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Educational and Cultural Environments Enriched Using Augmented Reality Technology

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Abstract

The domain of cultural-educational and tourist environments has entered the digital age, this allows the implementation of technologies of Augmented Reality (AR) to improve the user experience in these environments, and entails the possibility of providing greater satisfaction to the user visiting these locations. Hence, the problem was formulated. What is the effect of integrating AR to improve the user interaction of a cultural-educational environment? Case: UPTC natural history museum. It presents a documentary research that analyzes studies on AR, view it as a tool of support for learning and entertainment processes through the recognition of cultural, educational and tourist locations. We sought to identify the applicability of AR in cultural settings for didactic, adaptive and learning purposes, based on the concept of 'Edutainment'. Research methods: logical analysis and generaliaation of scientific literature, both absolute and relative statistical data and case studies. The analysis, obtaining, design, development, evaluation and implementation, methodology for projects based on AR was used for thi work; applied in 34% of the works identified. It sought to recognise the characteristics and advantages of using AR technology as a resource to improve the user experience, combined technology and entertainment to achieve learning objectives. In total, 210 papers were identified and reviewed.

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The technical and operational viability of the AR is deduced; this is an innovative technology that captivates the attention of the user. The combination of the real and the virtual; and its easy access are the characteristics of an application based on AR, implemented in cultural and learning environments.

Keywords: Augmented reality, cultural and learning environments, edutainment, e-learning.

1. Introduction

The present research presents the results of a documentary study based on the characteristics and advantages offered by the Augmented Reality (AR) technology from the strategic point of view, for the strengthening of learning within both cultural and tourist-interest environments.

This makes AR a tool of didactic use, which proposes to be a complement or a replacement to the traditional teaching method, the rise of technology takes all the environments in which the human being develops, in order to facilitate life, and give a plus to the teaching method to offer greater satisfaction of use and learning.

All this has become a challenge, which brings innovation and greater use of technology, which has become a key research topic for all those who recognise the well-known effects of a good implementation of AR. Inasmuch, that they affirm that a user immersed in an environment that involves technology, goes from being a passive user to being an active one, since he/she is immersed in an environment with more realism, more striking and interesting for his perception (Hassan & Abdelbaki, 2017).

The teaching processes based on technological inventions are generally more attractive to users, but it is not enough to use any technological tool, it is necessary to know which option is best suited to a given teaching process (Kiat, Ali, Halim & Ibrahim, 2016).

The AR allows the representation of information through different mechanisms that activate the senses and captivate the attention.

This technology facilitates the apprehension of new experiences, breaks the paradigms or physical limitations that a disabled person may have (Arvanitis et al., 2009).

A large number of researches demonstrate and support the viability and success of the use of a technology such as AR in environments of cultural interest such as museums, which are sites dedicated to the exhibition of objects considered valuable for history, art and science; places that open the mind and give a closer idea of knowledge, all this under the premise of technological advances lead to more people becoming interested in learning while they are entertained.

2. Materials and methods

This documentary research delves into issues related to the implementation of AR, use of edutainment and application of the e-learning system as part of the learning process within cultural environments such as museums.

For the classification of the literature, the relevant information was selected for the particular case study, the description of each work was analyzed, and the advantages, the tools and the degree of success of the applications based on the AR technology were identified.

For the selection of relevant literature, the degree of importance was classified and ordered.

Within the characterisation of the literature, it was important to organise and categorise the articles found in databases such as: IEEE, Scopus, and Science Direct.

3. Conceptualisation

The main objective of positioning AR is that this technology promises great changes in the field of application for the recognition of objects in cultural environments, which makes it a descriptive compendium of experiences resulting from this attractive technology (Torres & Torres, 2013), which gives way to the dynamic interaction between the users of a system.

Azuma (1997), who is a pioneer in the topic related to AR, raises for the first time three essential terms of this technology:

- The combination of real and virtual elements of an environment
- Real-time interactivity
- 3D Information

The main characteristic of AR is that it can complement an environment by means of virtual scenes that enrich a context, it is important to emphasise that this characteristic is given in real time.

