A Steerable Tangible Interface for Multi-Layered Contents played on a Tabletop Interface

Jun Lee, YoungTae Roh, Jee-In Kim+
Dept. of Advanced Technology Fusion,
Konkuk University, Seoul , Korea
{junlee, jnkm}@konkuk.ac.kr
82-2-447-6426

WooHyun Kim, SungPil Hong, HyungSeok Kim
Dept. of Internet & Multimedia Engineering,
Konkuk University, Seoul, Korea
hyuskim@konkuk.ac.kr
82-2-450-4095

ABSTRACT
We propose a steerable tangible interface (STI) with more intuitive interactions and manipulations of multi-layered digital contents played on a tabletop interface. The STI is composed of a ring with two IR (Infra-Red) LED's (Light-Emitting Diode) and a detector of the LED's. A user utilizes the ring as a magnifying glass. When a user moves and rotates the ring of STI on a tabletop interface, its position and orientation can be recognized. A more detailed view of contents on the tabletop interface can be presented inside of the ring based on its position and orientation. We applied the STI to educational contents which consist of five layers of images of human body information played on a tabletop interface. The layers are Skin Layer, Front Layer, Middle Layer, Back Layer and Bone Layer. A user can navigate the different layers and view the details of the different images of human body information as the user moves and rotates the ring of the STI.

Author Keywords
Tangible Interface, Tabletop Interface and Multi Resolution Display.

ACM Classification Keywords
H5.2 [Information interfaces and presentation]: User Interfaces.

INTRODUCTION

The focus context plus technique, which shows images with different resolutions of information according to a human user's focusing areas, can be effectively utilized in multi-resolution displays such as a tabletop interface and a wall display [1]. There are also many interesting researches on applications of the focus and context technique. Bier et al.[2] showed the magic lenses interaction for see-through interface. Staadt et al. [3] showed an intuitive interaction method using a laser pointer for manipulating a focus region in a wall display. Hu et al. [4] proposed a steerable focus region with a touch-based interaction on a tabletop interface. Hsiao et al. [5] compared a fixed focus region with a steerable focus region on a tabletop interface. A steerable focus region generally showed better performance than a fixed focus region.

We propose a steerable tangible interface (STI) with more intuitive interactions and manipulations of multi-layered digital contents played on a tabletop interface. The steerable tangible interface is composed of a ring with two IR (Infra-Red) LED (Light-Emitting Diode) lights and a detector of the LED lights. A user can utilize the ring as a magnifying glass in order to navigate and examine interactive digital contents played on a tabletop interface. When a user moves and rotates the ring of STI on a tabletop interface, its position and orientation can be recognized. A more detailed view of the contents on the tabletop interface can be presented inside of the ring based on its position and orientation.

In this research, we developed educational contents about human body information as an application using the proposed STI and a tabletop interface. The digital contents can visualize human body information with five different image levels as follows: Skin Level, Front Level (for a brain, lungs, a liver, stomach, and so on), Middle Level (for ears, a heart, and so on), Back Level (for a gullet, a kidney, and so on), and Bone Level. The organs and bones can be displayed on the top of the tabletop interface. A user can examine a specific area or organ on the tabletop interface by moving and rotating the ring of STI, as if it is a magnifying glass. More detailed information and a three dimensional model of the magnified area or organ are also displayed on the tabletop interface.

SYSTEM

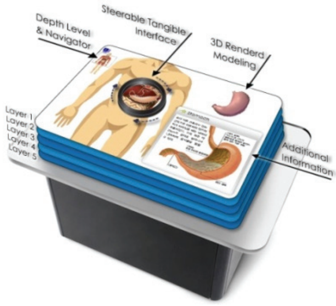

Figure 1. Five Layers of Contents on u-Table.

The proposed system is briefly described in Figure 1. The system is based on a tabletop interface called 'u-Table' [7, 8] and an STI. As shown in Figure 1, a user can move the STI in order to locate a

+ Corresponding Author

region of interest and rotate the STI for navigating different layers of visualized human body information on u-Table.

u-Table provides users with intuitive ways of multi-touch based interactions and hands gestures. Also, u-Table can communicate with various devices such as PDA, mobile phones, and so on. Figure 2 illustrates various interaction channels among u-Table, STI, users and applications. Users can interact with u-Table using fingertips and/or tangible interfaces.

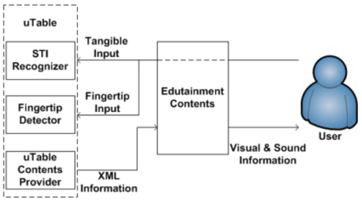

Figure 2. Interactions among u-Table, users, STI and application.

