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When the Giant meets the Ant
An Asymmetric Approach for Collaborative Object Manipulation

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INTRODUCTION
This work proposes a set of metaphors that enables several users to collaborate in order to achieve common manipulation tasks in Virtual Reality (VR). For instance, the tasks proposed for the contest consist in overcoming different obstacles by moving, rotating and scaling a cube collaboratively. In order to cover these requirements, we propose an asymmetric collaboration between 2 or more users with different devices (cf. Fig. 1). The users are embedded in a co-located multi-scale virtual environment thanks to a model inspired from the Immersive Interactive Virtual Cabin (IIVC) generic model [2]. We chose to use devices that are or will be soon on the consumer market. Our system is designed to be easy to use and to learn and aims improving a difficult manipulation task using collaboration.

1 INTRODUCTION

For the 3DUI Contest 2016, we propose an innovative approach that enables two or more users to manipulate an object collaboratively. Our solution is based on an asymmetric collaboration pattern at different scales in which users benefit from suited points of views and interaction techniques according to their device setups. Our system provides an efficient way to co-manipulate an object within irregular and narrow courses, such as the contest material scenes, taking advantages of asymmetric roles in synchronous collaboration.

Keywords: Collaborative 3D Interactions; Shared Virtual Environments

Index Terms: H.5.3 [Information interfaces and presentation (e.g. HCI)]: Group and Organization Interfaces—Computer supported cooperative work (CSCW); I.3.6 [Computer Graphics]: Methodology and Techniques—Interaction techniques

2 ASYMMETRIC COLLABORATIVE SCENARIO

For the 3DUI Contest 2016, we propose an innovative approach that enables two or more users to manipulate an object collaboratively. Our solution is based on an asymmetric collaboration pattern at different scales in which users benefit from suited points of views and interaction techniques according to their device setups. Our system provides an efficient way to co-manipulate an object within irregular and narrow courses, such as the contest material scenes, taking advantages of asymmetric roles in synchronous collaboration.

The collaborators benefit from complementary interaction techniques to perform the manipulations tasks proposed for the contest.

3 INTERACTION TECHNIQUES

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3 INTERACTION TECHNIQUES

The users on the zSpace (Giant) can translate the cube with a bent ray inspired from the interaction technique proposed by Riege et al. [6]. The ray is controlled in position and rotation by the tracked stylus. One button is used for object grabbing, and the other buttons are used to switch between four point of views: front, left, back and right. The ray is bent during the cube translation in order to respect three constraints:
3.2 Inside Object Manipulation

The Ant is placed inside the manipulated object, here a cube. He can scale and rotate it with the two Razer Hydra controllers thanks to bi-manual metaphors inspired from the work of Cutler et al. [1]. These manipulations are performed with a fix reference: the cube front face. This reference face can be changed with a button. The manipulated object can not pass through an obstacle. As shown in Figure 2, the rotation is made with a modified version of the grab-and-twirl metaphor. Compared to the classical version, the pitch rotation is performed with a metaphor close to a plane yoke by orienting the two controllers to the top or to the bottom. The scale of the cube is controlled with a grab-and-scale metaphor by bringing closer or further the two Razer Hydra controllers while pushing two corresponding buttons. The scale control is shared with the user of the GearVR. To solve this concurrency, we add the factors that the two users want to apply to the scale. Two visual feedbacks are rendered to make the Ant understand the distance between the cube and possible obstacles. First, we render particles at the collision points. Second, a virtual grid visible in blue at bottom in Figure 1b, parallel to the user current front face, is displayed outside of the cube.

To guide the Ant when he is placed in a closed environment such as the provided labyrinth, different spatial cues can help him. They are shown in Figure 1b. First, a World-In-Miniature [7] shows a third person view the that focuses on the cube front face, is displayed outside of the cube. As shown in Figure 1b, a progressive transparency effect is applied to the manipulated cube from the screen extremities to the screen center (cf. [5]). Here, it is used as an anti-cybersickness filter that aims to make the peripheral view of the user consistent with his head movement. Therefore, the user’s peripheral view is less disturbed by translations performed by the Giant. Some preliminary evaluations of this effect have been performed in another context and have shown good results.

For awareness issues, the viewpoint of the Ant is shown to the other users by displaying his frustum and up vector.

4 IMPLEMENTATION

Regarding the implementation of the prototype, a software overlay of SmartFox Server is used to manage collaboration. For the rendering, scripting and managing the scene we use the Unity3D game engine. The interaction part is independent from the devices and from the game engine used. Indeed, it is developed with an implementation of the plasticity models presented by Lacôte et al. [4]. With this solution, each user automatically benefits from the adapted interaction techniques according to his available devices. We have used the different scenes provided for the contest. Some textures have been added to stylize the demonstrator as shown in Figure 1a for the labyrinth. Another scene is also available in order to demonstrate other advantages of our interaction metaphors. It is the virtual factory, shown in Figure 3, where the Ant can perform different actions such as painting the box or opening doors.

5 PERSPECTIVES

Preliminary users tests show a good efficiency of the different interactions techniques. A formal evaluation should be done in order to compare our proposal with a solution from the state-of the art where the collaboration is symmetric. Moreover, in our current proposal, only the scale of the cube can be concurrently modified by several users. We plan to add a concurrent access to its rotation by providing this capability to the Giant. In particularly difficult passages, the bending of the Giant’s ray will dynamically define his power in the concurrent cube rotation in order to take the lead on the Ant.

REFERENCES