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## Use of Augmented Reality and Gamification techniques in tourism

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Combining Augmented Reality (AR) and Gamification techniques, applications with ludic and education content can be created. In this article, the authors present the most outstanding examples of Augmented Reality application focused on tourism, as well, as their own Augmented Reality application NosfeRAtu. The application creates a virtual tour in the Orava Castle (Slovakia), where the users are accompanied by a virtual character based on a film personage Nosferatu. During the game, the users discover and learns about the marvellous places and a history of the castle as they complete the different quests.

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## **Introduction**

We can understand the emergence of AR within the environment of heritage restoration as an extension of experimentation between Virtual Reality (VR) and cultural heritage. In the same way that VR systems are used to display and introduce visitors to the contents that no longer exist or their reconstruction is impossible, AR applications are used to show the objects and places of cultural interest, superimposing the virtual contents upon physical space where they were originally located. This mixture between the real and virtual, produced by the AR, can increase the interest and understanding of the content by the public. Without the need to produce any intervention or physical damage on the material cultural heritage where it is located. There are modes of AR application based on geolocation, where it is only needed to know the user's position. Depending on the position of the user the virtual contents are placed, enabling the correct visualisation of these contents related to cultural heritage.

### **Augmented reality – definition and technology**

Nowadays the term Augmented Reality is well known as it proliferated into so many branches like art, commerce, tourism, education, music, gaming, etc. The widespread of AR came with the use of mobile devices like Smartphones, even that the AR technology has started in 1960's and has become more important in the last decade of 20<sup>th</sup> century.

“We can understand the augmented reality (AR) as the expansion of information from the physical world that allows us to perceive the virtual part that surrounds us. It enables us to distinguish the digital information flowing through the physical space. It creates a sensory interface that allows us to appreciate the virtual part that is hidden in physical space.” (Mesárošová, Ferrer) [7].

To better describe the AR Ronald Azuma in 1996 pointed out the three key features of AR technologies: it combines the real and the virtual, it has to be interactive and registered in a 3D environment.

The first AR applications related to tourism and cultural heritage employed the typical devices used by VR applications. Using the devices for displaying the virtual contents such as HMD devices the user's immersion is possible. To these devices is added a camera that simulates the first person view of the user in the real-time. It also allows the realization of tracking, the method that calculates the position of the virtual content which this has to occupy within the real physical space. Nowadays these types of HMD devices became practically obsolete, especially for the time limitation of its use and the need for great financial investment for the acquisition of such devices. At the present these devices have been replaced by the mobile devices such as Smartphones. This change has advantages but also disadvantages. Thanks to these devices, it is much easier for users to employ the AR applications because they can use their own smartphone or device and it is not necessary to provide them with one. Moreover, we find the disadvantage of the use of these screen-based handheld devices, where the degree of user's immersion is greatly reduced.

The use of AR applications for mobile devices permits the use of the user's own device as a display device, thus it is increasing the degree of familiarity, avoiding the need for previous training or explanation. Therefore, it assumes that users are well aware how their own devices works, introducing these technologies to new users who have never had previous contact with AR applications.

The augmented reality combined with the use of virtual reconstructions enables visualization of specific contents that have disappeared, thanks to the technological potential of virtual reconstructions based on the use of specific documentation generated by research fields close to archaeology and tourism (Ruiz [7]).

The widespread of application of AR technology helps to the dissemination of knowledge and makes it more attractive to the wide public. It represents a new kind of interpretation of the tourist contents, allowing the visual overlay of different periods in the history upon the real space. The introduction the concept of gamification in the content thus increases the interaction between users and content. The AR permits that the digital reconstructions and real ruins fit together in harmony, without creating the visual interference with each other and offers a personalized view to the user. It is able to combine both worlds, allowing a closer relationship between the disappeared artwork or monument and its present state. It can also show more than one state, if there were several changes executed throughout history.

### ***Augmented Reality head mounted displays***

Within the field of augmented reality and archaeology we will point out several relevant projects developed since the beginning of the use of augmented reality technology and that can be considered as clear references of AR applications. Examples that have been developed “in situ” just right upon the real position of monuments of archaeological importance as the case of Archeoguide [2]: in Olympia Greece, or Life Plus in Pompeii, Italy.

Archeoguide Research covers the fields of cultural heritage and archaeology from the technological point of view. A very ambitious project which explores the possibilities of AR systems designed for the outdoor use. For its the realization the photogrammetry techniques were employed and helped to create a true three-dimensional reconstruction. The project began about 2001, so it does not use the mobile devices, due to low quality parameters of the contemporary devices. In this project was used a server system capable of managing the flow of data through a portable computer connected to the server via a network Wi-Fi [3].

