A phygital gamification approach for Cultural Heritage in pre-visit, visit and post-visit

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***Abstract*—The use of gamification (GAM), or the application of game elements in non-game contexts, offers numerous advantages in the field of cultural heritage (CH) and is an innovative approach that aims to make the experience of enjoying cultural heritage more engaging. The use of innovative technological approaches in the field of CH is now becoming essential to preserve and enhance tangible and intangible CH. The potential of GAM techniques can be employed through the emerging technologies of virtual reality (VR), augmented reality (AR) and mixed reality (MR) in the pre-visit, visit and post-visit phases in order to increase and qualitatively improve the user's experience of CH by improving respectively its promotion, interactivity aimed at learning, loyalty through data collection and personalization of the experience. The possibility of enriching the real environment with three-dimensional models opens up the possibility of narrating the real place with innovative storytelling not only of the environment itself but also and above all, telling and conveying all that is the intangible heritage that a place inevitably brings with it. The study focused on defining a methodology to apply an integrated gamification system in VR and AR combined with storytelling techniques to enhanche the visitor exeprience in pre-visit, visit and post-visit in the context of cultural heritage. An example of the potential of applying some GAM techniques in the pre-visit in a virtual reality museum context is proposed.**

***Index Terms*—(Cultural Heritage and IoT, E-Tourism, E-Education**

I. Introduction

The use of digital technologies for tourism and heritage enhancement is a relevant research topic and developments in digital representation technologies applied to heritage have increased interdisciplinarity between distant worlds.

GAM is considered a particularly useful tool for establishing a good level of engagement and in recent years it has seen an increase in its use in the field of software development of mobile applications for the most diverse domains [1], [2]. The close derivation from the gaming environment, from which it draws the elements, mechanics and more generally game dynamics, makes GAM effective for engaging and retaining users [2]. The so-called "serious games", already existing several hundred years ago, can be considered the ancestors of today's concept of GAM. They were originally used in areas such as learning in education and training in the military environment. Starting in the 1980s, some researchers began to study the use of game elements in the design of user interfaces for human-computer interaction. Today GAM and serious games, although they have substantial differences [3], are sometimes considered synonymous.

The widespread use of mobile devices, such as smartphones and tablets, in the last decade has greatly favored the use of software solutions to everyday problems. Lately, GAM techniques, or small aspects related to it, are present in many applications that we use daily. The number of domains and contexts to which software solutions based on GAM are applied is constantly growing [1].

The use of these techniques in the cultural heritage domain and more specifically in the museum sector is still maturing in growth. There are various solutions on the market but gamification is not yet considered a standard in this environment [4]. The main objective that we want to achieve with this project is to find a way to build visitor loyalty in museums, maximizing their level of long-term engagement and multi-museum coverage of visits through the use of GAM techniques.

The primary objective is to build an integrated phygital system based on GAM techniques that exploits the potential of new technologies in three phases to provide visitors with quality multimedia content via the web and mobile environments by redirecting travelers, highlighting points of interest and providing information for tour operators. Phygital (physical plus digital) bridges the gap between the physical world and the digital blending digital experiences with physical ones. GAM is prevented to connect users to specific sites and activities, improving users visit experiences and encouraging constant interaction with the application through a playful experience.

An example of the potential of applying some GAM techniques in the pre-visit in a virtual reality museum context is proposed. The solution presented only partially represents the objective of creating a more complex integrated path that involves visitors before and during the visit through a system of cumulative and spendable rewards in the territory in VR and AR.

II. The proposed methodology

The methodology is based on the idea that digital and physical worlds can be interconnected (phygital) and exchange

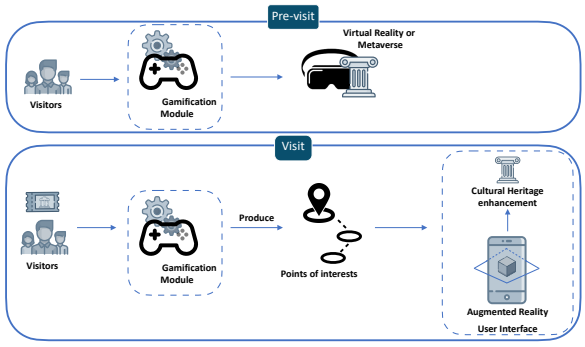

Fig. 1. VR and AR framework in CH context

information to enhance and influence each other.

In the context of cultural heritage, this element has enormous potential and can be exploited, through appropriate storytelling, to tell the tangible heritage through elements of intangible heritage [5].

The general idea is to exploit the potential of new emerging technologies, in particular virtual and augmented reality, to improve and personalize the user experience in the three phases of cultural heritage fruition. The aim is to define a framework with which it is possible to attract the visitor in the pre-visit, improve his experience during the visit, and collect data and feedback to personalize the user experience. The approach is therefore based on:

- Design of a storytelling based on tangible and intangible heritage;
- Implementation through emerging technologies of a GAM solution in VR and AR that connects the digital world to the physical one;
- Data collection;

A. *implementation*

Specifically, the VR application "Looking for Van Gogh" is an immersive experience that combines art, history and gaming in a fascinating virtual museum where the user takes on the role of an art explorer tasked with finding and analyzing Vincent van Gogh's masterpieces. The virtual museum is meticulously recreated with realistic environments and historical details, offering an authentic representation of the works and exhibition spaces. The main mission is to locate the iconic paintings of the painter, such as "Vincent's Bedroom in Arles", "Still Life with Bible", hidden in various rooms of the museum. Each painting found unlocks a series of secondary missions that require collecting specific objects related to Van Gogh's life and work. These objects can include his famous straw hat, the palette with the colors used in his paintings, his easel and more. Each object has a story to tell and allows users to learn more about the artist and the historical context in which he worked. By completing missions, users earn experience points and badges. Each badge represents a significant achievement: from discovering the first painting, to collecting all the objects in a room, to completing thematic paths dedicated to particular periods of Van Gogh's life. Intuitive game mechanics and support for various VR devices ensure a smooth and immersive experience. It is an educational and fun journey that allows to explore the world of one of the greatest painters of all time through the potential of virtual reality. Starting from virtual reality, missions can be completed in the physical museum through the application of GAM techniques in augmented reality.

III. Conclusions

The proposed methodology is only intended to be representative of the potential applicable in different contexts. The use of game mechanics to engage users can easily be adapted to other art collections, archaeological sites or museums. For example, each museum or gallery can develop specific missions, treasure hunts and digital rewards to encourage exploration and learning. The 3D technology used to recreate the virtual museum and the environments of Van Gogh's paintings can be applied to any historical and artistic content. Museums around the world can create virtual reconstructions of their exhibition spaces or works of art, allowing users to explore them from anywhere. Accessibility and customization features can be standardized and used in other VR applications to ensure that the experience is inclusive and adaptable to different needs and skill levels. The system of digital badges and rewards can be replicated in other contexts, creating a sense of progression and achievement. The modular structure of the application that allows for regular updates and the introduction of new content can be implemented to maintain user interest in the long term. This strategy can be applied to any educational or entertainment platform. Interactive guides and contextual clues that help users navigate and complete missions can be developed and used in other digital, but also phygital application contexts to improve usability and user experience. We aim not to interfere with the value of the real heritage experience but as an experiential added value.

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