ISSN 2348-1196 (print)
International Journal of Computer Science and Information Technology Research ISSN 2348-120X (online)
Vol. 2, Issue 3, pp: (138-140), Month: July - September 2014, Available at: www.researchpublish.com

A Handle Bar Metaphor for Virtual Object Manipulation with Mid-Air Interaction

B. Amala

Saveetha school of engineering, Chennai

Abstract: **Commercial 3D scene acquisition systems such as the Microsoft Kinect sensor can reduce the cost barrier of realizing mid-air interaction. However, since it can only sense hand position but not hand orientation robustly, current mid-air interaction methods for 3D virtual object manipulation often require contextual and mode switching to perform translation, rotation, and scaling, thus preventing natural continuous gestural interactions. A novel handle bar metaphor is proposed as an effective visual control metaphor between the user's hand gestures and the corresponding virtual object manipulation operations. It mimics a familiar situation of handling objects that are skewered with a bimanual handle bar. The use of relative 3D motion of the two hands to design the mid-air interaction allows us to provide precise controllability despite the Kinect sensor's low image resolution. A comprehensive repertoire of 3D manipulation operations is proposed to manipulate single objects, perform fast constrained rotation and pack/align multiple objects along a line. Three user studies were devised to demonstrate the efficacy and intuitiveness of the proposed interaction techniques on different virtual manipulation scenarios.**

Keywords: **Virtual Object Manipulation, 3D virtual object, Virtual Reality Interfaces.**

I. INTRODUCTION

In recent years, mid-air interaction supported by 3D spatial gestural inputs has received increasing attention from both the research community [8, 23, 17, 27, and 4] and the gaming industry, as evidenced by the popular gaming devices such as Nintendo Wi-Fi- mote and Microsoft Kinect, which allow us to perform natural physical interactions in our own physical space while moving freely in front of a large display.

There are basically two approaches to accommodate mid-air interactions in such a visual interactive setting. The first employs a handheld controller device, such as the Nintendo Wi-Fi-mote User inputs via button clicks and accelerometer-based motion sensing are integrated to form high-level gestures to support the interaction. The second is a controller-free approach, where users can manipulate the graphical contents on the display with their bare hands. Temporal information to support mid-air interaction is obtained by using an image and/or depth sensor (e.g., Kinect) to continuously sense and analyze the user's body posture and hand gestures via real time image processing techniques.

Interaction with 3D Virtual Environments:

There are a wide range of methods to interact with 3D contents in virtual space since this work focuses on interactions with freehand gestures, we review mainly two more

Relevant areas:

Virtual reality and freehand interfaces. Virtual Reality Interfaces. This approach immerses users in a virtual space for them to perform interaction via various sensors and input devices. And the proposed a 3D interaction technique called "Skewer," which enables two users to move the same virtual object collaboratively. Employed hand and head reconstruction as well as tracking for 3D interaction in a desk-based computer environment. More recently, proposed to enable multipoint haptic grasp in a virtual environment by using a gripper attachment developed a soft hand model to achieve robust finger-based manipulation of virtual objects.

Among the virtual reality interfaces, some employ data gloves for gestural mid-air interactions. Built a virtual reality system that allows users to naturally manipulate virtual 3D models with both hands on a tabletop stereo display. In particular, they proposed a grab-and-carry tool for a user to hold an object with two hands, as well as to "carry" it and turn it around. Zigelbaum et al. [34] presented gestalt, a gestural interface for users to navigate and manipulate a 3D graphical environment filled with video media using various hand gestures. Proposed 3D bimanual gestural interface using data gloves for 3D environment interaction; the left hand is employed to perform gestures for selecting interaction modes while the right hand is for the interaction itself, e.g., rotating or scaling the desired object. Though VR interfaces provide highly immersive perception and interactive controls to users, they typically require users to wear instrumented gloves for gestural input, which could be uncomfortable and restrict the freedom of movement

Freehand Interfaces:

Freehand interfaces employ tracking systems to recognize mid-air hand or arm gestures as user input. Estimated 3D hand poses and recognized hand shape patterns in real-time using multiple cameras. Developed interesting gestural interactions with multiple fingers over a spherical volumetric display. Employed scalable computing methods for vision-based gesture interaction in a large display setting. Enabled intuitive manipulation of 3D digital contents by leveraging the space above the surface of a regular interactive tabletop display. Proposed to interact with a large curved display by combining speech commands with freehand pinch gestures to provide immersive and interactive experience to multiple users. More recently, proposed a set of mid-air gestures to support pan-and-zoom interaction with graphical contents shown on a wall-sized display.