The application use a tracking system based on geo data, able to calculate the position and orientation of the user and locate sufficient data to visualise the digital content in the physical space.

The display of the content by the user is performed by a HMD device that allows modification of the user's view as a first-person view. Modifications that allow users to view temples, sculptures and reconstructions, belong to the time of maximum splendour of the city. For rendering the virtual image the "Avalon" software was used. Developed by ZGDV, this software was also employed to design the numerous applications of Virtual Reality. It poses also its own virtual modelling tool."[3]

We could say that is not a truly an application of augmented reality, but rather an application of virtual reality. The digital images displayed to the user are not captured in the real-time, but they have been pre-recorded, in the manner that matches with the real space where users interact. The image seen by the user fits the reality.

In the case of application called LifePlus the location corresponded to the ancient Roman city of Pompeii. An application which sought to overcome the technological challenges at the time of its creation, offering to the user the possibility of being in different time corresponding to the same physical space, creating a false sense of being in the city before its destruction. (Papagiannakis) [4]

The project was divided into two applications, on one hand "Arguide", a mobile guide that allows the realization of a guided tour over the site, which included audio, image, text and 3D reconstructions and architectural information related to the location.

On the other hand "AR Life Simulator", in which were represented the scenes from the Roman social life, generated from images obtained in the mosaics. Evenly they are distributed in the city, where the users can observe the scenes from everyday life, also including flora and fauna.

As in the previous case, the application used a geolocation system that could detect the position and orientation of the user's head in space. This information was processed at a central high-speed computer and sent via wireless to the laptop wearied by the user, which included an HMD device and built WebCam. These devices allow the insertion of digital content in the first-person view of the user.

In both cases, a tracking system based on the recognition of AR Markers, cannot be fully employed due to the protected historic area. The application LifePlus used both outdoor and indoor spaces and a tracking system based on natural features was implemented.

Although the first experience met the objectives to show the versatility achieved by using the augmented reality as a conservation tool in the cultural heritage, the authors ended up not feeling pleased with the interface used. This resulted to be not ergonomic enough for its users. Currently, these HMD devices have significantly reduced their weight, and use of a laptop is not necessary while the data can be processed in real time by the most of the mobile devices.

### ***Augmented Reality Viewpoints***

An example of augmented reality unifying heritage and tourism within the scope of the commercial brands is InnoView AR applications. A prototype created by the mark Active Media System. It is a device similar to the traditional viewpoint binocular. This viewpoint allows the overlapping of digital content on the actual view that is seen in the background. Several icons relevant to the attractions of the area appear in this binocular view. These points of interest actuate as if they were a hyperlink that allows access to more information regarding the contents.

These viewpoints of AR have a system for inserting the coins, similar to the old viewpoints found in most cities. Determining the display time based on the amount of inserted coins.

InnoView AR has been installed in various areas, such as the Arena shopping center (old bullring of Barcelona from where you can see the Plaza of Spain and Montjuic).

Virtual Sightseeing (2005), as InnoView AR was developed by a commercial brand, in this case, the company Ydreams and consisted of a viewpoint of Augmented Reality. In this case was used a touch screen instead of the traditional binocular device. Geo-tag system appears in the user's vision, fulfilled with information related to the specific location. The system was installed near the Environmental Interpretation Centre of Lisbon, with the intention to raise awareness about the coastal fauna and flora of the Cidadela. Later it was employed in the National Pantheon in Lisbon (2008), where besides providing additional information about the flora and fauna, offered also information related to historical buildings of the surrounding space.

This type of augmented reality applications that actuates as virtual viewpoints, demonstrates the huge potential of AR in the tourist and cultural promotion, allowing the user to obtain the tourist and cultural information. The interaction through multimedia contents causes a greater rapprochement between the viewer and content. Creating a false sense that the content is personalized for each user and increasing the time of use. Besides this interactivity it is capable of transforming the landscape images in images with high information content, enriching the user experience in tourism environments.

### ***Augmented Reality Smartphone***

Since the introduction of mobile telephony in the daily social life, the numerous applications using Augmented Reality oriented cultural tourism appeared. It is worth mentioning two applications of AR for the smartphones: CodeCabanyal (2011) and MiraAlicante (2012).

