Direct, Spatial, and Dexterous Interaction with See-through 3D Desktop

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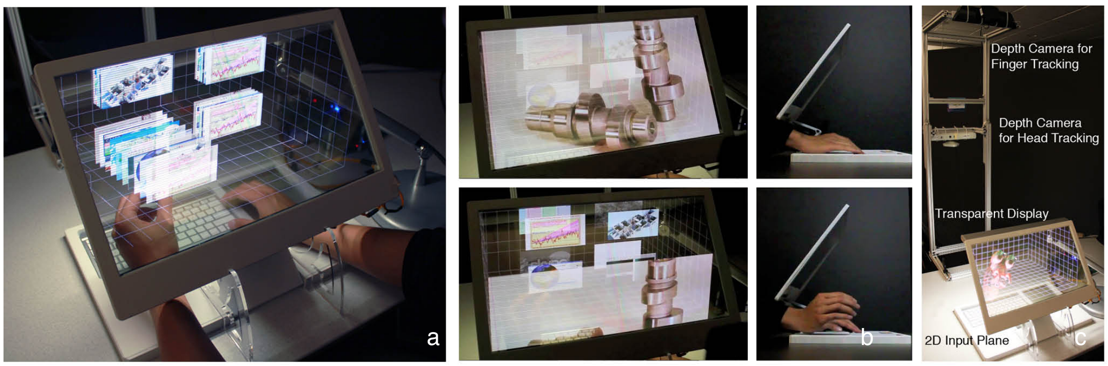

Figure 1. a) HoloBook Prototype b) Seamless Mode shift between 2D and 3D I/O. c) Technologies

1. Abstract

Despite advances in 3D sensing and display technologies, our interactions with desktop interfaces have remained stagnant from the form that evolved under 2D I/O modalities. HoloBook enables users to manage windows with their hands in a 3D physical space. HoloBook is a term for the entire ensemble of necessary components for realizing this spatial operating environment: visualizations of the desktop rendered on a see-through display, technologies and physical design for emulating collocated 3D input and output space.

2. Interaction

Holobook looks similar to a conventional laptop computer except that the screen is connected to a leading edge of the 2D input panel unlike in a conventional computer where the screen is connected to the far-edge. Users can casually open up the HoloBook and type on the keyboard or use a trackpad as in traditional 2D operating environment. Windows or files are perceived to be placed in a 3D space behind the screen. The user can lift up his or her hands to reach the displayed windows and move them in this space. Here are examples of interactions with HoloBook.

Virtual Cabinet: Interaction with stack of Windows

Multiple aggregated windows are represented as layers stacked in a 3D volume. The windows pop up as a user selects or pull one of them. This enables a better access to the desktop content. When the user wants to pull up one of the layers from the 'cabinet', he/she reaches the specific layer with his/her finger.

Sliding Door: Interaction behind a layer

The main active window can vertically slide down as the user try to reach the space behind it. This metaphor of sliding door can be applied in many other occasions when there is the need to see what is hidden by the top layer.

3. Technologies and Design

To enable our ideal scenario of interaction, we developed supporting technology and designed our prototype to emulate a collocated 3D I/O space without user instrumentation, with seamless transitions between 2D and 3D input. A combination of a transparent display and 3D gesture detection algorithm contributes to 3D interaction technologies collocating 3D input space and emulated 3D rendering without tethering or encumbering users with wearable devices. By rendering perspective corrected 3D scenes on a transparent display based on a user's head position, we achieved an illusion that virtual windows are floating in the 3D space behind the screen.

We employed a depth-sensing camera to detect the position of a user's face. We built our algorithms on top of Microsoft Kinect–SDK to estimate the position of the user's eye. Another depth-sensing camera sees the 3D position and pose of a user's finger tips. Following Wilson's techniques [Wilson. 06], the system detects the position of both finger tips by image segmentation and estimates "pinch" gesture through connected components analysis.

4. Conclusion

We propose the HoloBook demo a novel spatial operating environments for direct dexterous interaction with 3D desktop. The specific contributions of our work are as follows.

- Visualization: windows and Icons represented in a physical 3D space. Various opacity change/physical motion are used to emulate 3D space.
- Unencumbered 3D I/O: The technologies enable unencumbered direct interaction with 3D virtual objects, close to touching a holographic display with bare hands.
- Design of I/O space for seamless mode shift: Holobook's novel design collocates the 2D input space and 3D I/O space. It allows users to transition between conventional input modalities and 3D I/O.

References

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HOLODESK: HTTP://WWW.YOUTUBE.COM/WATCH?V=JHL5TJ9JA_W

SIGGRAPH 2012, Los Angeles, California, August 5 – 9, 2012.
ISBN 978-1-4503-1435-0/12/0008