Voodoosketch: Physical Interface Palettes and Sketched Controls alongside Augmented Work Surfaces

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Abstract. Voodoosketch is a system that extends a graphical table top interface with physical palettes on which users can dynamically deploy controls as shortcut to application functionality. The system provides physical 'plug and play' controls as well as support for sketching of controls, and allows controls to be associated with application functions via handwritten labels. The system uses a special digital pen, which writes 'real' ink on the palettes and while functioning as a digital input device on the graphical work surface.

Keywords: Adaptable user interface, table-top interaction, physical user interface, sketch-based interface.

1 Introduction

Digital workbenches and table tops have become widely studied as they facilitate around the table interaction on larger work surfaces [1]. One way to operate conventional applications on augmented work surfaces is to interact with the application's graphical user interface using a digital pen [2]. We introduce a system, *Voodoosketch*, which extends such an environment with interface palettes that are physically separated from the actual workspace (c.f. Figure 1).

Voodoosketch palettes can be of different sizes, and users can deploy multiple palettes in extension of a graphical work surface. On the palettes, users can create physical shortcuts to elements of the graphical user interface. The system offers two methods to instantiate such a shortcut: the user can either chose from a repository of physical components and plug them in into the palette (e.g. buttons, sliders or dials) or simply sketch controls onto the palettes' surface (e.g. square ~ button, rectangle ~ slider, circle ~ dial). The user can bind a new control to an application's function on-the-fly, by simply annotating the control with a handwritten label. If the label matches one of the application's function names (e.g. 'zoom' or 'move') the annotated control becomes instantly active and linked to the appropriate function. In that way, a user can create and maintain a personalized set of physical shortcuts to only the required interface components.

Figure 1: Voodoosketch allows controls to be taken out of the graphical user interface to be deployed on the physical palettes.

Figure 1 also shows that the system deploys a special digital pen, which can be used across palettes and the graphical work surface. The palettes are covered with augmented paper, allowing the pen to write on it with real ink, as well as to digitally track the pen activity. This allows the system to recognize shapes and to recognize the handwritten labels. On the work surface, the pen serves as a pointer-like input device.

2 System Description

The Voodoosketch system integrates two existing technologies, Anoto and VoodooIO, as input devices. Anoto comprises a unique pattern of very small dots that can be printed on paper of any size, and a digital pen that leaves 'normal' ink on the paper but in addition has a built-in camera to track pen movement in relation to the pattern. From the small view that a pen has at any point in time, the Anoto system can identify the paper on which the pen is used, as well as its position on the paper.

VoodooIO is an add-hoc physical interface toolkit, consisting of different types of controls and a flexible substrate material that has embedded conductive layers to support networking [3]. The physical controls have coaxial pins for their flexible attachment on the substrate, which acts as power and data bus for attached devices using the 1-wire network protocol. The VoodooIO system continuously monitors the substrate network to detect arrival of new controls (which have a built-in unique ID and type), and to track manipulation of present controls.

Voodoosketch palettes are flat paper-based surfaces that can be cut to any size and shape. In its simplest form this is a disposable piece of paper printed with an Anoto pattern for live sketching and labelling of controls. In addition, the paper can be augmented with underlying layers of VoodooIO material to also support plug-in of active VoodooIO components on the palette.

Based on the Anoto paper on the palettes the system detects when a user draws a shape and recognizes it as a potential control area (e.g. a rectangle could be used as a slider). Like the VoodooIO components these control areas have no a priori meaning and have to be assigned to a function in order to become active and useful.

In order to derive the meaning of new controls (VoodooIO as well as sketched controls) the Anoto data is also analyzed for handwritten labels. For that purpose, any pen strokes that do not match the description of a shape is parsed for textual content using a standard text recognition engine. Once the recognition returns a result, it is being matched with a pre-programmed list of available application functions. This list is provided by an application proxy, which has access to both, Voodoosketch subsystem and the application. Based on the incoming label the proxy can then assign the control to the appropriate function. After that the proxy continuously converts incoming interaction events from the control to the required parameters of the function and triggers the appropriate mechanisms within the application.

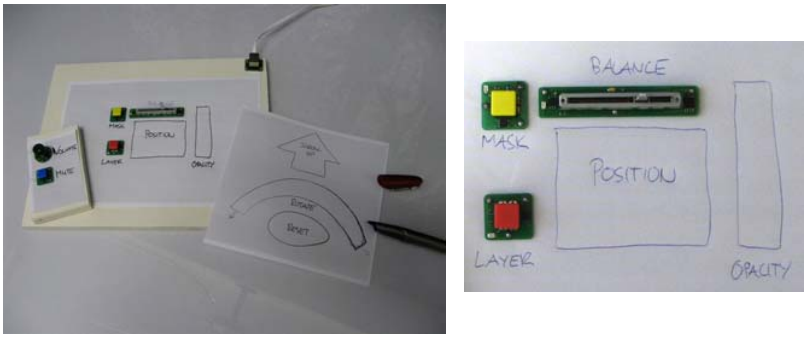

Figure 2: A collection of physical palettes based on paper and conductive sheets to support sketched controls as well as physical devices. Components can be plugged into the surface or be sketched and gain their meaning by handwritten labels.

Figure 2 shows examples of Voodoosketch palettes with different control configurations (left), and a close-up of a palette that contains a selection of sketched and physical controls for interaction with Adobe Photoshop (right). For instance, the large rectangle in the middle is associated with "position" delivering two-dimensional input as soon as the user touches the area with the digital pen. The long vertical rectangle on the right becomes a slider after being assigned to "opacity". As soon as a user touches this control with the pen, the system sends a scalar to the opacity-function in Photoshop, which is derived according to the pens position along the height of the rectangle (top = 100, bottom = 0). The physical VoodooIO controls can be directly operated by hand and forward their input values and events to the Voodoosketch software infrastructure.

The Anoto pattern is also the basis for the augmented table top [2]. This makes it possible to use the same pen fluidly across palettes and work surface, and to distinguish between graphical and palette interaction as both the table top and the palettes return distinct "paper IDs". Note that in this combination the pen is used for sketching and writing with real ink on palettes, and as pointing device on the display which, for this purpose, is protected with an ink-repellent surface.

3 Application

We have developed a demonstrator of Voodoosketch for interaction with Adobe's Photoshop CS2, deployed on a table top. More then 60 of Photoshop's functions are exposed via a proxy, and can be dynamically associated with Voodoosketch controls. Figure 3 shows a number of users interacting with this setup. Note that multiple pens make it possible for users to interact simultaneously with the interface and the application.

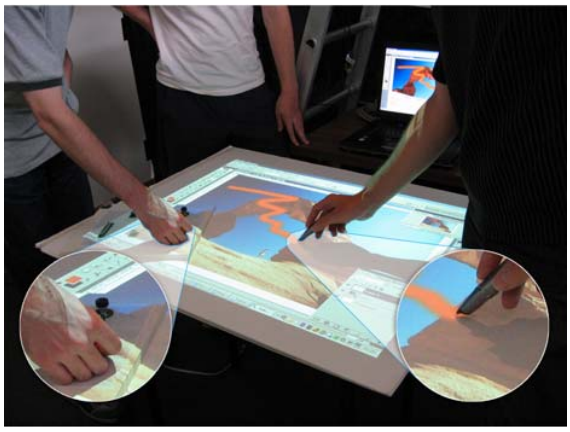

Figure 3: A number of users interacting with Adobe Photoshop on an table top augmented for Anoto pen interaction and extended with Voodoosketch palettes.

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