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Realizing External Avatar's Action Control on WWW-based Pseudo-3D Space

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Abstract

In the virtual space, as it is common that a user selects an avatar from several avatars provided to represent himself in the space, a number of users may use the same avatar. As a result, it becomes hard to distinguish the users by their avatars. However, if each user uses a unique avatar, the relation between a user and an avatar will be one-to-one and the user can customize his own avatar. In this research, we propose the Open Avatar Architecture (OAA), which enables users to utilize various virtual spaces using their own avatars. We also implement a prototype system to achieve OAA using pseudo-3D space we have constructed. Using this prototype system, it becomes possible to control single avatar in multiple virtual spaces.

1. Introduction

Recently, there are many applications on the computer network which use virtual spaces[1, 3]. Most of these applications utilize avatars to represent the user in the spaces. In general, the control mechanisms of avatars, as well as shapes and behaviors, are prepared and embedded in each system. In some cases, users can choose their avatars from some alternatives prepared in each system[4]. Since it is hard for a system designer to prepare a variety of avatars, several users often use the same avatar in each system. As a result, it becomes hard to identify the users via their appearances. In addition, when a user moves to another space using hyperlink connecting virtual spaces, the user has to change his/her avatar and may be forced to learn another method to control the new avatar.

These problems are mainly due to the fact that each virtual space system contains both the data of the avatars and

the mechanisms to control the avatars. The problem can be solved if the users can seamlessly operate the same avatar even though the user moves to another virtual space.

Aiming at realizing the integrative use of several avatars in virtual spaces, in this paper, we propose the open avatar architecture(OAA). OAA separates the data and the control mechanisms of avatars from the virtual-space management system and makes it possible to distribute them on the network. The control mechanism for each avatar is stored in a conventional WWW server called an avatar server. The avatar server provides data of the avatar and its information. We consider images as the basic data format of OAA. The actions of avatars are realized as animations. In the 3D virtual space, the image data is used as a texture of a rectangular polygon.

OAA allows users to move from a virtual space to another using a single avatar. As a result, OAA enhances the reusability of avatars and, at the same time, the availability of virtual spaces.

The rest of this paper is organized as follows. First, we explain the schema of the OAA in section 2. Next, we describe in detail our prototype using pseudo-3D space as the virtual-space system in section 3. Finally, we summarize the paper and mention our future plans concerning our proposal in section 4.

2. Open Avatar Architecture

The approach of OAA is to separate avatars from the virtual-space systems and to distribute them over the network to make it possible for users to use their own avatars. The separated avatars are stored in conventional WWW servers to allow users to own their avatars easily. Those who create a new avatar should store the data in a WWW server in a unified directory structure. This is because the avatar

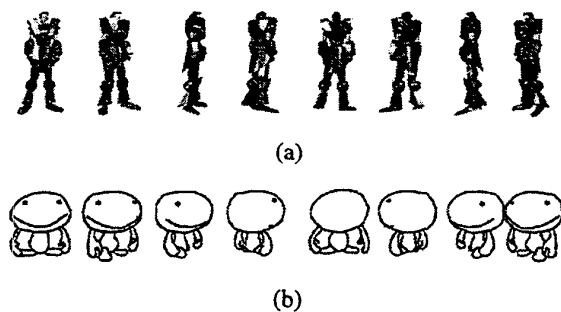


Figure 1. Examples of visual data of avatars.

server should be available to provide data according to the request using an URL as a parameter. We show the directory structure in the next section. We call such a WWW server an avatar server. OAA adopts HTTP as a basis of communication among virtual-space systems and avatar servers.

In the avatar server, visual data which express appearances and actions of the avatar are stored. In addition, attribute information such as height, width and definitions of actions are also stored as a single text file called 'initial file.' Based on the following three observations, we use images as the default format of visual data.

- Images are well suited to be transferred over HTTP.
- Images are easy to be created.
- Images can be used in various virtual-space systems.

Example images to represent avatars are shown in Figure 1. The avatar shown in Figure 1(a) is originally a 3D model and rendered into images. The other is a free-hand drawing(1(b)). From these eight-directional images, the virtual space systems possibly generate intermediate viewpoint using IBR technology[2, 7].

