

Adventure in Plovdiv's Cultural Space: An Augmented Reality Serious Game

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Abstract. The present paper discusses the development of an augmented reality serious game, which allows the players to interact with cultural heritage artifacts in seven institutions in the city of Plovdiv, Bulgaria. The objective of the game is to encourage the participants to go through all of the cultural institutions and to learn interesting facts related to local history, culture, society and biological life in an amusing and attractive way.

Keywords: Serious Games, Plovdiv, Cultural Heritage, Augmented Reality.

1 Introduction

There has been a significant focus on the potential usefulness of serious games to support cultural heritage (CH) with the aim to enhance the interaction with its potential audience, and to promote cultural learning, awareness and appreciation of the tangible and intangible CH (Laamarti et al., 2014).

The ubiquity of smartphone-based mobile applications suggests that they have the potential to increase awareness of cultural heritage among a broader demographic. According to statistical analysis, in North America and Europe, the smartphone adoption rate is approximately 80 percent of the total population (Laricchia, 2023), which makes mobile applications highly regarded as valuable technology instruments in the field of CH. Smartphones have powerful capabilities that combine the features of computers and other mobile devices such as personal digital assistants (PDAs), GPS navigation, digital cameras and multimedia players. These capabilities can even be further enhanced with specific functions such as touchscreens, wireless connectivity over high-speed networks, positioning and motion sensors, augmented and virtual reality. In order to take advantage of the developments in mobile technology, the cultural institutions in the town of Plovdiv participate in a project for the development of a serious game, which employs augmented reality (AR) to take the players on a quest across multiple CH institutions in the town. This article aims to introduce the main concepts behind the creation of the mobile AR serious game and to give a description of the game's ideas and objectives, its design specifics and limitations.

2 Main Concepts, Advantages and Expectations of Mobile Augmented Reality Serious Games in the Field of CH

Serious games are “games that do not have entertainment, enjoyment, or fun as their primary purpose” (Michael & Chen, 2006). They are frequently utilized as a means of engaging the players in game-based learning, which is a specific form of their application with the goal of acquiring knowledge. In the case of their employment in the field of CH, this goal is combined with inciting appreciation and support for its importance and need for preservation.

Regardless of the seriousness of the game, it must maintain an element of entertainment; failing to do so will prevent the achievement of the game's serious objective, notwithstanding the meticulous development that went into its creation. (Laamarti et al., 2014). Challenge and competitiveness have been recognized as elements influencing learners' motivation to participate in games, with both contributing to the fun and enjoyment that players experience (Hwang et al., 2015).

AR is a system that provides an enhanced perception of the physical environment by providing an additional layer of virtual digital items in real time. (Casella & Coelho, 2013). The data displayed by the virtual objects is not readily available in the information naturally perceived by the human senses (Azuma, 1997). According to studies, the employment of AR for educational purposes has an overall positive effect, compared to non-AR alternatives. A comprehensive literature review and meta-analysis, carried out by Chang et al. (2022), concluded that “AR instruction showed on average a medium effect to promote students' positive responses to the learning experience, a medium to large effect to enhance students' knowledge and skill, and a nearly large effect to facilitate students' authentic performance” (Chang et al., 2022).

In the CH sector, the advent of AR technology facilitated a shift in the emphasis of cultural institutions from their cultural heritage to their visitors, thus adopting a visitor-centric strategy (Matviienko et al., 2022). In general, the purpose of these applications is to provide visitors with informative and engaging content with the intention of fostering a pleasurable experience for tourists (tom Dieck & Jung, 2018). In this way, CH institutions are able to gain more visitors, consequently to generate greater revenues and achieve wider appreciation of their precious holdings.

In order for a cultural tourism mobile application to reach the public effectively, it is crucial to understand and meet the needs of the potential users. The consideration of technology readiness and visual appeal is of utmost importance in the development of AR applications (Koo et al., 2019).

There is a number of existing theoretical propositions and realizations of AR projects offering gamified CH presentation in a multi-institutional, interdisciplinary, citywide format. Such games stimulate the imagination and inquisitiveness of players by testing their existing knowledge and abilities, and inadvertently enhance their understanding of the cultural legacy of a particular region (Díaz, Toftedahl, & Svensson, 2014). The game's objectives should not feel like school homework, questions should be concise and less abstract, the presented information understandable and not overly

academic. (Jones et al., 2017). Introducing a social element and fostering collaboration leads to higher motivation and healthy competition between players (Ramly & Neupane, 2018).

3 Project Information and Context

Combining gamification and AR, the creators of the Plovdiv CH game intend for the visitors to learn facts by listening or reading bilingual (Bulgarian/English) audio or text information, and with the addition of AR, their experience will be enhanced through creative animation. The game Art&Fact (Fig.1.) is developed within the framework of project Nr. BGCULTURE-1.001-0016 with the name "Cultural heritage of Plovdiv, presented in revitalized, restored and renovated places", initiated by the Bulgarian Ministry of Culture. The project is funded by the Financial Mechanism of European Economic Area 2014-2021. A major goal is to enhance the role of culture and tangible CH and to foster local and regional development, emphasizing employment, social inclusion and entrepreneurship in the cultural sector.



Fig. 1. Screens from the Art&Fact game (from left to right): start screen, map of sites, virtual backpack with achievements, AR presentation.

