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Dušan Tatić
Metropolitan University, Belgrade, Serbia
Dragan Stanković
Faculty of Technical Science, Kosovska Mitrovica, Serbia
Ana Stanković
Metropolitan University, Belgrade, Serbia

MULTIMEDIA INTERACTIVE SYSTEM BASED ON AUGMENTED REALITY (MISAR)

Abstract. This paper is based on the application of Augmented Reality technology which enables the integration of real world images with computer generated contents. It describes a system MISAR (Multimedia Interactive System based on Augmented Reality) which is used to augment and improve the exhibition of museum artifacts and archaeological sites, by integrating 3D models of the artifacts and different multimedia content in images of the real environment. The system is designed as a modern information platform which in an innovative way brings together multi-touch technology and the system of augmented reality.

1. Introduction

Today simple presentations in the form of images, schemas or textual panels cannot keep up with the increasing demands of museum visitors. New technologies, such as augmented reality (AR), enable museum artifacts to become far more interesting to the visitors and help develop the necessary interaction between the visitor and the museum artifact.
This paper describes the Multimedia Interactive System based on Augmented Reality - MISAR which can offer the visitor completely new interactive multimedia contents and help the museum exhibition offer higher quality and more attractive information.

1.1. The definition of AR. Augmented Reality (AR) is defined as a real-time direct or indirect view of a physical real-world environment that has been enhanced/*augmented* by adding virtual computer-generated information to it [1]. Through the advance of the technology of computer graphics, the world of virtual reality has become more and more real, and the possibility of combining it with real environments in our world opens up a new dimension in the understanding of the concept of reality. In the case of a combination of real space and virtual elements, the practical use indicates that there are no clear boundaries. According to Milgram [2] the possible combinations are shown in figure 1. The implementation of virtual objects in a real environment creates augmented reality. Similarly, the implementation of elements from the real environment into the virtual environment creates augmented virtuality.

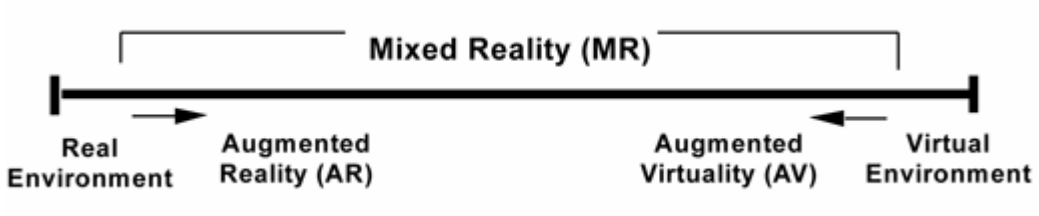

Figure 1 Milgram's reality-virtuality continuum [2]

1.2. Characteristics. Augmented reality is a technology which makes a composite of information from the real world with computer-generated images and contents, and then presents this combination on the display of a particular device (a computer, tablet or cell phone). In that way, the user's perception of the world is augmented by additional information, which in turn creates a new image. The basic characteristics of augmented reality are that it: combines real and virtual objects in a real environment; runs interactively and in real time; and registers (aligns) real and virtual objects with each other [3].

2. Related Work

The applications realized by means of the technology of augmented reality are increasingly more numerous, especially in the field of medicine, entertainment, the military, and the field of cultural heritage. In the case of cultural and historical heritage, or in other words, their presentation by means of the augmented reality technology, we get a completely new qualitative form. In this section we will give a short summary of some of the projects completed in this field.

ARCHEOGUIDE [4] [5] is one of the first AR projects. It is designed for the archaeological sites, tested in Olympia, with the aim of introducing a new method for presenting archaeological sites. With the help of an HMD (head-mounted display) the visitor could see real space augmented by 3D objects, that is, he could experience the architecture and sports of ancient Greece. Carrying around equipment enabled communication with the central server by means of a wireless connection, which gave the visitor the necessary information in real time, depending on the position-orientation tracking component. The system used a hybrid technique for tracking which includes GPS and a digital compass along with optical tracking.

In the Ancient Pompeii [6] [7] project, the mixing of a virtual scene from the real world was described, all on the site of ancient Pompeii. With the help of the AR framework, the 3D scene was augmented by means of reconstructed fresco paintings, and the revival of the flora and fauna from that time, along with the behavior of people from that day and age. The visitors could use mobile equipment in real time to experience the ambience of that time in the past, which showed both the people, their movements and their speech (figure 2).

Figure 2 The Mobile AR system (left), AR animated characters (middle, right) [4] [5]

The AR-museum guide [8] is another interesting project designed to meet the needs of the Louvre museum, which consists of two systems: the presentation room system and the guidance system. The presentation room system implements a system which with the help of AR technology provides additional information regarding the artifacts in the museum. The second, Guidance system, uses an ultra-mobile PC which is used to guide a visitor through the museum with the help of a virtual character, some historic figure, while a vir-

tual balloon leads the visitor to the desired location (figure 3). The system uses markerless hybrid tracking.

Figure 3 A visitor using Mobile guidance system AR (left) guide application (right) [8]

Museum exhibitions such as Rome reborn, 20 Years Fall of the Berlin Wall, and A Future for the Past were realized in a system presented in [9]. The system described the setup consisting of large static images superimposed with digital information layers via augmented reality interaction devices like UMPCs and MovableScreen.

3. Description of the system

MISAR consists of two basic components. The static part of the system consists of markers which can be parts of museum artifacts or previously marked museum space. Within the museum, if we wanted to show a certain piece of information regarding for example a painting or a map, we would use the picture or one of its parts as a marker. If we wanted to position a certain 3D object in space, where it had once been, we use a fiducial (black-white) marker.