When necessary, the virtual-space system downloads proper visual data by sending HTTP requests according to the attribution information which is described in an initial file acquired from avatar servers beforehand. The visual data are used to represent the avatar in the virtual space. For example, when sequential images expressing an action(like Figure 2(a)) are prepared, the virtual-space system can replace the avatar's image in succession to represent the avatar's action as shown in Figure 2(b).

The definitions of the actions are described in the following manners:

- How many images are used to realize the animation.
- Key frames of the animation to realize the LoD(Level of Details) of the animation.
- How the objects around the avatar are affected by the action.

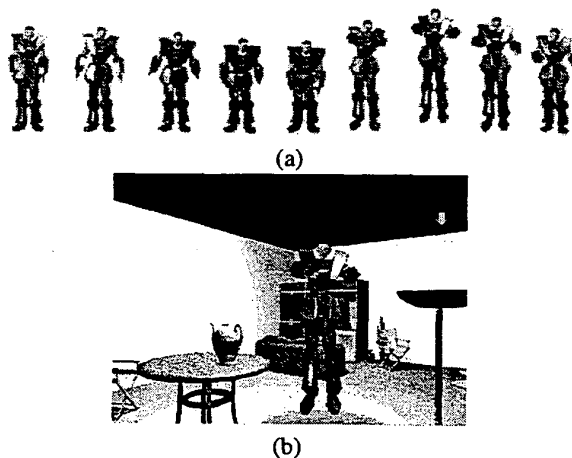


Figure 2. An example of an avatar's action.

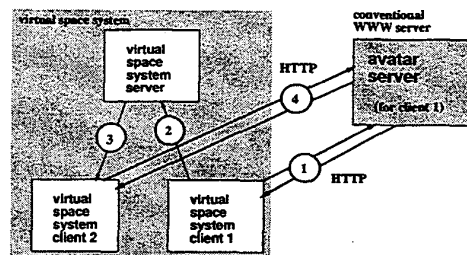


Figure 3. The schema of OAA.

The virtual-space system realizes the avatars' actions by referring to these descriptions. The system also calculates the effects of the action according to the definitions. Therefore the system should download the initial file at first.

Here, conventional virtual-space systems usually adopt the client-server model. Each user corresponds to a client. The server manages the whole virtual space. In this model, when a user instructs the system to make his/her avatar take an action, the client represents the avatar's action and at the same time notifies the server of that event. The server multicasts a notification to other clients. Each client synchronizes to the first client according to the notification. OAA alters two parts of this client-server model.

Figure 3 shows the schema of OAA. First, instead of representing an action of the avatar prepared at the client against an instruction of the user, OAA applies the visual data stored at the external avatar server(Figure 3①). Second alteration is that the external avatar server is also used at other clients to represent an action of the avatar when they are to synchronize to the client(Figure 3④). OAA uses

a conventional communication method between the server and the clients to realize the synchronization(Figure 3② and ③).

3. Implementation

We have implemented the prototype of OAA using IBNR(Image-Based Non-Rendering)[8] as the virtual-space system. IBNR is our proposed method which realizes easy construction and easy browsing of pseudo-3D virtual-space on the WWW.

3.1. IBNR(Image-Based Non-Rendering)

IBNR is a simple approach where we use scenic images such as those taken by a digital camera. Each scenic image on which avatar images are composed is used without distorting them. IBNR lets anyone to enjoy both easy construction[6] of real virtual space and easy browsing of it.

We have realized the virtual spaces for several purposes, such as guidance and introduction of some places and buildings[5] and remote communication.

3.2. Avatar Server

In order to represent an avatar by several images, we quantize the possible directions of an avatar against a camera in eight. Thus, we provide a way to express in what direction the avatar faces in an image. We use file names to express directions of the avatar. The manner to name an image file is based on the combination of 'f' for front, 'r' for right, 'b' for back, and 'l' for left.

In Figure 1, we show image-based avatars which face eight directions as examples. From left, they are named as; "f.gif", "fr.gif", "r.gif", "br.gif", "b.gif", "bl.gif", "l.gif", and "fl.gif", respectively. These images are used for the avatar with no action. The data for actions are also named in the same way.

In the following, we explain how to store the image data using the directory structure shown in Figure 4.

Initial file : The initial file should be stored under the root directory of the avatar server with the fixed name 'avatar.js'. Therefore, any systems can obtain this file by accessing the root directory. This file must be prepared.

