Augmented reality environments for immersive and non linear virtual storytelling

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Abstract

The work reported in this paper has the purpose of creating a virtual environment where the recipients (the user) will experience a virtual story telling. In order to introduce the user to a plausible, near to reality experience, we use augmentation methods to create an environment maintaining its physical properties, while three dimensional virtual objects and textures change it for the needs of a real time and controlled scenario. The augmentation is implemented using marker based techniques while the superimposed objects are rendered through the wearable equipment that the user is carrying. In the current implementation we try to blend intelligent non controllable characters that interpret the users' choices and actions in order to intensify his or her interest for the story, while the real time events are being acted. The user is free to explore, interact and watch the desired events, while others are being carried out in parallel.

Keywords: virtual reality, mixed reality, virtual story-telling, wearable systems, computer vision

1. Introduction and problems outline

As technology moves forward, the needs and purposes of virtuality are getting more and more clear. The applications that have already released expand to the fields of education, entertainment, simulation, telepresence and others. What has always played an important factor in all these implementations is the way that a user perceives the artificial environment and with what ways he or she can become a part of it. Throughout the years of evolution of virtual reality, researchers have managed to transfer the sense of vision, hearing, touch and recently smell, inside the virtual worlds, making the user able to live an experience that is truly close to reality. In this way, the progress regarding perception has come a really long way. But what about the sense of actually 'being' in an environment? This feeling is given by human movement, by the ability to make dialog and by receiving intelligent feedback from the behaviour of actors. How can such an experience achieve immersion if the user cannot move freely without constraints and cannot have a plausible feeling of object weight? How would this experience be altered if the ability for conversations was given to the user in order to collaborate with virtual characters?

Our goal is to create an environment which is not bound to projected screens, cables , large constructions or dark rooms but uses augmented reality techniques, which are bound to the physical world, giving the user an alternate reality, ready to host events that compose stories or simulating scenarios [9]. Ultimately, we try to make the user re-live an event in a certain and prepared location as if being actually a part of the story.

2. State of the art

Until now, a lot of research has been done and several steps have been made on user interaction with virtual environments. The tendency is towards the built of systems that are integrated in our everyday life and somehow extend the information received by reality. Below we are referring to concepts of wearable systems, augmented reality story telling, tangible devices, that have already achieved this goal in some extent.

The techniques of Augmented Reality have already concerned the field of Intelligent Environments as an expanding possibility to building realities [5]. Merging these two, a lot of issues arose regarding the kind of context inside these realities, the interaction techniques, the equipment used and finally applications which could benefit from these hybrid systems. In this paper we are addressing the family of applications using portable devices which allow the function of a per user basis and thus tailor made experiences [5, 15].

An implementation for augmented context through a portable device (PDA) is the AR phone [6]. By using the open source AR toolkit [17] and OPENGL GLUT library [18], M. Assad et al. managed to create a prototype using standard equipment. This application along with other implementations using AR toolkit, have shown how much this technology has matured and that it is ready to continue on larger scale projects.

A recent very successful try to transfer the digital world to the real, has been made by MIT media labs and Pranav Mistry's SixthSense. This invention augments the environment projecting digital content on various surfaces using them as interfaces. To control this, P.Mistry, connects system commands to common hand gestures [7]. Another great implementation has been done from the University of South Australia with their system Tinmith [8] which is a collaboration platform for teams existing on the field and teams established indoors. The latter have reference material, global picture and advanced technology and can transfer it to the field in order to organize and guide the remote teams to points of interest.

Augmented Reality technologies have been implemented in concepts of story telling in the past, for projects as the 'Geist, Computer Supported Collaborative Interactive Storytelling' of N. Braun [10], or the great approach from HIT lab New Zealand with the 'Mixed Reality Book' of R. Grasset, A. Dünser and M. Billinghurst [11]. In the first case, Geist is an education platform for historic data. The users wander inside location holding an AR viewer which is activated in certain areas. Through this viewer, 3D models appear as ghosts and verbally interact with the users. In the second case we meet the system of HIT lab New Zealand, where the user is, this time, static in front of a book whose pages are augmented with 3D context.

Our case though is not locational static, but dynamic. This infers navigation of the receiver inside an environment which is an open issue in virtual worlds. Other control methods than just pushing buttons on a controller have made their appearance in the field. A notable and promising way is the (Electroencephalogram) EEG-based navigation [1, 2] where the user thinks in order to navigate. Despite the novelty factor of this approach, still the user can't use walking. A feasible project, where the user gets to navigate by walking to any direction, is 'CyberWalk' [3]. This approach uses a construction of a two dimensional treadmill and the addition of sensors to record user's direction.

Regarding tangible interfaces [13] and devices, there are many implementations for transferring hand movement in the digital world but a lot less when talking about weight or tactile feedback. Most of these, with sophisticated feedback, are like system MEMICA [12] – met in surgical applications – or the MR glove of J.Blake and H.B.Gurocak [4] for virtual reality. In the case of MEMICA the need of real time scientific monitoring is essential [12]. On the contrary, the MR glove is more compact and it is proved that it can convey the sensation of contacting with an object by enabling its brakes.