These projects introduce the cultural heritage in the field of artistic research and augmented reality technologies. Transforming and using the AR as a critical and poetic tool

able of the dissemination of cultural heritage content. These two applications work the same way, using mobile devices of users, without the need of another device used for viewing the contents. The Smartphones are equipped with electronic elements necessary to obtain the geolocation of the users and their orientation respect to the north. These mobile applications transform the mobile devices into a kind of display which permits the users to appreciate the characteristics of the elements of cultural interest that surround them. Expanding the information depending on the time of navigation.

These applications use different navigation systems based on the user's choice:

*Live Navigation:* Allows the user to see through the mobile phone camera, a real-time image from the camera with the virtual content overlapped.

*Navigation Map:* Offers a view of the location of all content on the map, so it easy to locate items on the map without using any other navigation systems.

*Guided car navigation:* allows the application to calculate the path to by car to the selected content.

*Navigation index:* access an index of all content, where we can select which content should be displayed, regardless of our geographical location.

*Navigation comments:* Displays the opinions and experiences that users are left after using the application.

The interaction occurs in both applications in different ways:

- Interaction of the user by displacing in the real environment, because the application is able to guide the user by using GPS data and inertial sensors of the mobile phone (live navigation, navigation map, guided navigation for cars ).
- Touch Interaction, produced by the user to navigate within the menus offered by the application.

- Social Interaction, is produced by providing the option to share their impressions, which forces the user to do a little reflection about the cultural elements.

These two applications use the same technology but focus the cultural visits from very different points of view. Codecabanyal was held in the district of Cabanyal in Valencia, a district rich in cultural heritage, because it is the only part of town where the Valencian modernist architecture was developed. This area has also generated a very particular urban planning related withdrawal of the sea through the years, creating a grid of streets that flows parallel to the coast.

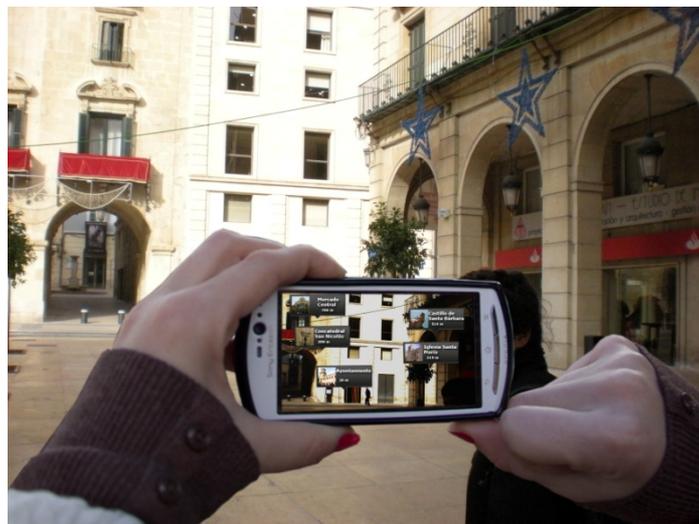


**Figure 1** Codecabanyal application

Cabanyal neighbourhood represents an area that remained excluded from the tourist routes of the city because the local government intended to destroy it in order to expand a great avenue to the sea. We decided to present this city quarter to tourists by using AR application, made with the idea of creating an alternative tourist route that allows to better know this neighbourhood and its cultural and historic value. A neighbourhood that partially disappeared, since much of it, has been destroyed by the public administration, regardless of

the importance of the architectural heritage of its buildings. So we consider as necessary to introduce in this guide not only the part of the neighbourhood that still exists but also information of the part that has been destroyed and its specific features. Allowing tourists generated an idea about how was this neighbourhood because today is full of empty spaces which left the buildings of historic importance.

Mobile application MiraAlicante seeks to highlight the important buildings and monuments of the city of Alicante. Increasing the visibility of them by showing the specific characteristics of each content in order to offer the information about them and facilitate the tourist movement between the different relevant locations of the city.