Steerable Tangible Interface

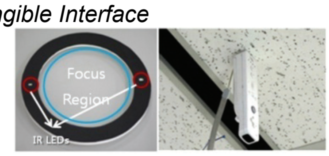

Figure 3. STI and WiiRemote.

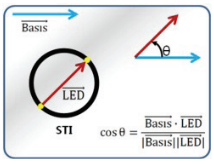

Figure 4. An algorithm of calculating rotation angles of STI.

STI is a black ring with 18cm in internal radius, 1.5cm in thickness and 1cm in height. The internal circle of the ring is to represent a focus region area. STI has two LED lights to track its positions and its orientations. By changing positions of the ring, the visualization area is relocated in the focus region of the moved ring. Also, a user can select a layer to be displayed by rotating the ring. In manipulating process, user should be careful about obstacle to LED lights on the STI.

To recognize movements, we use WiiRemote[8] as a tracking device. We installed WiiRemote under the ceiling (Figure 3). WiiRemote recognizes positions of two LED's on the STI. With this information, its positions and a rotation angle are computed. As shown in Figure 4, the system computes a rotation angle from positions of LED (red vector) and pre-defined a basis vector (blue vector).

Application : Medical Education Contents

As an example of multi-layered visualization, we use medical education contents about human body organs [9]. The contents consist of external skin, organs and bones in different layers such as Skin Layer, Front Layer, Middle Layer, Back Layer and Bone Layer.

Initially, a user is viewing the outer skin level. If the user wants to see more detailed information below the Skin Layer, s/he puts the STL on the area of interest. In the focus region of STI, different views of the human body information, such as inner organs and bones are visualized. By rotating STI, the user can select which layer to be visualized in the focus region. Also, related information of parts in the focus region is placed in the side area of the tabletop interface (Figure 5).

Figure 5. Visualization of a heart using an STI.

CONCLUDING REMARKS

For applications with interactive contents, it is often required to visualize multi-layered information in different forms. To control layers of contents, we propose a steerable tangible interface (STI), which works with a tabletop interface.

The proposed STI is a ring-shaped device to enhance visualization of the region inside of the ring, and to provide controls of visualization methods by rotating the ring. The STI is able to be applied to applications with multiple views, including one with multi-layered educational contents. User can move his/her area of interests by moving STI. By rotating a STI, s/he can change types or layers of the contents inside.

Currently, we are planning to develop a mechanism to adopt multiple STIs. Especially, recognition of multiple markers(LEDs) and parallel algorithm to render focus regions are to be developed. Also, we are developing contents in different application areas to investigate application-level usability of STI.

ACKNOWLEDGEMENT

This work was supported by the Seoul R&BD Program (10581).

REFERENCES

1. Baudisch, P., Good, N., and Stewart, P. Focus plus context screens: combining display technology with visualization techniques. In Proc. of UIST 2001, ACM Press (2001), 31-40.
2. Bier, E.A., Stone, M.C., Pier K., Buxton, W., and DeRose, T.D. Toolglass and Magic Lenses. In Proc. of SIGGRAPH 1993, ACM Press(1993),73-80.
3. Staadt, O.G., Ahlborn, B.A., Kreylos O., Hamann B., A Foveal Inset for Large Display Environments, Proceedings of the 2006 ACM international conference on Virtual reality continuum and its applications, (2006) 281-288.
4. Hu, T., Chia, Y., Chan, L., Hung, Y., and Hsu, J. i-m-Top: An interactive multi-resolution tabletop system accommodating to multi-resolution human vision. In Proc. of IEEE Tabletop'08 (2008), 177-180.
5. Hsiao C., Chan L., Hu T., Chen M., Hsu J. and Hung Y. To Move or Not to Move: A Comparison between Steerable versus Fixed Focus Region Paradigms in Multi-Resolution Tabletop Display Systems, In Proc. of CHI 2009 (2009), 153-161.
6. Lee J.H., Kim J.I. u-Table: A Tabletop Interface for Multiple Users, In LNCS 3980 (2006), 983-992.
7. Lee J.H., Lee J. Kim J.I. and Kim H.S. Believable interaction with a quasi-tangible tabletop interface, In Computer Animation and Virtual Worlds (2007), 18, 121-132.
8. Nintendo Wii, http://wii.nintendo.com/
9. The Ultimate Human Body 1.0, Global Software Publishing.