A New Interface For Virtual City Environments Using Motion Capture

Jun Sakai (210039)

School of Information Science,
Japan Advanced Institute of Science and Technology

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1 Introduction

With recent advanced computer and networking system, virtual reality technology is attracting a great deal of research attention. Virtual reality is the technology that enables users to access electronic world implemented in computers with a realistic sense as humans feel in the real world. For designing a city in the real world, we can estimate the safety and comfortability in the designed city by virtual technology. In order to make user's feeling more realistic many researches have been dedicated to present immersive visual information. As well as the visual information, it is necessary to provide user-friendly interaction interface between users and virtual environments.

Several interfaces have been proposed to move around in the virtual environments. The hand-wabing interface one of intetutive tools to achieve user-friendly system. However, user can not use hands for other purpose such as object manipulation. The weight-shifting interface annother movement interface. Although this interface is hands-free, the action of weight-shifting is not close to human walking. Considering the virtual city design applications, users need to inspect the virtual city from various viewpoints

and change the arrangement of buildings or objects if there is problems in safety or comfortability. Thus, virtual city design system should have user-friendly interaction interface for two essential functions, moving around the virtual city and operating virtual objects. However, most of the previous interaction interfaces are not sufficient for the city applications.

In this paper, we propose a new interaction interface between users and virtual city environments. Our interface allows users to interact with user-friendly actions as in the real world, that is, users can move around in the virtual city by stepping and can handle virtual objects by grasping. The virtual city interaction system was implemented in CAVE using motion capture. It is confirmed by performance evaluations that the proposed sysetem achieves smooth movement in virtual environments. Furthermore, we introduce avatars to guide users in virtual cities and to collaborate with virtual enviroment.

2 Interface for Moving and Operating in Virtual Environments

We employ stepping as an interaction interface to move around the virtual city. The stepping on the same spot is very close to human's walking and users can use their hands for object manipulation in the virtual city. It is necessary to decide speed and direction for movements in stepping interface. We propose a method to decide speed and direction using the 3-dimensional spatial data of stepping obtained by motion capture. It is obtained from measurement of actual walking, that walking speed is proportional to the number of steps a second. The moving speed in virtual cities in proportional to the number of steps a second. Additional functions are also adopted to overcome the disadvantage of human-scale in virtual cities. When users want to move in high speed, our system can adjust the walking speed by enlarging a step. In case of long distance movement to other cities, our system allows to move easily by changing the scale of the virtual city.

User-friendly object manipulation method is also proposed by employing the motion of grasp. We consider the model which has two coordinates at fingertip and wrist. User can select an object by grasping if the length of

the two coordinates becomes smaller than a threshold and the fingertip is in a box area surrounding the virtual object. While user is grasping an object, the user can change the position of the object moving the hand.

3 Implementation of Virtual City Intraction System

The proposed interaction system provides user-friendly interaction in virtual environments and was implementes motion capture obtaining the 3-dimensional spatial data of user's motion. The virtual immersive display CAVE is also used to present realistic 3-dimensional stereoscorpic scenes around the user. The user who wears motion capture in CAVE can move around in the virtual city and operate virtual objects to design the virtual city.

To evaluate the effectiveness of the proposed interface, our interface is compared with a conventional 3DWAND in virtual city environment. In experiments, users follow a marker on the floor and defferences between positions of user and the marker are measured. The marker uniformly accelerats and turns 3 times at the corners of 90 degrees until a goal. The experimental result shows that the potion error of our interface is less than approximately 30cm. Users are stepping by looking the marker ahead approximately 20cm in front of under the their foot. Hence, the 30cm difference means that a user can move as the same speed as marker. On the other hand, 3DWAND shows the difference over 30cm at 3 corners, that is, 3DWAND does not control speed and direction simultaneously due to the device limitation. From these experiments, The steppin interface makes users move easly in a virtual city as in real world.

4 Collaboration with Avatar in Virtual City

We introduce an avatar in virtual city to collaborate with user. The avatar is designed as a simple model consists of feature points (head, neck, shoulder, elbow, wrist, hip, knee, ankle) and lines connecting each point. This avatar is implimented by the primitive of OpenGL. 3-dimensional position data obtained form motion capture is input into the 15 feature points at intervals of 1/30 seconds to represent the human-like motion. The imput

data is stored into a database. It needs 2.7M bytes to move avatar for about 1 minute.

5 Conclusion

User-friendly interfaces have been required for virtual city designing. This paper addressed user-friendly interfaces with motion capture obtaining 3-demensional spatial data of user's motion. We proposed the stepping to move around in the virtual city and grasping interface to handle virtual object. The proposed interfaces are implemented in CAVE using motion capture system. We compared our interfaces and a conventional 3DWAND in the virtual city application, and confirmed that users can move easly anywhere in virtual city. Additionally, we introduced avatars in our virtual city to collaborate with virtual people.