To manipulate a 3D virtual object with a single hand, one typical metaphor is to grip and manipulate it with the thumb and forefinger, i.e., a pinch gesture. Described the Gesturer system that used this metaphor to continuously manipulate 6DOF of an virtual object; the object can be translated by moving the hand and oriented by rotating the wrist. Later extended this metaphor by allowing users to resize the object by moving the thumb and forefinger apart or towards each other. Though this metaphor is very natural and intuitive for common users, it requires fine and robust detection of dynamic fingers poses, which is not achievable with the poor image resolution of low-cost depth sensing devices such as the Kinect sensor, or when the user stands too far away from the sensor as in the case of large display setting

Interaction with the Kinect sensor:

Kinect is a controller-free real-time depth sensing de-vice, primarily designed for supporting gaming with the Mi-crosoft Xbox360 system. Since its launch, it had sold at an average volume of around 133 thousand units per day in its first sixty days. Due to its low-cost and wide availability, it has not only gained popularity for gaming, but also employed in numerous research projects in various disciplines. In particular, this recent innovation spawned many interesting mid-air interaction applications, which have made their rapid debut on the Internet. For example, the manipulation of 2D and 3D objects tracking of human motions, gesture control for robot systems, multitouch like interface for controlling GUI functions like those seen in Minority report, In this work, we explored the use of this low-cost device for object manipulation. Our proposed handle bar design can support efficient and effective bimanual manipulation of 3D objects while accommodating the limitations posed by the Kinect sensor.

II. SYSTEM SETUP

Our system setup consists of an Alien ware Aurora ALX desktop computer with Quad Core CPU 3.20GHz and 9GB memory, running Linux Ubuntu 10.10 (Maverick) with an NVIDIA 1.5GB GeForce GTX480 graphics board, a Kinect sensor, supporting an image resolution of 320×240 at 30 frames per second with both color and depth, and an LCD display of physical size 32 inches. The Kinect sensor is placed below the large display and the user stands at a distance of around 2 meters from the display during the interaction.

The Software used:

We use to open source drivers and the NITE middleware to interface with the Kinect sensor; the depth generator in the Open NI framework is first employed to obtain the depth image data from Kinect. Then we use the skeleton tracker in NITE to compute the user's joint positions from the depth image so that we can determine the 3D location of the user's hands. At the same time, we use the perception point cloud library (PCL) from the Robot Operating System (ROS) framework to generate point clouds from the depth image. Lastly, based on the hand locations obtained from the 3D skeleton, we segment a point cloud set associated with each of user's hands. Our experience suggests that the use of the 3D skeleton as a guide produces more accurate and robust segmentation.

III. APPLICATION EXAMPLES

The proposed interaction designs based on our handle bar metaphor were applied to three different applications to illustrate their potential. The first application example shows how furniture can be arranged to a desired layout in a 3D virtual environment. The multiple object manipulation technique was used to quickly arrange similar chairs. The translate-rotate manipulation was used to "pick up" a toppled flower pot and place it on the table in one continuous bimanual hand movement. Once on the table, constrained rotation was invoked to continuously rotate the pot till it was deemed to be at the desired orientation.

IV. CONCLUSION

We propose the handle bar metaphor as an effective way to perform mid-air interactions that manipulate the pose and scale of 3D virtual objects, suitable for use with a low-cost depth sensing device like Kinect in a large-display setting. The main strength of this metaphor is the physical familiarity it provides users with, as they mentally map their bimanual hand gestures to manipulation operations such as translation and rotation in the virtual 3D environment. The provision of visual cues in the form of the instantaneous orientation of the protruding virtual handle bar that corresponds interactively to the ever changing positions of the user's two hands was observed to be very effective in providing a strong sense of control to the user during interactive visual manipulation.

In addition, the flexibility and variety of interaction designs based on the handle bar metaphor have been demonstrated. These include the constrained rotation operation based on a novel "cranking" bimanual gesture and speedy techniques to manipulate and align multiple objects along a straight line using a simple combination of CLOSE and OPEN hand gestures. The virtual molecule exploration application.