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The Visual Interaction Platform

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Abstract: The Visual Interaction Platform (VIP) is an Augmented Reality system that builds on human skills of real world object manipulation and allows unhindered human-human communication in a collaborative situation. The platform supports architectural design and medical planning through the use of physical props for interaction with 2D and 3D data.

Keywords: Augmented Reality, Human-Computer Interaction, Pen interaction, 3D interaction

1 Platform Components

The Visual Interaction Platform (VIP) is an augmented reality platform that enables different natural interaction techniques such as writing, sketching, manipulating and navigating in 2D and 3D data (Aliakseyeu et al 2002).

The set up of the VIP uses the following (Figure 1):

- An LCD projector to create a large computer workspace on a horizontal surface – action-perception space (2 in Figure 1).
- An UltraPad A2® (Wacom ®) digitizer tablet as the horizontal surface (6 in Figure 1).
- An ultrasonic wireless position-tracking device of InterSense (IS-600 Mark 2, http://www.isense.com), which extends the interaction to the 3D space above the tablet (1 in Figure 1).
- An infrared light source and a camera. This allows the system to track physical objects, such as small bricks, that are coated with infrared-reflecting material. The camera and the infrared light source are located above the table (3,4 in Figure 1).
- A second vertically oriented workspace – communication space. The communication space is equipped with a 21-inch monitor (5 in Figure 1), which allows 3D visualization. This optional second workspace is usually used to supply the user with more extensive visual feedback for increased spatial awareness.

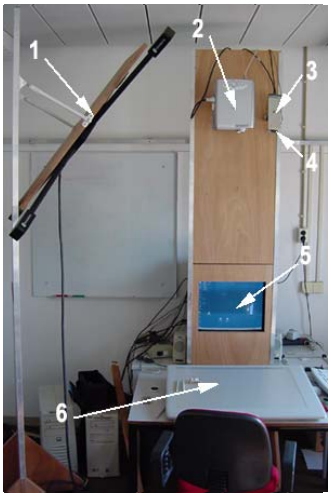

Figure 1: Visual Interaction Platform. 1–IS600 tracking device, 2–LCD Projector, 3-Camera, 4-Infrared light source, 5-Back projector (Communication Space), 6-Wacom Tablet (action-perception space)

The platform is equipped with two computers. An Intergraph® workstation is used for visualization. Dell OptiPlex GX1 is used for gathering the data from IS600 and camera.

2 Props

The hardware setup facilitates the realization of props (input devices) for interaction with the system. The VIP has four basic props namely, the brick element (BEL), the digital pen in combination with the digitizer tablet, the Enhanced Paper prop (EPP), and the Rigid Intersection Selection Prop (RISP).

The brick elements are physical objects coated with infrared reflecting material, which can be tracked by the system. The BEL is used for selecting and positioning the different objects on the action-perception space. An object is selected by placing the BEL on top of it. The object can be moved to the required position by dragging the BEL there.

The *Wacom UltraPad* consists of a *tablet* and a *digital pen*. The digital pen can be used like a conventional mouse or as a writing tool. In our current implementation the digital pen is used to make menu selections and 2D data (usually images) annotations.

The Enhanced Paper Prop (EPP) is a piece of real paper, which is placed on the action-perception space, The EPP contains infrared reflecting tags that allow the system to track it. Sketches made on the EPP, using the digital pen, can be traced into the computer. The visual feedback has two different modes. Sketch can be projected either onto the paper or can be created by digital pen with ink cartridge.

The RISP is a rigid rectangular frame, which acts as a cross-section picker. The RISP is tracked using the IS600 tracking device. If the intended application involves interacting with 3D, then the user can use his/her non-dominant hand to move the (light-weight) RISP above the table, thereby making the desired cross-section of the 3D data.

The essential features of the platform are:

- Two-handed interaction is possible
- The platform provides extensive visual feedback through the communication space
- The action and perception spaces coincide in the action-perception space
- The users do not have to wear intrusive devices like head-mounted displays
- There are no messy wires to hinder user movements

3 Applications

We created a prototype of the system for architectural design and medical planning.

For architectural design, the action-perception space contains previously made or scanned sketches; inspirational photos, for example, photos of work of other architects; images from previous projects and/or other relevant material. These materials can be retrieved from an image database browser that's available in this space. By moving the BEL with the non-dominant hand, the designer can change the position and orientation of images. A pen in the dominant hand can be used to annotate or sketch on these images. This annotations or sketches can be saved or printed for future use. The EPP is also part of the prototype for the architectural design. A digital copy of the EPP content (sketches, annotations, etc.) can be printed or saved. The system can also add visual information that supports the design, since any image can be projected on top of the EPP.

For medical planning the 3D model can be positioned anywhere within the action-perception space by moving a resizable window (3to2D window) to the desired location. The user can dynamically view slices of the 3D model by moving the RISP above this window. If the user finds any of the cross-sections interesting and wishes to investigate it further, s/he can save it immediately onto image database browser. The communication space (vertical display area) provides a perspective view of the horizontal workspace with the surface rendered 3D model sitting in the location of the 3to2D window. The 3D data requires some form of segmentation in order to map it into a surface model (Currently this segmentation is based solely on the gray value). When the user moves the 3to2D window in the horizontal space the 3D model moves accordingly in the projection space. The RISP is also visible in the projection space as a translucent plane moving through the 3D model. For user convenience the vertical projection space also provides the same bitmap that is shown in the 3to2D window.

Formal and informal evaluation by domain experts suggests that the system has added value in task performance for both domains.

References

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