**Figure 2** MiraAlicante application

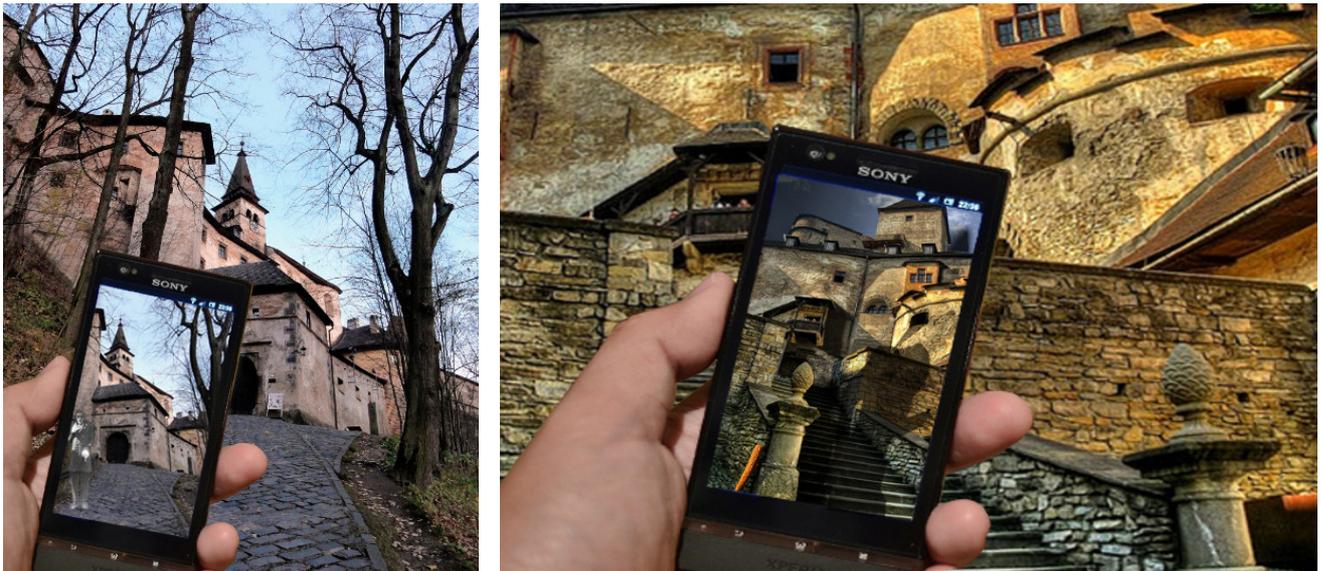
### **Gamification techniques**

Gamification techniques offer a new possibility to the application oriented towards the tourism. The term “Gamification” comes out in 2002 and first was resumed by the game designer Nick Pelling as an introduction of videogame concepts into the context of social life (Ursyn, 2013) [5]. Mainly the gamification techniques are used in marketing, but also, it found its way to another branches such as medicine, education, art, economics etc. The gamification techniques in Zimmerman and Salen (2003) [6] definition applies the game

mechanics to any project or idea. It is strengthened by the engagement that reaches the user in videogames enabling the users' confidence in these playable environments and introducing the contents related to the different aspect of specific fields.

### ***NosferAtu project***

In this experimental self-financiered project we explore the possibilities and advantages of the gamification methods with the combination in Augmented Reality technology. This game was developed by Manusamo&Bzika Art group. The application is designed as an AR game focused on tourism, cultural heritage and also the cinema history. It presents the historical information in a playful and participative way by implementing interactive elements within the application. The AR game is geo-located at the marvellous and historically significant Orava Castle. The castle which also forms the part of cinema history, as it was chosen by director F.W.Murnau to shot the vampire story Nosferatu. The game is designed as a quest where the player has to collect the virtual objects which are hidden all over the castle. The goal is to pick all of the objects before the virtual vampire gets you. The objects are placed in the locations where the original film scenes were taken and also at the places where the historically important events took place. The information can be retrieved at this points, so the users can learn about the history. In this manner, the user makes his own AR castle tour, based on the virtual data. The application is rune in the users' own mobile devices and employs the device's camera, inertial and location sensors. The virtual content is visualised on the device screen and uses it also as an interaction interface, as the mobile devices are provided with touchscreens. This makes the application accessible to the wide public and also there is no time restriction.



**Figure 3** NosferRatu application

## **Conclusions**

The advantage of the AR technology, in this case, consists in the manner in which the virtual object are placed. The real-time image from the camera makes the experience more real, as the user sees the real environment with added virtual objects. This produces the sensation of the presence in the real world and not in some kind of the synthetic environment which is characteristic for the virtual reality worlds. It makes a user to be aware of space which surrounds him and there is a need to be physically present at the specific place. This makes of AR a unique tool for tourism and cultural heritage. The AR applications offer the possibility of visualising and telling stories about the places and the history at the specific location. It can employ the gamification techniques to be more attractive and interactive for the users. There exist the option to connection to the Internet in the real time which permits to retrieve the significant information for the user but also can be used to collect the data from the user which can contribute to create a database from which can benefits the tourism in that specific area.

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