For an application to be declared as AR, it must comply with attributes that distinguish it from a conventional application (Delgado, 2015):

- Ability to integrate the real world with pre-designed virtual scenarios, according to the environment.
- The maximum use of AR technology is when virtual elements are almost exactly integrated with the real environment, so that the user who uses the system does not distinguish reality from the unreal.
- AR applications are characterised by a 'marker' that fulfills the tag function, and helps the device recognise and present information about the real environment.

On the other hand, edutainment refers to the increase of interaction within a teaching process, as an incentive for the achievement of learning objectives (Torres, 2015).

Edutainment uses video games as a form of application, but in the field of education, it is a didactic tool available to the teacher.

'Why would it be good to change the way we learn?' (Digital, s. f.). A more personalised training and a more didactic interaction is what the E-learning technique intends, which can be equal to or more efficient than the conventional teaching method.

4. Applications success stories

The analysis of the applicability of AR technology as a basis for learning and training for cultural environments is increasingly booming, recognising its characteristics and advantages as appropriate and accurate for the implementation of edutainment and e-learning.

Through this study comes the assessment that AR, edutainment and e-learning are seen as a whole, can become a novel initiative to support educational processes.

At the moment it is very common to see that more museums present the exhibitions of their objects supported in technology, or by means of 3D-type printings (Katyal, 2017).

The MUVIG Museum of Local Traditions of Viggiano, located in the region of Basilicata, southern Italy (Cianciarulo, 2015), describes that it has supported visits to the museum, making use of AR technology, improving users' experience, in addition to promoting more people to visit this site.

The project called 'VisualVersilia 3D' (Castagnetti, Giannini & Rivola, 2017), implemented in the region of Versilia (Tuscany, Italy), describes its development and is mainly based on the following

stages: First, an improved virtual tour with images, audio, second, 3D design of objects or parts that are no longer available.

This study allows us to conclude that, by implementing the previous strategies based on the use of technology, it is possible to provide a more 'interactive' service and users get more immersive experiences.

Some museums and immemorial sites of tourist interest already make use of the benefits of technology, the transmission of history and dissemination of their heritage, although it should be noted that, 'these new experiences for visitors of these locations are still very strange' (Castagnetti et al., 2017).

Similarly, in the Casa Batllo Museum (Barcelona, Spain) (Gimeno, Portales, Coma, Fernandez & Martinez, 2017), emerges a new bottom-line solution based on AR, this offers a new alternative for some of the common problems presented by museums, becoming a solution applicable to any other museum.

This work (Tom Dieck & Jung, 2017) adds value to the gap between the impact of the use of AR and the risk involved if visitors to cultural sites do not enjoy these new experiences.

At the Roman theater in Byblos, an exhibition was held that incorporates virtual scenes from about 7000 years ago (Younes et al., 2017). Cultural and tourist attractions. Currently, museum administrators and coordinators of educational institutions find the importance of applying Information Technology as a teaching method, and so it is supported. (Kabassi, 2017).

The results of these studies (Chang et al., 2014; Wafa & Hashim, 2016), showed that the application based on AR significantly improved the learning of visitors in the visit through these paintings of cultural value.

Acquiring knowledge is something that can happen in 'any moment and in any place' (Gutierrez, Molinero, Soto-Martin & Medina, 2015), in the temple of Debod, located in Madrid, expose its famous graffiti using AR, it is possible to appreciate that after the implementation of an application of this type the tourists who visit this temple see that besides being a history source sight, they also enjoy a more interesting and attractive experience.

'A didactic and interactive environment that stimulates the learning of children using AR' (Arcos et al., 2016), exposes the development of software, where children develop competitive learning advantages while having fun. This study shows positive results after carrying out the implementation of this application.

Changing the paradigm of museums to exhibit their pieces, by proposing that the visitor of these cultural locations be guided by an application, is the solution proposed by the study (Pantile, Frasca, Mazzeo, Ventrella & Verreschi, 2016).

Nowadays the use of multimedia technologies has increased and its use in education is growing. This study (De Paolis, Vaskevicius & Vidugiriene, 2015), uses 3D modelling and uses AR applications in themes such as history, biology and arts.