The game Art&Fact is free of charge (only institutional admission fees are payable) and is accessible as a downloadable mobile application for Android and iOS. The main target audience of the application are tourists, exploring the city's cultural heritage for the first time, as well as locals, who are willing to experience their city's familiar highlights in a new way and to gain more knowledge. Most of the game's players are projected to fall within the age range of late childhood to adulthood. Hence, it is imperative to modify the content and level of difficulty appropriately.

The game Art&Fact will use GPS location to direct the player to different CH sites in Plovdiv. The player has to complete a certain mission at each site. The participating institutions are:

- National Library "Ivan Vazov" (NLIV) – the game in the library focuses on a large mural inside the building, which depicts the Bulgarian writer Ivan Vazov, together with characters from his literary works. The mural provides insight into Ivan Vazov's literary heritage, mural art in Plovdiv, Bulgarian history and folklore (Kratchanov & Minev, 2023). In addition, material from the Digital Library are involved as well, thus popularizing the digitized collections.
- The City Art Gallery (CAG) - the gallery participates with two of its expositions: "Bulgarian Art" and "Icons".
- Municipal Institute "Ancient Plovdiv" - the mobile application includes a presentation of the paintings of Zlatyu Boyadzhiev and Dimitar Kirov.
- The Regional Natural History Museum - provides information about a wide variety of representatives of the animal kingdom, with special focus on species found in the Plovdiv region.
- The Regional History Museum (RHM) - information about the buildings which house the historical expositions, including their main collections: "Unification of Bulgaria in 1885", "Bulgarian Revival" and others.
- The Regional Ethnographic Museum (REM) – players are engaged in the "Agriculture", "Coppersmithing" and "Musical Instruments" halls, together with an interactive ethnographic map.
- The Regional Archaeological Museum (RAM) - presents highlights from its exposition, graphical AR restorations, animation, etc.

The development of the application is done by a contracting company jointly with CH specialists, representing each of the participating institutions, in order to provide accurate and appropriate information. The development framework is based on the Rational Unified Process (RUP). A total of 72 objects are digitized, transforming them into virtual 3D models by photogrammetry or three-dimensional modeling, supplemented by video and audio content, original music and sound effects, bilingual voice-over by actors for in-game characters, text and audio recordings with information about the cultural objects in Bulgarian and in English.

4 Gameplay Specifics and Rules

The action of the Art&Fact game takes place throughout the central part of the city, outside in open areas and inside the library, museums, galleries, expositions and cultural spaces. The application can be used as a guide for visitors unfamiliar with the city of Plovdiv, utilizing the mobile device's GPS functionality, by way of a navigation map and routes connecting the areas included in the game. The player is guided by the game's mascot - the syenite golem Filly, who provides tips and encouragement. The mascot's name is a reference to Philippopolis (one of Plovdiv's historical names) and is made of the same rock material as the hills on which Plovdiv emerged. While the game has a narrative structure, the story progression is nonlinear and sites may be visited in any order. In the process of the game, when the player points the camera of his mobile device at a certain gamified object, the automatic recognition system of the application becomes agitated and audio or text information about the object is presented.

The player is challenged to guess different riddles, reveal certain objects, solve quizzes, assemble puzzles, and gets points for his performance. If the player passes through all the levels, he receives a code with which he may register to receive a prize, such as a free ticket to a cultural event.

The end is achieved when the player has gone through all of the points of interest and has passed all of the game tasks, which test the knowledge gained. The game can be stopped at a certain point of completion and can be finished at a later time, for instance during the player's next visit to the city. The objective of the game is to encourage the participants to go through all of the cultural institutions, to get to know their exhibitions and to learn interesting facts related to local history, culture, society and biological life in an amusing and attractive way.

5 Discussion

The game has been released just recently (end of April 2024) and not enough data has been collected yet, in order to make conclusions about its efficacy. One of the possible downsides is that the game requires constant internet connection, to which some visitors, especially those from other countries, might not have access. In addition, as result of graphical processing limitations of mobile devices, contemporary augmented reality renderings frequently lack complexity (Hammad et al., 2023). Because of this, some players may find the presentation not attractive enough. Another issue to consider is that having the mobile device function at high resource usage for a prolonged amount of time would lead to a rapid drain of battery power. A way to mitigate this issue is for the institutions to provide easily accessible fast recharge spots. Adding an optional collaborative element in the future is desirable as well, in order to increase player motivation.

6 Conclusions

The use of digital technology is becoming increasingly prevalent in cultural heritage organizations, as VR and AR serious games have become significantly more widespread in recent years. (Bontchev, 2015). The aforementioned technology advancements create novel prospects for augmenting players' comprehension of the information conveyed through serious games, as well as fostering creativity, introspection, and active engagement.

The AR serious game Art&Fact presented in this paper offers a way to bring together the holdings of different cultural institutions with a multidisciplinary, user-centered approach. It is an attempt to unite the city of Plovdiv's CH artifacts into a digital cultural ecosystem. The objective is to consolidate diverse materials and digitized collections, artifacts, textual resources and locations with the aim of enhancing their accessibility and appreciation (Paneva-Marinova et al., 2017). This endeavor seeks to introduce and foster reevaluation of cultural information through innovative means.

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