Interactive Distributed Guided Tours of Historical Sites

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Abstract

In this paper we propose a new metaphor of information retrieving, usable in heritage management and publishing. Based on the net, the user is able to participate in virtual guided tours, sessions of conferences-like. A human expert will be the guide for all the connected users. He will use different media (sound/video) to communicate; the members of the guided group will communicate between them through chat sessions.

Each virtual tourist will be autonomous in its 3D world movements but he will receive audio/video information or other multimedia documents or 3D objects, eventually autonomous entities placed in its 3D virtual universe, from its guide.

The guide is able to suggest to its group of tourists some interesting viewpoints during the tour. More, he is able to augment the database, particularly the associated behaviours to the entities. It is enough to analyse the entities in a scene and to attach them some new behaviours. For example, he can place in the environment some virtual guides, and the users will interact with them. These virtual guides recognise some keywords or intentions; i.e. if a tourist spends some time near a specific place, the virtual guide will initiate a dialog upon the place’s history. The user is able to cancel the dialog with a virtual guide and return to its group.

The application is based on the ARéViJava (Atelier de Réalité Virtuelle) platform, developed in our laboratory.

1. Introduction

The 3D historical sites reconstruction is one of the very first step in using 3D numerical models. These sites were animated by the means of human activities and the problem that follows is the reconstruction of these activities in cooperation with other entities, having specific behaviour. The navigation in virtual environments, the animation of some mechanisms (cranes, drawbridges, vehicles), the interactive manipulation of objects, finally, the use of the models as data-bases interfaces, are some other problems which are still waiting to be solved by an expert using the virtual reality, without being a computer scientist.

The information publishing on the Internet is now a wide used technology, and virtual reality, based on this, permit multi-user access in such of distributed animated environments. This way, we can easily organize meetings, chat groups, tours and even achieve cooperating tasks.

The proposed platform, ARéViJava, is an open-kernel for developing such applications.

The paper is structured as follows. First we recall the three principles of immersion, interaction and autonomy used in VR applications and argument them from historical heritage point of view. Next, the implementation of these principles in the ARéViJava platform, the virtual environment and agent architectures are presented. In the section 4, we present guided tours in an inhabited world, eventually distributed on the net and guided by a domain expert. Next, we’ll introduce the virtual guide, as an autonomous agent.

2. Virtual Reality

The virtual reality represent the set of techniques which permits a mediation between one or multiple users and a 3D numerical model, in our case a historical site. Most of the efforts in virtual reality are oriented to obtain a multisensorial immersion of the human user in the proposed virtual environment, based on the 3D model, and not only to offer a collection of resources for consulting and interpretation. The user of a virtual reality environment become part of the environment, through its
avatar. According to this new perspective, the user is able to explore the environment, to examine the component objects and more, to interact with them.

2.1. From presence to autonomy

To realise the user plunging in a virtual environment the implementation of three principle is necessary: the immersion, the interaction and the autonomy [8].

- The immersion: the user’s setting in situation was realised based on its senses, particularly on its visual and auditive ones. For this, models and algorithms make possible a realistic generation and rendering of objects.

- The interaction: here we have to put on work the constructivism of Piaget; we learn better by making ourself. For this, we have to permit to the user not only to observe but to act on the environment. In general, this action will be an object movement, for example by pressing a lever to making work a crane.

These two principles – the immersion and the interaction – correspond to the sense of presence; giving the impression of being there to the user which is able to interact and modify its environment.

But, because an environment without its users seems like an empty theater stage waiting its actors, we need to taking into account yet another principle in order to transform this user-oriented world, the principle of autonomy of some of its components.

- The autonomy: the environment is inhabited by agents which live their lifes, each with its own goals. These agents are autonomous in the measure of their adaptability to their dynamic environment, accordingly with their psychological profile and objectives. For this, they have to be able to perceive their environment, to decide and to react accordingly.

The notion of autonomy is interesting from different points of view:

- One of the goals of historic publishing is to transmit knowledge about our ancestors. And this it can be done by presentation of objects they made, or better, by showing them at work. Viceversa, to visualize a human activity can presume the use of an existing object in a specific spatial content.

- To the autonomy of the objects components of virtual environment correspond to the software component’s autonomy by which we implement it. For this it is necessary to know the use cases in which all the components and/or users are involved. The adaptability aspect simplify the software completion.

These three principles corespond to different types of models:

- Geometrical and photometrical models for the principle of immersion,
- Algorithmical models for the description of certain autonomous behaviours, and for the interactions between the users and their virtual environment.

2.2. The virtual reality and the historical heritage

The virtual reality complete the historical documentary repository by reconstitution of old lost sites and by immersing the tourist in the spirit and atmosphere of this site. In the same time, this technology facilitate the user access to the information stocked in large world spreaded databases.

3. The ARéViJava virtual reality platform

ARéViJava is a software platform designed for developing virtual reality applications [7]. The core is based on Java™ language. As graphical render we are using the Java3D API, based on OpenGL or DirectX and J3DFly for graphical objects persistence and navigation. In this software components context, our platform realize the multi-agents simulation.

3.1. The immersion

In order to realise the user’s immersion we have considered the virtual environment as the union of all perception and emission fields of the entities, which populate a multi-dimensional informational space [6]. These are generalizations of medium, nimbus, aura, and awareness notions as they were introduced by Benford [1]. We were inspired by the human perception mechanisms [3], as Herrero did [4], and we adopted a fuzzy approach. The virtual environment evolution is based on informational links established between the entities that populate the environment. These entities are looking for carrying out some specific tasks in order to achieve their objectives. In other words, they interact with their environment and with each other.

