Believability and Presence in Mobile Mixed Reality Environments

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Abstract

Mixed Realities (MR) and their concept of cyber-real space interplay invoke such interactive 'touching' experiences that promote new patterns of believability and presence. Believability is a term used to measure the realism of interaction in the MR environments. Presence is defined as the measure that is used to convey the feeling of 'being there'. A rich media storytelling case study is used as an example for illustrating the effects of introduction of virtual characters in mobile AR. Although presence is strengthened, believability is not keeping its pace, due to limited interaction between the real participants and the virtual characters, as part of limitations of mobile technology. In this work we are addressing the issues of creating interactive applications for mobile MR, in order to deliver 'real' experiences. We argue that future steps in mobile MR enabling technologies should cater for enhanced social awareness of the virtual humans to the real world and new channels for interactivity between the real users and virtual actors. Only then the believability factor of virtuality structures will be enhanced and allow for compelling real experiences through mobile virtual environments.

CR Categories and Subject Descriptors: Artificial, augmented, and virtual realities, Animation, Three-Dimensional Graphics and Realism, Visualization techniques and methodologies

Additional Keywords: Believability, Presence, Mixed Reality

1 Introduction

Mixed Realities (MR) [1] and their concept of cyber-real space interplay invoke such interactive digital narratives that promote new patterns of believability and presence. However, the "narrative" part, which refers to a set of events happening during a certain period of time and providing aesthetic, dramaturgical and emotional elements, objects and attitudes [2], [3] is still an early topic of research. Mixing such aesthetic ambiences with virtual character augmentations [4] and adding dramatic tension has developed very recently these narrative patterns into an exciting new edutainment medium [5]. Since recently, Augmented Reality (AR) Systems had various difficulties to manage such a time-travel in a fully interactive manner, due to hardware & software complexities in AR 'Enabling Technologies' [6]. Generally the setup of such systems was only operational in specific places (indoors-outdoors) or with specific objects which were used for training purposes rendering them not easily applicable in different sites. Furthermore, almost none of these systems feature full real-time virtual human simulation. With our approach, based on an efficient real-time tracking system, which require only a small pre-recorded sequence as a database, we can setup the AR experience with animated virtual humans anywhere, quickly. With the interplay of a modern real-time framework for integrated interactive virtual character simulation, we can enhance the experience with full virtual character simulations, as depicted from our Pompeii case study in Fig. 1. Even if the environmental conditions are drastically altered, thus causing problems for the real-time camera tracker, we can re-train the camera tracker to allow it to continue its operation.

In the following sections we will be taking as example our mixed reality simulation and subsequently discuss the issues it raises in terms of Believability [13] and Presence [14]. Our premise is that these two factors are essential for making experiences in the virtual environment to be *real*. However, taking into its limits of current AR enabling hardware technologies as well as virtual human simulation storytelling frameworks, we were able to enhance Presence but not Believability in equal terms (with respect to previous mobile MR experiences), according to qualitative user tests performed during the described demonstrations.

Fig. 1. Example of mixed reality animated characters acting a storytelling drama on the site of ancient Pompeii (view from the mobile AR-life system i-glasses)

1.1 System Overview

As a preprocessing stage, our real-time markerless camera tracker system [11] is being trained on the scene that is aimed to act as the mixed Reality stage for the virtual actors. During real-time mobile operation and having already prepared the VR content for the virtual play, our system allows the user to be immersed fully in the augmented scene and witness storytelling experiences enacted by realistic virtual humans The minimal technical skills and hardware configuration required to use the system, which is based on portable wearable devices, allow for easy setup in various indoors and outdoors feature rich locations.

Our AR-Life system is based on the VHD++ [7], component-based framework engine developed by VRLAB-EPFL and MIRALab-UNIGE which allows quick prototyping of VR-AR applications featuring integrated real-time virtual character simulation technologies, depicted in Fig. 1. The framework has borrowed extensive know-how from previous platforms such as presented by Sannier et al [8]. The key innovation is focused in the area of component-based framework that allows the plug-and-play of different heterogeneous human simulation technologies such as: Real-time character rendering in AR (supporting real-virtual occlusions), real-time camera tracking, facial simulation and speech, body animation with skinning, 3D sound, cloth simulation and behavioral scripting of actions.

