iSphere: A Free-Hand 3D Modeling/Animation Interface
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Introduction
iSphere is a 3D input device that can respond to the proximity of hand positions in order to provide visual feedback interactively. Physical interactions can simplify processes of manipulation by mapping functions to physical settings. iSphere is able to simplify the mappings between low-level manipulation commands and modeling concepts, such as pushing and pulling 3D geometries and viewpoints. A user is able to view, create, and edit 3D geometries through the proximity-based interaction between hands and the device.

Motivation
In most 3D modeling systems, keyboards and mice are essential for inputting 3D commands. However, it limits designers to performing simple editing commands by certain intuitive actions. It still costs a large amount of time to do a series of commands to get the right viewpoint or pull the surface along certain axes. Low-level operations of keyboards and mice are time-consuming and costing extra efforts to complete a task in a 3D environment. A user does not have direct feedbacks from command-based manipulation. The fragmented mental views and visual representation should be coupled in order to reduce the cognitive load of 3D manipulation.

Scenario
A user is playing with the iSphere with a 3D penguin model inside a 3D software-Rhino. When his hand is touching the top surface, the penguin is squeezed. When he puts his hand above the surface, the penguin model can be stretched by the proximity between hands and the device.

Physical Actions
3D designers can use their hands instead of a keyboard and mouse in order to have direct sensory feedback. View and edit functional buttons are projected on the desktop surface allow users to switch between inspecting or edit mode.

Proximity Sensing
Each facet equipped with capacitive sensor can be aware of hand position about 6 inches above the surface. The relative movement between hand and the device is corresponded into pulling the view point or squeezing the 3D model.

Sensors
For long-distance proximity sensing, we use a transmitter and a receiver in our capacitive sensing circuit. A user needs to place one hand on a conductive plate. The other hand can be sensed within 6 inches above the surface of this device. A microcontroller is used for getting the digital inputs from the sensor and output the signals to the serial port to a PC.

Hardware
The system consists of a dodecahedron made by acrylic pentagons and a micro-computer connected to transmit proximity sensors on the surface. Proximity sensors can be capable to understand users' actions and provide feedback interactively.

3D Output
Connecting to 3D CAD software, like 3DS Max or Rhino, iSphere is able to manipulate 3D mesh-based model. Hands can be used for modeling or inspecting 3D geometries directly.

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