Cloud Mouse: A New Way to Interact with the Cloud

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ABSTRACT
In this paper we present a novel input device and associated UI metaphors for Cloud computing. Cloud computing will give users access to huge amount of data in new forms as well as anywhere and anytime, with applications ranging from Web data mining to social networks. The motivation of this work is to provide users access to cloud computing by a new personal device and to make nearby displays a personal displayer. The key points of this device are direct-point operation, grasping UI and tangible feedback. A UI metaphor for cloud computing is also introduced.

Keywords
Cloud computing, Natural user interaction, Cloud UI metaphor

1. INTRODUCTION
The metaphor behind the virtual desktop is a literal one: information is presented to the user as if it were on a desktop, and the form of information is designed to replicate paper-based ones, such as documents and reports. This metaphor has shown itself useful. However, as new information forms begin to show themselves, with new web data mining, for example, offering ways of capturing and visualizing relationships that are not best conveyed in 2 dimensional layout, and, for another example, social networks being more than simply messaging systems but also geographic arrays of 'things to do' and 'people to meet', so other metaphors begin to appeal. Central to these new forms is the idea of what is 'natural'. Instead of being limited to the two dimensions of a desktop, a greater emphasis is laid on the body, and making use of the body to place and retrieve objects through various gestures in three dimensions. Interaction of this richer form could leverage entirely new information formats.

Cloud computing necessitates new interaction metaphors and new input-output devices. The cloud mouse is one of such device, as it provides an effective manner to use cloud data with six degrees of freedom and tactile feedback. The cloud mouse will enable users to orchestrate, interact and engage with their data as if they were *inside the cloud.*

The scenario is the one in which data is presented through handheld projectors, augmented eyeglasses, or across multiple surfaces as 3D visualizations. In terms of hardware, the cloud mouse is the key to this interactive experience. When users move the cloud mouse through these data visualizations, various sensory outputs such as vibration and sound will guide users to locations where to retrieve, view, post and store information, and to steer closer toward a target.

Whatever the mode of display, the cloud mouse is designed for virtual content and enables interaction with 360 degrees of movement, spatial depth, proximity, and geometric relationships between objects. In one demo scenario, the user views a photo as though standing inside the picture with the ability to view 360 degrees, make the mouse point up and down, and move deeper into the picture.

Figure 1: The core of cloud mouse is inertial sensor and haptic sensor. While pointing, users can squeeze cloud mouse to hold virtual object in display.

The cloud mouse allows the user to navigate across multiple screens with great precision. It's tactile and natural to use. The user can drag and drop by grasping it, use it to point directly at objects in the cloud space or drag and drop objects across different screens. We want users to feel as though they are right inside in the cloud space.

2. RELATED WORK
Benefiting from different mechanical, electromagnetic, optical, acoustic, and inertial sensors and technologies [9], several kinds of 3D input devices have been done during the years to facilitate interaction with 3D models and applications. Among these, pointing to the targets (objects or other GUI components) using some devices such as mouse is probably the most appealing interaction method [4]. Several commercial or experimental 3D pointing devices are introduced to facilitate working with 3D objects in 2D/3D space by simplifying the fundamental tasks such as zooming, rotating, panning, and so forth.

Among the recent devices, 3D space navigator [5] and its counterparts use pressure sensing technology to provide simultaneous panning, zooming, and rotation of the 3D object. 3D Mouse [10] can translate the movements such as push, pull, twist, and tilt to the appropriate movement of the 3D object. The 3D air mouse [7] mounts a small ultrasonic transmitter as part of the mouse equipment which is worn on the index finger like a ring and uses an array of receivers to track the movements of the transmitter (finger). These movements are then translated to appropriate actions on the 3D object. OptiBurst [6] uses IR tracking to map the natural hand movement composed of translations and rotations to the appropriate actions inside the 3D application.

Gyroscopes and accelerometers are widely used as sensors to detect the movement in 3D pointing devices, such as The Gyro mouse [1], XWand [11], Tiltable interfaces [15], and the Nintendo Wii game controller [14]. Since gyroscopes and accelerometer-based devices offer no absolute orientation information, some other sensors, such as IR camera [14] and compass [11], are used to assist the device and to reduce the position error.

The cloud mouse (see Figure 1) is a novel device which is designed to explore the new user experience possibilities that cloud computing might enable. It will allow user to interact with their cloud, or inside their cloud. Cloud mouse functions like a traditional mouse enabling the user to point and move objects and interact with them. It can offer users 6 DOF movement (up, down, forward, backward, yaw and pitch), which can be used to create particular input commands. Cloud mouse uses compass as the orientation sensor, so it can be used at anytime and anywhere. This will meet with the requirement of Cloud consuming. In addition, cloud mouse use pressure sensing technology to allow the users to select object and hold it by squeezing and holding it. It can also give user a tangible feedback by vibration to confirm an object has been grabbed.

3. SYSTEM DESIGN

We have constructed a hardware prototype of the cloud mouse, a handheld device which embeds a variety of IMU sensors which in combination support pointing and gesture recognition tasks. The orientation of cloud mouse is used to compute what the user is pointing at with cloud mouse, given 3D model of the UI and the display position. The 3-axis gyroscope can provide angular rate of three-axes with high-speed. The 3-axis accelerometer can give true pitch and roll angle when cloud mouse is still. The magnetic sensor can give absolute yaw angle with slow rate. So we use complemented filter algorithm to combine angle computed from difference sensors.

Unlike traditional mouse designs, the cloud mouse uses a “squeeze and direct point” mode instead of “translation and click” mode to control, which provides a more natural drag & drop experience with tangible feedbacks like touch and sound.

We use the universe as UI metaphor to present the cloud data and relationships. The depth, Z-axis of screen is a timeline, and forms a “cosmic tunnel” with data aggregation, called a galaxy. Users can use the cloud mouse to browse, control, re-arrange and edit galaxies. Moreover, the “cosmic tunnel” can be viewed in a lateral viewport. The trend map of different task or event, therefore, is intuitively perceived through the senses.

4. CONCLUSITION

The cloud allows human-computer interaction to move beyond the desktop, and the cloud mouse puts the user inside the cloud. With it users can interact with data in ways that create richer experiences. We are currently optimizing the algorithm of cloud mouse to obtain more accurate absolute positioning in 3D space.

Figure 2: The UI of working scenario.

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