Continuing with the status of research on virtual, mixed and augmented environments, another section is the use of virtual agents for interaction. In this field, previous approaches have been implemented by Marc Cavazza et al. and their highly accredited articles on agent planning and character-based storytelling [14] in virtual worlds. Given that a pre-scripted story is non existent, the agents create the plot dynamically considering their hierarchical needs. Through the dialog interaction with the user, relative information with the agent's needs may come forth resulting on a change in the agents priorities. In this way the user receives a dynamic scenario where the change to the plot continuum is awaited and acts as stimulative factor to the user's experience. Such an implementation has released for a mixed reality enviroment in the 4th International Workshop, IVA 2003 where the user is being recorded by a camera and is transfered inside the application. The user's gestures and speech are analyzed by the storytelling engine in order advance the scenario [16].

Summarising the above, we have gathered the factors that led to our approach. On one hand, there is the appearance of portable devices having enough processing power for 3D graphics and image analysis in parallel. On the other hand, there are the existing problems of transferring human movement and touch in virtual environments. Finally, the progress on Virtual Storytelling and Interactive Intelligent Virtual Agents has not yet transferred on ubiquitous systems offering immersion to the users. In this direction we propose the construction of an augmented enviroment where the user equipped with a wearable system will wander in the terrain, able to interact in the locations prepared with fiducial markers. These markers are used either as positions for interactive virtual actors or as marks on objects whose texture is being altered in order to represent something different for the purpose of the story.

3. Methods and approach

Trying to work around the above-mentioned problems of free movement and touch, we need to sustain the physical properties of the world and its objects. To gain that we chose to build our virtual environment on top of the real. The result of such an approach is that the user encounters a physical environment that is altered visually and has the ability to host application-triggered events in order to meet a story's needs.

3.1 Technologies

For the construction of such an environment we are using augmentations on predefined spots where we have installed marked printouts with certain patterns. As the user wanders inside our prepared space the head mounted digital camera receives an image stream which is then analyzed using computer vision algorithms. When a marker has been successfully captured in an image frame, the Marker Tracking library is responsible to compute the marker's angle an thus translate, rotate and scale the 3D object which consecutively is placed on top of the fiducial marker. With the extensive use of markers throughout a pre-allocated space we manage to create a full scene of 3D objects. This generated environment is our altered reality. Furthermore, fiducial markers act as way-points and track the user's presence which is therefore linked to trigger story events and three dimensional audio effects in the environment. Audio samples can also be one-way linguistic constructions uttered by the story teller and/or be natural language interactions.

3.2 Equipment

The user is needed to wear the necessary equipment for the duration of the application. The devices that synthesize the prototype system are: a pair of VR glasses to see the environment and its augmentations, a digital lightweight camera which will record images in front of the user for marker tracking, a standard microphone to record user's voice for dialogs and finally a laptop will undertake the task of rendering the 3D objects and augmentation textures while binding all the previous components together for the execution of the main programme.