Action directories : The action directories should be prepared under the root directory for each action. Images representing the appearance of an action are stored in the action directory whose name corresponds to that of the action(e.g. 'run', 'jump', 'walk').

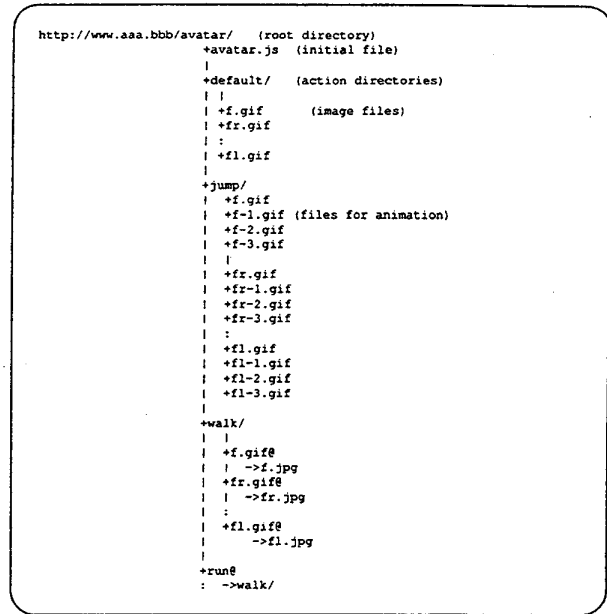


Figure 4. The structure of an avatar server.

It is also possible to prepare animation files in this directory. Images representing a rifting animation will be numbered sequentially. The jump directory in figure 4 is an example.

To unify the format of the image file, we use aliases for real data in various formats like that shown in the walk directory in figure 4. In a similar way, using alias for another directory, existing data may be reused as data for a new action. The run directory is an example. In this case, image files in the walk directory are used for the action run.

Default directory : This directory is one of the action directories. This directory and its contents should be prepared. The data stored under this directory are used for the default appearance of the avatar.

3.3. System Behavior

In our prototype, we prepared two independent IBNR virtual-spaces. Here, independent spaces mean that they do not share system resources in their construction and operation. We implemented an additional mechanism to each virtual-space system, which enables users to use these spaces applying their own avatar. We also realized the sequential use of two virtual spaces by transferring the management information of avatars between these systems. In this case, users can use the same avatar even if they move to another virtual space (Figure 5).

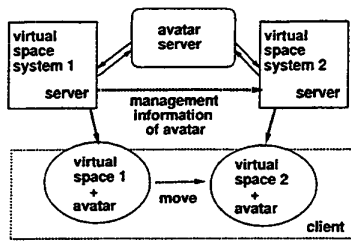


Figure 5. The realization of the sequential use of two virtual spaces.

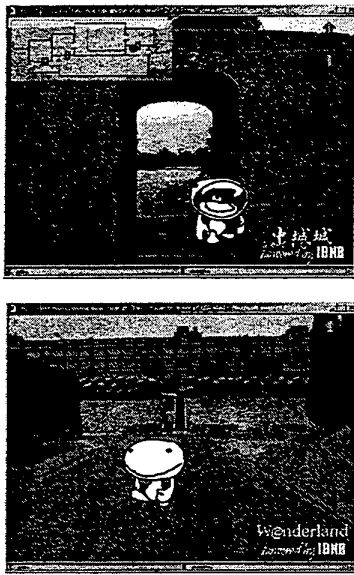


Figure 6. Examples of the system behavior of the prototype.

When a user wants to use these virtual spaces, first of all, the user logs in one of them with specifying the URL of his/her avatar. Once the user specifies the avatar, the user will not be asked to specify it again, i.e., the migration-process to another virtual space is done automatically. Therefore our prototype is effective for users to have a feeling as if these virtual spaces are connected seamlessly.

Figure 6 shows that a user browses two different virtual spaces successively by controlling the same avatar.

4. Conclusion

In this paper, we have proposed OAA, an architecture to make avatars independent of the virtual-space systems, and mentioned the mechanism of the prototype. In the prototype, we use pseudo-3D IBNR space as the virtual space. By adopting our method, users can use several pseudo-3D

virtual spaces in succession by operating a single avatar of their own.

In the future, we will still enhance the implementation. For example, we are planning to support not only image-based avatars but avatars in 3D data format. Furthermore, we will adopt OAA to the virtual-space system in 3D format.

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