SVEn - Shared Virtual Environment

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Abstract

This paper presents a system for a shared virtual experience which was developed within a student project. The main idea is to have two or more persons at different locations, who can interact with each other in the same virtual environment. In order to realize this idea every person is motion-captured and wears a head-mounted display (HMD). The virtual environment is rendered with the Unity game engine and the tracked positions are updated via the internet. The virtual environment developed in this project is highly immersive and users felt a strong sense of presence.

1. Introduction

The student project SVEn, presented in this paper, has been developed within a module in a Media Technology Master's degree. It is a graduate module lasting one year and it is worth 12 ECTS. The objective is to develop an interactive graphical system in a team of 3 to 5 students. SVEn has been carried out by 3 students. The Media Technology degree specialises on methods, algorithms and devices for production, storage, transmission and display of media. Hence the students already have a background in computer graphics, computer animation and virtual reality. Furthermore, a solid knowledge of required mathematical methods as well as programming skills are presumed.

The module requires that the project definition is completely up to the students. The lecturer just gives a rough idea and points out which hardware will be available. This is how students are encouraged to develop their own vision for the project and to keep this vision for the project's whole duration. Within the project the students' project management skills as well as their ability to design a complex technical system are challenged.

2. Project Description

The main focus of this project is real time cross-linking of two or more motion capture systems via the internet so that multiple people can interact in one single virtual environment. By this virtual training simulators or games can be realized with increased realism.

The skeletal data of the participants can be tracked at different locations. SVEn uses 12 OptiTrack Flex-13 cameras (120 fps) in one place and 24 S250e cameras (250 fps) in another place. The skeletal data is processed with Motive

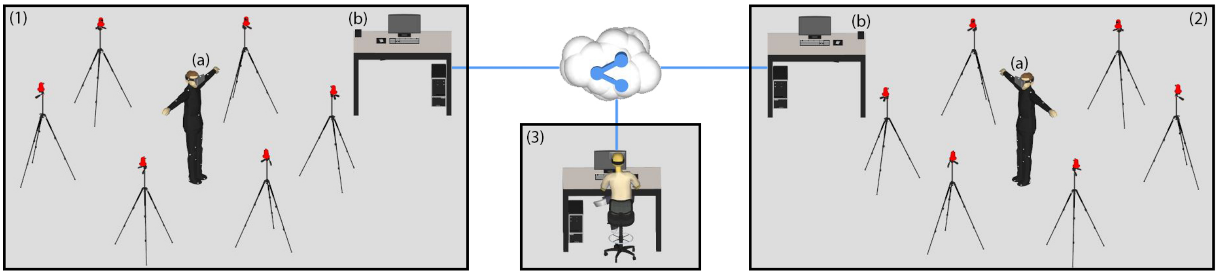

Figure 1: *(1,2) different motion capture systems, (3) observer-participant with Oculus Rift, (a) Oculus Rift with wireless HDMI receiver (peerless-AV HDS-WHDI100R) and powerbank (LogiLink 10000mAh), (b) wireless HDMI transmitter*

1.5.2. The data from Motive is streamed via a network port to the game engine Unity Pro 4.6. There, the skeletal data is mapped to a virtual character. Finally, the virtual environment is rendered and displayed on HMDs (Oculus Rift DK1s which have been modified to work wirelessly). The orientational tracking of the Oculus Rift is not used. Instead, the head rotation is determined by the tracked skeletal data. Altogether, this provides each participant with his own immersive first-person view including its own virtual body which moves exactly like himself.

Three usage modes are available in the developed software. The first one is the normal usage. All participants are fully tracked in different locations and wear HMDs. The second mode is an observer-mode where only the users' heads are tracked. The third mode is an observer-mode without any tracking at all intended for participants who do not have a motion capture system. They can connect to the server to observe the virtual scene using an HMD or on a conventional computer display. An overview on the hardware and the modes is shown in Figure 1.

The starting point of the virtual environment is a room, in which each user is able to change his virtual avatar individually. To let the user see his avatar, a mirror is placed inside the room. The user can leave the room and get to different scenes by moving through teleporters. The first scene is a fitness studio where a group of people may follow the instructions of a trainer. Here it is possible to interact with real existing sports equipment like weights, which are tracked as well. Therefore, a one to one copy can be replicated in the virtual world at the correct position. The trainer can check if exercises are done correctly. The second scene represents a multiplayer first person shooter game, which uses the flexible spaces idea to extend the virtual space by reusing the trackable area [VKBS13]. A tracked Nintendo Wiimote is used as input for virtual weapons and gives the user haptic feedback in form of vibrations. The third scene is a classroom, where an instructor can present objects, such as complex engines, which might not be physically available. For better understanding of the object's functionality animations can be triggered by touchable 3D GUI elements (e.g. buttons and sliders).

3. Results and Benefit

The development of the shared virtual environment was an interesting and motivating task for the students since it required a lot of different engineering skills as well as creativity. The most significant challenge was the implementation of the data streaming between the motion capture systems and the game engine. Unity provides many components for the internet connection between the clients but several new scripts had to be written. Additionally, the design of the scenes and the interaction between the participants were major tasks. The result of this project is a highly immersive virtual environment. Surprisingly, most users even felt a very strong sense of presence.

For many scenarios the combination of real time motion-data streaming and virtual interaction is very beneficial. Playing games together in an immersive virtual environment might be fun to many people. For companies the system could be interesting as well, because the application of remote virtual training will reduce travel costs.

In future many other applications and extensions can be imagined. One next step could be the extension of the marker set to track fingers as well. Furthermore, studies could be performed in order to quantify the immersion and to measure the degree of presence in the virtual environment perceived by the users. The project results presented here demonstrate that education is greatly improved by group projects and that it will even be possible to use these results as a basis for future research.

References

[VKBS13] Vasylevska K., Kaufmann H., Bolas M., Suma E. A.: Flexible spaces: A virtual step outside of reality. poster presentation: IEEE Virtual Reality, Orlando, FL (USA); 2013-03-18 – 2013-03-20, 2013. 2