To meet the hardware requirements of this aim, a single Alienware P4 3.20 Ghz Area-51 Mobile Workstation was used, with a GeforceFX5600Go NVIDIA graphics card, an IEEE1394 Unibrain Camera [9] for fast image acquisition in a video-see-through i-glasses SVGAPro [10] monoscopic HMD setup, for advanced immersive simulation. Our previous efforts were based on a client-server distributed model, based on two mobile workstations as at the beginning of our project a single laptop could not suffice in simulating in real-time such a complex MR application. To achieve the requirement of 'true mobility', a single mobile workstation is used currently in our final demonstrations. That was rendered possible only after the recent advances on the hardware side (processor, GPU) of mobile workstations and on our further software/algorithmic improvements in the streaming image capturing and introduction of hyper-threading and GPU calculations of the MR virtual character renderer.

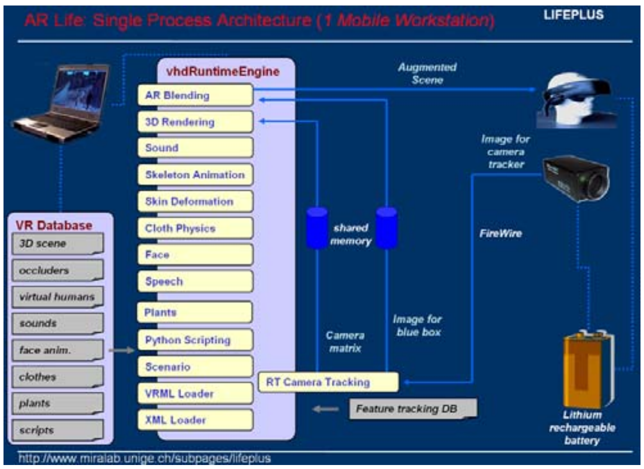

Fig. 2 AR-Life simulator system

In all our case studies we employed 5 fully simulated virtual humans[11], 20 smart interactive objects for them, 1 python script, 1 occluder geometry and in the case of the 'lab maquette' the 3D geometry of part of the thermopolium. The case studies statistics utilizing the above hardware configuration boil down to 20fps for the camera tracker and 17fps for the main MR simulation for the 'lab maquette' trial and 13fps and 12fps respectively for the Pompeii trial.

2 DEMONSTRATION AND RESULTS

2.1 Controlled environment setup trial

In order to validate that our integrated AR framework for virtual character simulation operates in different environments, we have tested the system directly in the ruins of Pompeii. However, in order to further continue AR tests in a controlled lab environment, a real paper 'maquette' was constructed in order to resemble the actual Pompeii site that we visited for our first on site tests. This allowed us for extra fine tuning and improvement of our simulation and framework, without having to visit numerous times the actual site. Fig. 3 and Fig. 4 depict an example of augmenting the real 'maquette'.

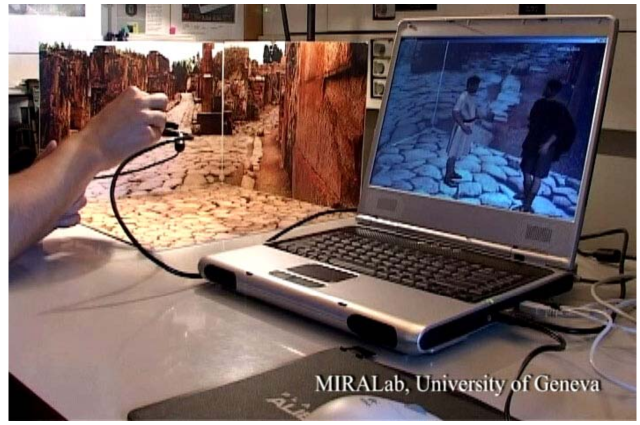

Fig. 3. Lab 'maquette' controlled AR tests. For optimum flexibility and tests the camera is detached from the HMD and moved freely within the 'tracked area' augmenting it with virtual characters (laptop monitor)


Fig. 4. Further examples of mobile mixed reality animated characters in the lab maquette controlled environment.

2.2 Pompeii and the thermopolium of Vetutius Placidus trial

With the help of the Superintendence of Pompeii [12], who provided us with all necessary archaeological and historical information, we have selected the 'thermopolium' (tavern) of Vetutius Placidus and we contacted our experiments there. The results are depicted in the following Fig. 5 to Fig. 8 where the technologies employed for simulating and authoring our virtual humans are already described in [11].