3.2. The dynamic aspect of programming

The interactions between agents are of cause-effect type: any change of the agent’s state represents a possible cause and may have as effect a stimulus emission. In our approach, the stimulus is a container that conveys information regarding the agent state. At the same time, it is the object of the agent’s perception (see Figure 1).
The interaction principle leads us to modify, during the execution, the environment’s agents population and their properties: state and behaviour. For this, the access to the agents is needed, and the simulator offer a list of **alive**d entities. The entities management is realised by dynamic load of Java™ classes.

3.3. The agent’s autonomy

A world from ARéViJava perspective is a set of autonomous interacting agents by the means of a singleton object, named simulator. The objects’ modeling is multi-agents oriented; i.e. each entity is implemented as an agent characterized by:

- Its state: position, speed, world model, know-how, …
- Its behaviors, primary:
  - Perception activities, by the means of its receptors, based on the existing environment’s stimuli [6],
  - Environment events sensitivity, by the means of a set of methods,
  - Research to satisfying a set of specific goals. This research is obtained by simulator invocation of a specific method: act().

During the virtual agent’s life, the agent’s state is given by the values of its attributes that are the generators of its informational shapes. The shapes’ variations are produced by the effectors and are perceived by means of the receptors, under the form of stimuli.

These modifications may be initiated by the reception of an external stimulus such as a change in environment followed by emission of internal stimuli. The receptors generate perceptions based on these stimuli. The perceptions, in turn, will activate the decisional component, which will send orders to the effectors.

In order to evolve in the virtual environment, an agent uses its world model. This model is internal to the agent and is situated within agent’s knowledge. Many categories of information such as the agent’s objectives, abilities, perceptions, and/or sentiments are modeled and stored in the agent’s knowledge, too.

4. The Ozanne project

The access of the large public at multimedia databases suppose the use of metaphors. The “*reading a book*” one we will substitute with “*guided tour of a 3D model*”. The virtual reality allow us to learn, to accomodate and to accept much easier a complex and dynamic environment, described by large and various documentations.

The Ozanne project, based on the ARéViJava, uses a such of metaphor. It propose guided tours of an old part of Brest harbour, in 1810. The buildings modeling was made following the original raised maps from that time [2]. The textures were obtained based on photos of the same maps.

We propose three use-cases.

The first one is a local application. The user is visiting the 3D universe, can manipulate objects within it, and there are some animated entities in the environment (the boats in Figure 2).

![Figure 1. Interaction between the agent’s components and environment.](image1)

![Figure 2. Local version of virtual tour - Penfeld (old Brest region) view with boats.](image2)

![Figure 3. Database connected local version of virtual tour.](image3)
In the second use-case, the user is connected to a web server. The associated links to the universe’s objects permit the user access to a multimedia database (Figure 3).

In the third use-case, the users are in a scheduled meeting with a human expert (in history, paintings, numismatics…) (Figures 4 and 7). The guide propose to its group some guided tours. The user will connect to one of this proposals. He/she will conserve its moving in 3D autonomy during the tour, but will be able to receive multimedia informations (videos, sounds) or even 3D objects (Figure 5) from its guide and to participate into chats sessions, also. The received 3D objects can be autonomous entities, placed in user’s environment or in some other virtual museums.

For preparing its conference, the guide need to edit a HTML document which will permit him/her the rapid selection of informations, eventually from the database, used in its presentation (Figure 6).

The guide is able to suggest to its group of tourists some interesting viewpoints during the tour (figure 5). In the same time, he/she is able to augment the database (Figure 8), particularly to increase the number of entities associated behaviours. For this, all it has to be done is to analyse the existing entities in the environment and to send them new behaviours.
4.1. The virtual guide

The context in which the agents exist provides a framework that defines what their objectives should be and will give the sense of the agent’s actions within it. For this, we invoking the virtual theater metaphor [5], and we create environments which are populated with autonomous characters. These characters, according to their roles, may changing replicas between them, and based on their structure are able to feel the environment and to react at environment’s changes. Like in the classical theater, we make use of the spectator, the actor, and the stage manager as the author, as main roles of virtual agents.

From this perspective, the historical site’s environment is populated by virtual agents which perform some activities in specific places, the virtual theater actors, by the visitors which can interact with the environment and its habitants, the spectators in the theater metaphor, and the real guide, which is the stage manager, responsible with the site organisation and the tour advancement.

As in any real guided tour, it is possible that some of the tourists to temporary quit their group to get some other see sites. For this, the expert can place in the environment some virtual helper-guides and users will interact with.

This virtual guide recognise some keywords or intentions; i.e. if a tourist spend some time in front of an historical artefact, the virtual guide will initiate a dialog upon. Based on the keywords he recognises, he is able to browse the database and try to answer to the user’s questions.

The scenario the virtual guide has to follow contains a sequence of interesting hint points in the tour without being constraints. Doing so, the user is free to choose its tour having an expert behind, too.

The user is able to cancel the dialog with its virtual guide and return to its group.

5. Conclusions and future works

We propose an environment for distributing heritage using virtual reality. This technology allows to access complex and dynamic information. By using the autonomy of some virtual environment entities, the historical space becomes inhabited, so more realistic. Other aspects as multimedia or network distribution were implemented based on Java language facilities. The application is based on the ARéViJava (Atelier de Réalité Virtuelle) platform, developed in our laboratory.

Our future interests are concerning the believable behaviours module and cooperative aspects.

6. Acknowledgements

Thanks are due to the Raised Map Museum (Musee des Plans Reliefs) from Paris and to Alain Boulaire, the organising of the exhibition “Brest au temps de l’Académie de Marine” for facilitating the access to the original scaled-model of Brest harbour.

7. References