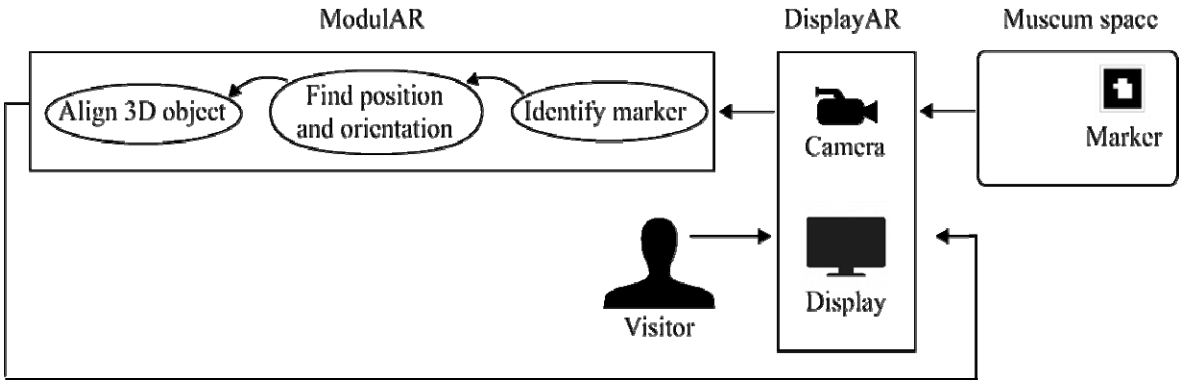

Figure 4 MISAR AR system

The dynamic part of the system consists of a multi-touch screen, positioned on a stationary pillar. The display can revolve, along a vertical axis, by 360^0. A web cam was installed on the back side of the display. The visitor watches, and with the help of the image displayed from the camera, he can look at the museum artifacts. By revolving the display, the visitor can search through the artifacts. When the system recognizes a marker the visitor will see the defined virtual elements on the display (figure 4). These elements are part of the multimedia contents such as the 3D objects, audio/video files, images, text.

Upon being shown the virtual objects, the visitor can, thanks to the specially designed software and a multi touch screen, have addition interaction with the displayed virtual elements. So for example, the visitor can, with the touch of a finger, move the 3D objects, list the additional textual contents and in accordance with his own preferences, select the offered contents.

3.1. Hardware. For the hardware part of the system a PC platform was selected, or in other words, one of the increasingly popular, all-in-one PC systems. This simplifies the very construction of the system and at the same time provides the necessary processor strength. The all-in-one system consists usually of a multi touch screen (in this case 24") which is fully integrated with the central unit, with an installed Windows 7 operating system.

3.2. Software. For the software platform we selected Flash as the most widespread multimedia technology supported by a large number of systems and architectures [10]. The software of the system is designed to contain ModulAR – the module for augmented reality. In order to realize this module, we used open source components which enable additional upgrades in accordance with the development of the system. The software is designed to be applicable to other platforms such as the Web; it can be burned onto CD/DVD media, and can be installed into interactive kiosks.

3.2.1. ModulAR. In the development of this module we tested the FLARToolkit [11] and IN2AR [12] software.

The FLARToolkit uses the marker-based tracking method. It uses fiducial (black and white) markers, which have become a symbol of augmented reality. They are easier for the software to recognize and more precise in the positioning which is very important in displaying 3D objects.

IN2AR software does not need a fiducial marker. It can use any image. IN2AR does natural features recognition and tracking within the Abode Flash Player. IN2AR is an Adobe Flash AS3 Library that allows you to detect images and estimate their pose using standard webcams/cameras. The pose information can be used to place 3D objects and/or videos onto the image and create Augmented Reality applications.

3.2.2 Application. The idea for this type of application was derived from the fact that the visit to a museum is often remembered as a collage of first impressions produced by the prominent feature of the exhibits, and the learning opportunity is missed. Most people do not have enough time and motivation to take in all the various types of information which are presented as part of standard museum exhibition. We wanted to offer a personalized interactive system which would offer the visitor various contents but also the possibility of personalized choice in accordance with the available time and the visitor's personal affinities.

The application is projected in such a way as to enable the visitor, by means of the AR display, to look at the museum space. Once the visitor comes across an artifact which is marked, the module for the AR recognizes the marker and generates its spatial coordinates. On the basis of these data, the positioning and display of the appropriate 3D model of the detected artifact is takes place (figure 5). The appropriate menu is also generated, which enables the visitor to select the desired information regarding the exhibited object in different multimedia forms such as movies, music, images or texts.

Figure 5 AR application example before (left) and after (right) detection of the marker

4. Future Work

We have shown a system which significantly improves the ways in which cultural and historical heritage can be shown. The designed system is stationary and designed to work like indoor system. Since archaeological museums and archaeological sites are found in the open, the use of such as system is rendered impossible. In the future work, the subject matter of our research will be focused on mobile devices such as tablet computers or smart phones, based on the Android platform.

5. Conclusion

The Multimedia Interactive System based on Augmented Reality (MISAR) presents a new form for the presentation of museum artifacts. The use of this system offers multiple benefits.

Thanks to the applied AR technology, the desire and the interest for new knowledge regarding cultural heritage and history has increased.

The constant presence of the problem of museum space can, with the use of this system, be resolved.

In order to use such a system, it is necessary to carry out the digitalization of the cultural heritage, which contributes to the preservation and protection of our culture and history.

6. Acknowledgments

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dusan@dragongroup.org
sfsgagi@gmail.com
ana.stankovic@fit.edu.rs