Fig. 5. The Real Pompeian 'thermopolium' that was augmented with virtual animated virtual characters. In this figure the scene is set-up for camera tracking preprocessing; consequently the laptop is put in the backpack for the run phase.

Fig. 6. The Mobile AR-Life simulator system (top left). The previously shown laptop is inserted in the backpack for the run phase. The IEEE1394 camera is attached on the i-glasses (top right) and a wireless trackball allows for interaction with the MR application (bottom left). The custom splitter cable (bottom left) allows for the i-glasses light lithium rechargeable battery to power both the HMD and the firewire camera (since in laptops the firewire port does not provide power). Thus true mobility is achieved surpassing existing car battery custom made heavier solutions. More visitors have tried and tested on the site the AR-Life system (bottom right).

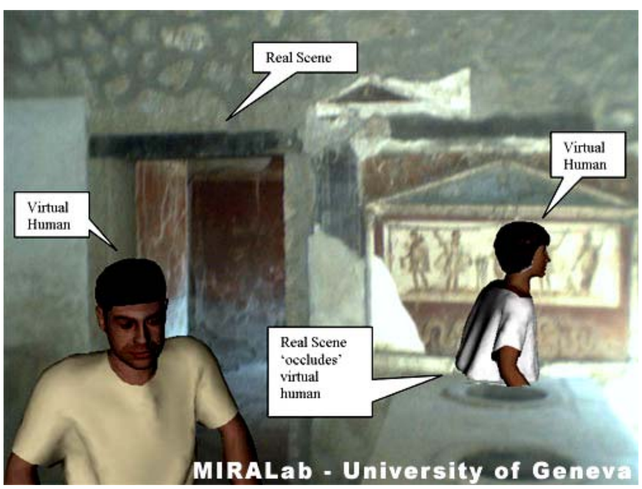

Fig. 7 Real-time virtual Pompeian characters in the real site of the Pompeian thermopolium. Note the use of geometry 'occluders' that allow part of the real scene to occlude part of the virtual human

3 Discussion and Future Thoughts

The main scenario of our Mixed Reality simulation involved 5 virtual characters (Vetutius, Celer, Ascla, Specula and Lucius) re-enacting a story based on a scenario created by the archaeologists of [12]. The scenario involved dialogues between the 5 characters, object manipulation, virtual human body and cloth animation and facial expressions according to each individual personality and emotions. The user has the ability in a wearable mobile manner to modify his position and orientation within the designated area and witness non-invasively the historical representation of ancient life.

Especially this representation constitutes one of the main limitations for presence and believability of such a complex simulation:

- There is no social awareness of the virtual world to the real; i.e. the virtual humans do not notice the real ones. In terms of the believability, it is important to make the environment is aware of the participants along with its real and virtual parts.
- There is no interaction between the real participants and the virtual characters, although such an approach was chosen in order to avoid 'non credible' reconstructions. . To make the world more believable, the interaction should come in a organized way based-on its past, current and possible future behaviors.
- There is no common view/sharing amongst multiple real users of the same mixed reality experience; instead it is fully individualized according to each wearable device and thus each user witnesses the same scene in different timing, rather than giving experience of co-existence..
- Although the geometrical registration of the virtual characters on the real scene is solved satisfactory, there is no photometric 'illumination registration'. Thus the lighting of the virtual humans is inconsistent of the one from the real environment.

Our belief is that Mobile MR can be a better vision for the future if the above shortcomings are met so that both notions of believability as well as presence can be reinforced.

Fig. 8. Further examples of mixed reality animated characters. In this example part of the geometrical structure of the 'thermopolium' is also reconstructed and another example of object manipulation is shown. A real human is also present in this MR scene.

So far, previous approaches regarded believability as related more closely with the platonic notion of inversed world of senses – ideas respectively used to represent the virtual-real world. In that representation, believable is what imitates reality (ideal) whereas actual MR experience is paralleled to the flawed sensual world.

In this work we have addressed the issues of creating interactive applications for mobile MR, in order to deliver 'real' experiences. We believe that further synergies between Knowledge Media, Semiotics of Presence and Hermeneutical Phenomenology will help to establish a theoretical framework of the 'signs' of Believability and Presence in MR media. Furthermore, recent state-of-the-art research in the areas of neuroscience and psychological models can provide the needed clinical and physiological evidence. Only then MR, Media, Vision and Wearable computer scientists will be able to capitalize on the foundations of Believability and Presence for extending the virtuality MR structures and enabling compelling real experiences through mobile virtual environments.

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