Although there are different forms of appreciation and experimentation of AR,' whether in museums, monuments, a painting, seen as a way to enrich or recreate a flat space.

Books with texts are a common way of visualising AR, some examples of this are (Bazzaza, Al Delail, Zemerly & Ng, 2014; Cheng, 2017; Ozdemir, 2017; Phadung, Wani & Tongmnee, 2017; Sugama & Murase, 2017; Zhang, Zhu & Yun, 2016).

REENACT (Blanco-Fernandez et al., 2014) is a study that arises from the need to propose an immersive learning method based on three tools: AR, role-playing and social networks, the Hellenic World Foundation in Greece and the School of Telecommunication Engineering University of Vigo in

Spain, concluded that there were significant improvements in usability; that the combination of these three components, which are currently applied, allows experiences supported in edutainment that until now have not been explored in education.

Fun combined with learning becomes the appropriate solution if you want to captivate the attention of a child, as explained by the study called GoGoBox (Ho, Chung & Lin, 2012), which allows to deduce that the use of pedagogical tools improve creativity and the level of learning is greater; after applying this learning system it is obtained that the cognitive ability and the ability to memorise objects visually improves the apprehension of a certain subject.

The game is a tool that supports and tests different behaviours that can be used for training purposes (where the user learns while having fun). The application of serious games (Ndao, Gilibert & Dinet, 2017), is an implementation easily executed since it stands out for the adaptive response given by users of a system supported by learning and entertainment, it stands out for its impact on the digital society in which the world is submerged.

AR implemented in mobile devices, such as the particular success case EduPARK (Pombo et al., 2017), describes an educational application and at the same time of entertainment and dispersion for its users, in a real and common environment as a park.

Edutainment, e-learning and AR are taking over classrooms, this particular case study describes the patterns in favor of the results that are obtained based on the use of the latter technology; the results show that students experience greater interest and better understand a particular topic when using this technology (Rizov & Rizova, 2015).

The application of AR in IT environments through the visualisation of 3D objects, allows system users to ‘understand analysis reports in a more interactive, intuitive and efficient way’ (Li, Xing-zhi & Yao -qiang, 2016). It follows that AR plays an important role in the functioning of the processes of obtaining energy.

5. Analysis of data and information

There is a wide variety of tools available on the net, regardless of the purpose of implementation to use this technology, whether for educational, entertainment, cultural or even marketing purposes. The most commonly used tools are described in Table 1.

Table 1. Most used AR tools, taken from (Ozdemir, 2017)

Tools	Features
Aumentaty author	Created for windows operating system, stands out for its ease of use. This tool stands out for its use, uses fixed mark technology to recognise the 3d space in which it is
Vuforia	It is an AR software development kit (sdk), compatible with android, ios, unity
AR toolkit	It is an AR development kit. It has open source code which implies a free access to the library
Zoo Burst	A tool that allows you to create 3D books in a simple and dynamic way
Lay AR	Easy-to-use tool, its operation is based on dragging interactive digital elements, including videos, music and photos, compatible with iOS, Android, Blackberry
Aurasma	Each image, object or place can have its own ‘aura’; this is what the creators call their experience of AR
AR Crowd	It is used directly from the browser (there is no need to install software on the computer)

6. Results and conclusions

AR is a technology that improves the level of apprehension of a particular theme, it motivates learning while it entertains and amuses, it has become a pedagogical support tool for all those who

are in charge of educational or cultural environments such as museums, sites that are characterised by the conservation and transmission of history over the years, recreating the history that is part of the past by means of technology has become a step that all must take to give greater interaction to the users who visit these types of environments that are of importance for the development of human knowledge.

From this review of the state of art, the viability of studies of this type is deduced, as well as AR is an innovative technology that easily captivates the attention of the people, that the combination of education and technology are remarkably complementary in aspects such as teaching and learning.

In previous studies, it has been argued that applications based on AR were limited in their implementation in other environments, as (Park & Woo, 2015) states, although more recent studies (Younes et al., 2017) state that the problem of interoperability for AR applications is already solved.

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