Demonstration of Guiding Techniques for Collaborative Exploration in Multi-Scale Shared Virtual Environments

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ABSTRACT

Exploration of large-scale 3D Virtual Environments (VEs) is often difficult because of lack of familiarity with complex virtual worlds, lack of spatial information that can be offered to users and lack of sensory (visual, auditory, locomotive) details compared to the exploration of real environments. To address this problem we propose three guiding techniques in the form of navigation aids to enable one or several users (called *helping user(s)*) to help one main user (called *exploring user*) to explore the VE efficiently. These three techniques consist in drawing directional arrows, lighting up a path to follow, and orienting a compass to show a direction to the exploring user. All the three techniques are generic so they can be used for any kind of 3D VE, and they do not affect the main structure of the VE so its integrity is guaranteed.

Keywords

Virtual Reality; 3D Navigation; Collaborative Virtual Environments.

ACM Classification Keywords

H.5.3 Group and Organization Interfaces: Computer-supported cooperative work (CSCW); I.3.6 Methodology and Techniques: Interaction techniques; I.3.7 3-Dimensional Graphics and Realism: Virtual reality.

INTRODUCTION

Navigation is a fundamental and important task for all VE applications as it is in the real world [2]. It includes two main tasks: *travel* [3, 1] and *wayfinding* [4, 3].

For an effective navigation task in a collaborative VE, we propose a set of three guiding techniques to reduce the wayfinding time of the exploring user by having the assistance from helping users who can have a global and complete view of the environment such as a bird's eye view. These guiding techniques in the form of navigation aids used by the helping users need to be simple, intuitive, efficient and easy to use. In addition, in order to be easily used in many different kinds of VEs, our approach does not require developers to create specific maps of the VE for each guiding techniques; to modify a system or its interface for a new VE model; or to add many fixed guidelines into VEs. By satisfying these conditions, our techniques can be integrated in many 3D complex, large-scale VEs while the integrity of these environments is ensured.

We demonstrate three guiding techniques in a collaborative application that aims at finding hidden target objects in a large and complex virtual building (see Figure 1). Without help from another user, the exploring user could not easily find these target objects in a short time.
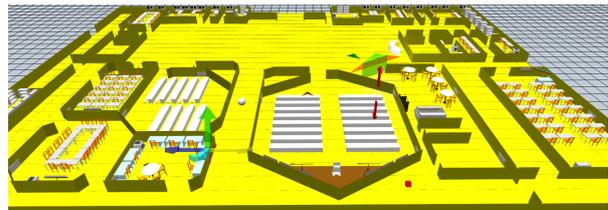
Figure 1. Helping user's bird's eye view of the virtual building

THE THREE GUIDING TECHNIQUES

Arrows

This guiding technique is based on directional arrows (see Figure 2) that are drawn by helping users to indicate the direction or the path that the exploring user has to follow. Helping users can draw as many directional arrows of different sizes as they want. These arrows will disappear after a while. Helping users are recommended to draw directional arrows within easy reach of the exploring user's visibility zone. To draw these arrows, a helping user simply has to make a kind of 3D drag and drop gesture through a 3D cursor. This kind of gesture can be driven by any device that can provide a 3D position and can send events to the 3D cursor. This 3D cursor can be brought to a Collaborative Virtual Environment (CVE) by a helping user when he joins the CVE, so there is nothing to change in the main structure of this CVE and its integrity is guaranteed.
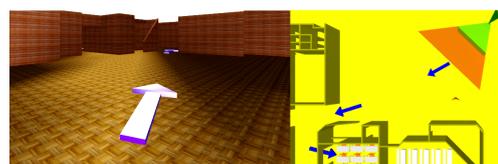

Figure 2. Directional arrows in each user's view.

Light source

The second guiding technique is based on a light source used to light up a path to each target object (see Figure 3). The exploring user cannot see the light source itself but only its effect on objects within the environment. The helping user controls the light source by moving it with a 3D cursor and shows up the path the exploring user must follow. Here again, this 3D cursor and the light source can be brought to the CVE by a helping user when he joins the CVE, so there are very few things to change in the main structure of the CVE: we just need to be able to put the lights of the CVE off.
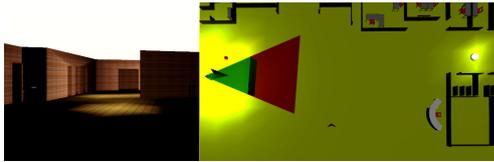

Figure 3. Light source in each user's view.

Compass

The third guiding technique is based on a compass attached to the position of the exploring user (with an offset), a typical tool to navigate in VEs (see Figure 4). The compass does not point directly to the target object location, but points to the location of another virtual object that plays the role of the target of this compass, which cannot be seen by the exploring user. A helping user can control this compass target by moving it with a 3D cursor, to show up to the exploring user the path he must follow. Here again, this 3D cursor, the compass attached to the position of the exploring user, and the virtual object serving as the target of the compass can be brought to the CVE by a helping user when he joins the CVE, so there is still nothing to change in the main structure of the CVE.
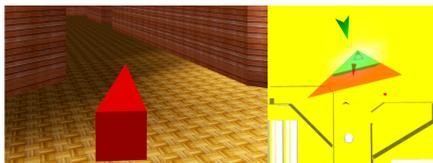
Figure 4. Compass in each user's view.

THE DEMONSTRATION

The task to achieve

The exploring user has to find different positions of target objects represented by small glowing cubes. When he picks up the target object, it disappears and a color signal appears to tell both users that the target had been reached.

Figure 5. A "looking over the exploring user's shoulder" view and a first-person perspective of the exploring user.

The guiding viewpoints

We built two principal kinds of views for our helping user: a bird's eye view (see Figure 1) and a first-person perspective by "looking over the exploring user's shoulder" (see the image on the left of Figure 5). These views were obtained by choosing some particular points of view: the "looking over the exploring user's shoulder" view was attached to the point of view of the exploring user and the bird's eye view was obtained by increasing the helping user's scale. Both views were built without any changes to the main structure of the VE, with the same concerns: to guarantee the integrity of the VE, and to offer the possibility to be used for any kind of VE.

The exploring user

The exploring user is immersed in the VE with a first-person perspective (see the image on the right of Figure 5). He is controlling a joystick to travel in the virtual world and as his head is tracked, he is able to move physically to observe objects more carefully in the environment. He is also able to move forward or backward, and to turn right or left by using a joystick. The direction of movement by the joystick is where he is looking at. The helping user uses some specific buttons of the joystick to pick up target objects or to return to a starting position.

The helping user

The helping user has a 3D cursor to manipulate objects within the VE, to add navigation aids such as directional arrows, or to control the light source or the target of the compass. He is also able to control the position and orientation of his own viewpoint as well as to change his own scale in the view. He is also able to see where the exploring user is at every moment. The interface of the helping users is also pure 3D.

CONCLUSION

These collaborative guiding techniques have been evaluated in [5]. They can be used in many kinds of 3D CVEs because they do not modify the structure of the environment: they are dynamically added in the CVE. Some come when helping users join the CVE (light, compass, compass target) and others (arrows) are created dynamically by guiding users through dedicated 3D objects the helping users bring with them (3D cursors).

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