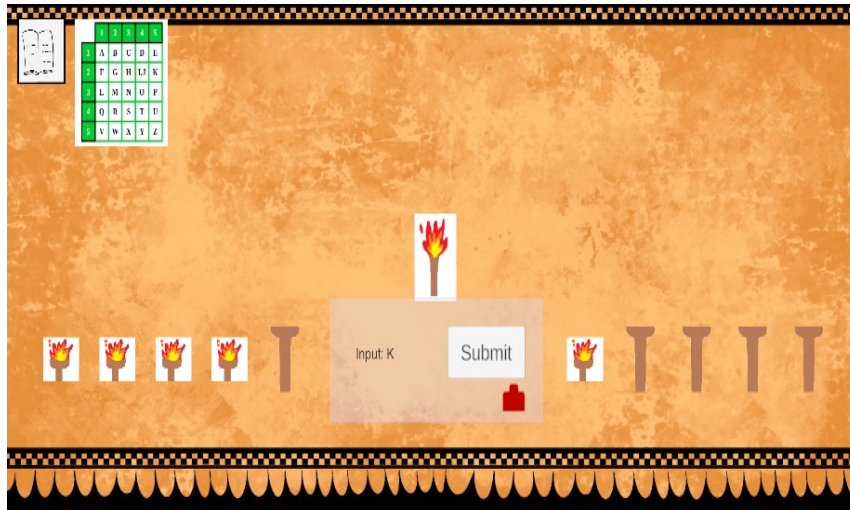
Fig. 5 Game demonstration.

The pictures provided show a demo of the game and the core game mechanics. These include talking to the companion to start the tutorial; lighting up torches with fire; creating a word from letters that are made from the fire and more to be implemented. Players can light torches to produce a letter, then it is displayed as a word. In our tutorial level the player must submit the word "fire".

5   Discussion and Conclusion

5.1   Discussion

The system of Phryctoriae was presented recently in another educational application [2]. Specifically, a working prototype was developed in a 3D virtual environment presenting on ancient Greek inventions. While this former application visualized Phryctoriae among other systems, the proposed digital game will provide a structured, playful and entertaining experience focusing on gradual building users' skills on the actual use of an encoding / decoding mechanism for effective communication.

5.2   Deployment and Evaluation

The alpha version of the escape room game is scheduled to be deployed and evaluated in the museum during the upcoming summer with selected pupils and experts (phase 1) before the launch of the beta version in October and its formal assessment by visiting schools (phase 2). For phase 1, a qualitative assessment approach is preferred to document the in-depth participants views, while in phase 2 additional quantitative measures will be added to evaluate the game's impact on students' perceptions and learning performance.

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