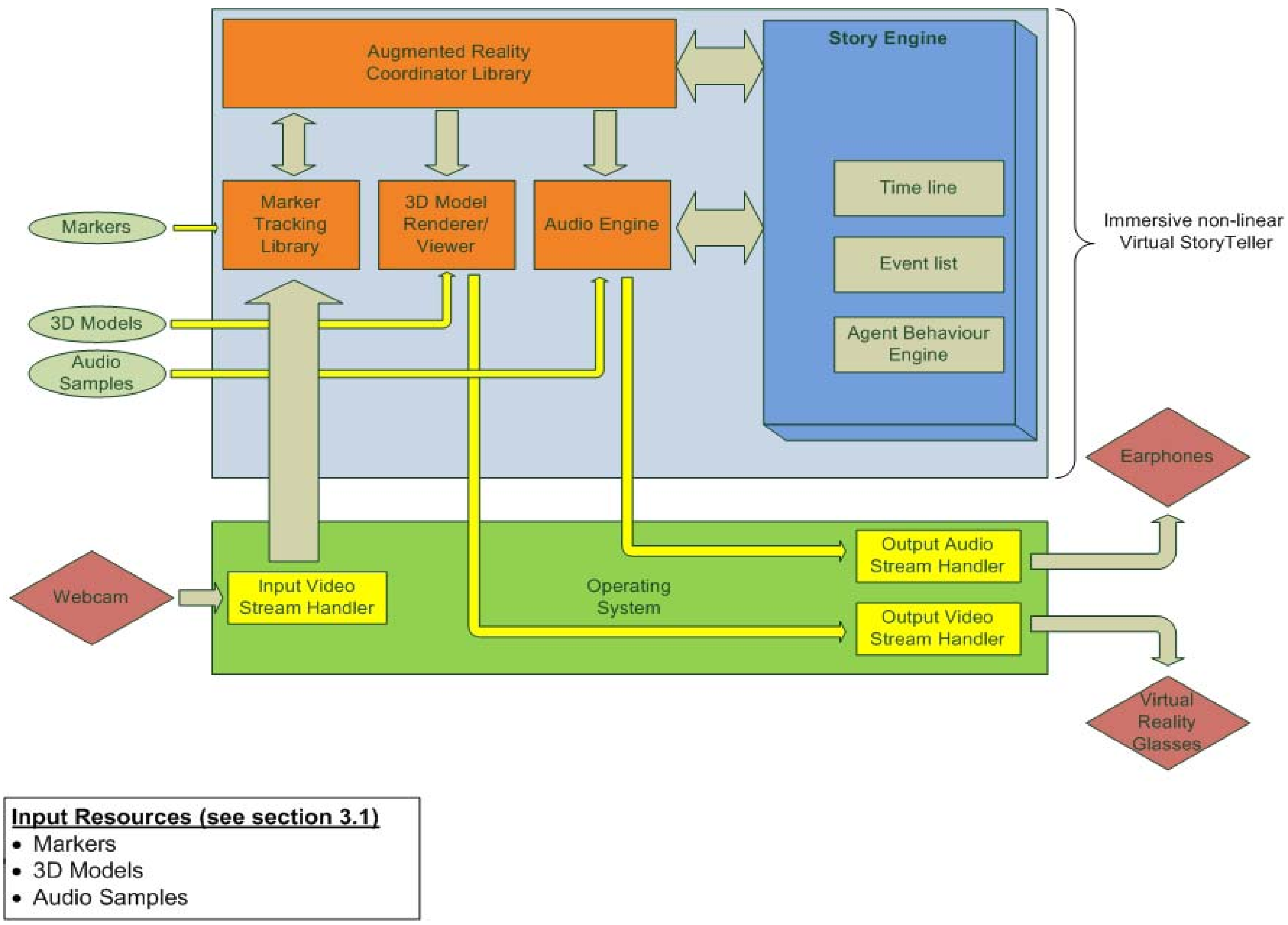

Figure 1: **Architectural overview**

3.3 The prototype

For the needs of the concept we are building a prototype application targeting the creation of an environment that is able to host pre-scripted scenarios, in which the user is invited to experience and act as a part of the plot. The user maintains the ability to walk freely and investigate or observe the surroundings from his or her preferred angle, while encountering events and characters to interact with, using natural language dialog or physical actions/gestures. Depending on the user's interactions the plot proceeds and the user is presented with events in sequence. The narrated story is evolving in real time and as a consequence, the user's position play an integral role on what can be seen or not. The scenario is designed in such way that the user's path will affect his or her experience, always focusing on keeping the atmosphere and interest to the maximum. None of the paths is considered optimum and each path delivers different audio-visual effects plus exclusive non playable character behaviours. For an architectural overview of our prototype see figure 1.

The first prototype will have some restrictions but will be modular, in order to later replace some modules with evolved ones. For example, the dialogs between the recipient (user) and the virtual characters (or the story teller) will, in the first prototype, be 3D GUI dialogs. Later, 3D GUI dialogs will be replaced with a module that receives input in the form of natural language utterances, process them by an NLU (Natural Language Understanding) submodule and create answers via a LG (Language Generation) submodule.

4. The advantages of the proposed virtual story telling approach

Until now we haven't been able to find other comparing systems to free movement Augmented Reality Story telling. As a result we can only compare our approach to other designed platforms for Augmented Reality storytelling. In R. Grasset's et al.Mixed Reality Book [11], the story unfolds stationary nit inside an environment and following the sequence of the book's pages. On the contrary, for stories implemented in our design the user is actually included in the story environment and is not required to follow a specific story flow. In the "Geist" [10] approach of N. Braun, the user is free to move but the augmentations are not directly registered graphics in the environment. The "ghosts" augmentations appear in front of the user in specific areas of the story field. The proposed here approach, registers the three dimensional graphics on very specific spots (on top of the markers), thus enabling the user to circle around and investigate the augmentations as if they were existent in reality. Finally, traditional systems of Virtual Reality Storytelling have the disadvantages of the user standing still, not able to move and connected to stationed equipment. By our architecture the user is free to move in the environment in every human possible way (walk, run, climb, jump) since the whole system is carried along through out the story's duration.

5. Conclusions and Future Work

This architecture has been designed while having in consideration the difficulties that emerge from the existing Virtual Storytelling Environments. In this article we propose a concept about the combination of current existing technologies while having the starting point of improving the user's experience in interactive scenarios. This is the first approach of constructing a completely free Storytelling Environment and many issues remain to be developed. In our future plans we have included the development of modules that take this architecture one step further. Currently a complete playable 10 minute scenario is being developed along with a first implementation of the user's interaction menu. This menu is scheduled to be replaced by two modules, the first one will be a natural language understanding module for the user's communication with the virtual actors and the second one will be, a hand gesture module for interacting with the 3D objects (pressing buttons, operating virtual devices) of the Augmented Reality Environment. Additionally the system will be integrated with a control module for the role of the "Story Director" where the events and actions will be controlled, at first, from a human. In later implementations this Director will be superseded from an Artificial Intelligent agent capable if weighing each user's interest in multi-user scenarios.

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