SLAP: Silicone Illuminated Active Peripherals

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Abstract

We present SLAP, a system of tangible, translucent widgets for use on FTIR-based multi-touch tabletops. Our initial widgets include a SLAP keyboard, button, slider, knob, and lens. SLAP widgets add tactile feedback to multi-touch tables, improving input accuracy. They can be relabeled dynamically via table rear projection, and provide inexpensive, battery-free, and untethered augmentations for FTIR tables.

1. Introduction

Multi-touch tabletop technology has spread rapidly in the research community. However, these tables do not provide standard UI controls with *tactile feedback*: for example, users cannot feel an on-screen button before pressing it. In particular, typing on on-screen keyboards is difficult without looking, interrupting visual activities and increasing typing mistakes.

SLAP, or *Silicone Illuminated Active Peripherals*, resolve this issue by synchronizing tangible and intangible representations [3]. They are simple flexible physical widgets cast from translucent silicone and other materials that can be placed on a tabletop. As in [4], their meaning is communicated by the table rear projection, but their input is also sensed by the table using FTIR.

2. Related Work

In VoodooSketch [1], users extend interactive surfaces by physically plugging widgets into a palette or drawing them. In comparison, SLAP adds dynamic relabeling via projection, and does not require power.

For text entry on tabletops, [2] provides an overview of existing external and on-screen methods. Following their taxonomy, SLAP keyboards combine the advantages of physical keyboards (no visual attention required) with those of on-screen keyboards (no switching between table and external device).
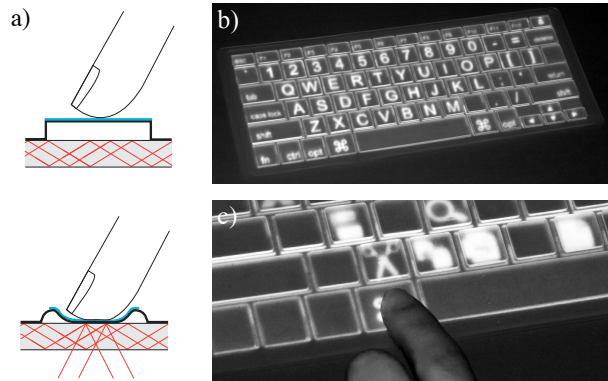

Figure 1. SLAP Keyboard. a) Pressing a single key sends IR light to the camera. b) Labels are displayed when keyboard is put down. c) Dynamic relabelling.

3. SLAP widgets

The **SLAP Keyboard** is a modified soft silicone keyboard protection cover. We increased the stiffness and translucency of the keys by gluing acrylic pads on top of each key. When placed on the table, the keyboard edges create an FTIR footprint that is detected using computer vision. When a user presses a key, its cap touches the surface, creating a FTIR light spot (Fig. 1a). The key is identified from the position of this spot in relation to the keyboard footprint.

We render a keyboard layout beneath the silicone keyboard, visible through the acrylic keypads (Fig. 1b). This also allows for context-dependent relabeling of keys. For example, characters can be grayed out when entering numbers, or icons can be shown when the Control/Command key is held down (Fig. 1c). The only physical keyboard supporting this, the Optimus Maximus[1], uses OLED displays in each key.

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[1]http://www.artlebedev.com/everything/optimus/
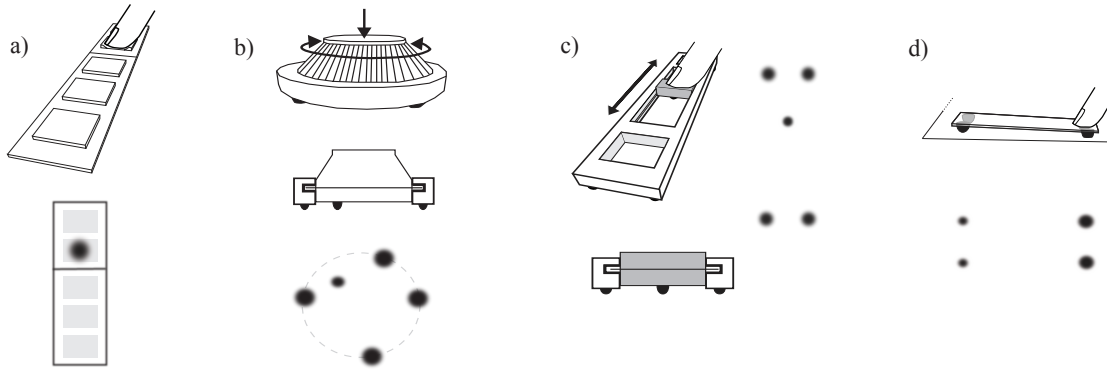
Figure 2. SLAP widgets (3D / cross section, footprint). a) Keypad. b) Push Knob. c) Slider. d) Lens.

The **SLAP Keypad** is a modular silicone strip with groups of buttons (Fig. 2a). When paired with an on-screen object (see below), it offers specific commands for manipulation. For example, if a user wants to navigate through a video, she can put down a SLAP Keypad to provide the corresponding controls (play, stop, etc.).

The **SLAP Push Knob** is a pushable rotary knob that provides circular selection and push detection. The system detects the widget and its current position by its specific footprint. The push state of the knob is derived from the intensity of the footprint. For example, it can be used to manipulate several object properties (Fig. 2b). The user selects from a circular property menu by rotating the knob. After a push, the menu may turn into a circular slider to adjust the selected property while the knob is held down. Releasing the knob returns to the circular menu.

The **SLAP Slider** (Fig. 2c) displays its value range at its end points when put on the surface and paired with an object and attribute. Being translucent, the slider can use colors as an additional cue for its value. Input detection works similar to the SLAP Push Knob.

The **SLAP Lens** exposes object details by physical or computational magnification (e.g., showing different layers in a map). It consists of a square acrylic frame supported by four silicone pads (Fig. 2d), detected as equally spaced spots on the surface. When users push down an edge, the adjacent spots appear brighter, enabling additional interaction metaphors.

4. SyncTap Pairing

The SLAP widgets require a focus policy: the widget must be linked to a specific object to edit, e.g., a text field. To pair the widget with the object, we introduce the following technique: when put down, the widget displays a diffuse halo until it is paired with an object. When the user simultaneously taps both near the widget and on the on-screen object, the two are paired, which the system confirms by flashing the objects in the same way. We anticipate that synchrony and locations of tapping can be used to distinguish pairing taps from other table activities, avoiding interference from unrelated activities of multiple users. Multiple widgets may be associated to a single target, and a single widget to multiple targets, including other widgets.

5. Future Work

We are designing and building additional SLAP widgets, such as a dynamically labeled chording keyboard, and image capture crop marks, and are implementing several applications to study their usefulness. We will also further investigate the synchronous tapping semantics of creating and deleting associations, and whether SLAP can help groups design traditional GUIs together using a multi-touch table.

6. Acknowledgements

References

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