Sensators: Active Multisensory Tangible User Interfaces

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Abstract. Although Tangible User Interfaces are considered an intuitive means of human-computer interaction, they oftentimes lack the option to provide active feedback. We developed 'Sensators': generic shaped active tangibles to be used on a multi-touch table. Sensators can represent digital information by means of 'Sensicons': multimodal messages consisting of visual, auditory, and vibro-tactile cues. In our demonstration, we will present Sensators as suitable tools for research on multimodal perception in different tangible HCI tasks.

Keywords: Tangible user interface, Active tangibles, Multimodal feedback

1 Introduction

In the quest for innovative forms of HCI, the research area of Tangible User Interfaces (TUIs) has received a fair amount of attention. TUIs can physically represent the underlying digital connection and as a consequence, the user can grab and feel the digital bits (See [1] for a recent overview). Since a TUI draws upon our skill to physically interact with the world, it is expected to enhance the intuitiveness of the interaction; an example is interacting by placing and manipulating objects on a multi-touch table. However, TUIs typically only take orientation and location as input, whereas our sense of touch offers many other means of communication: e.g., stroking, tapping, and squeezing. Moreover, whereas the digital world is highly dynamic and subject to change, TUIs are generally rigid and passive, not capable of representing these changes in information appropriately. For instance, objects placed on a multi-touch table usually cannot actively convey underlying information. Although TUIs enable intuitive tactile input (to a certain extent), they lack informative tactile feedback. This reduces the intuitiveness of the interaction as a whole and led to several investigations on ways to provide active feedback in TUIs. Self rearranging tangibles [2] can overcome a discrepancy between digital and physical information and can also provide force feedback (e.g., 'Tangible Bots' [3]). Moreover, system feedback can be provided in different modalities (e.g., 'SmartPuck' [4]). This trend in TUI research motivated us to enrich tangible objects with active feedback capabilities to be used in combination with multi-user multi-touch devices or as standalone devices.

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We developed several generations of generic shaped active TUIs: 'Sensators'. Sensators (Fig. 1) can serve as tangible input devices by means of translation and rotation, but also through multiple conductive touch-sensitive areas which sense whether and where the Sensator is touched. As means of output, the Sensators can provide multisensory messages: 'Sensicons' (analogous to icons and earcons). Sensicons consist of visual information through color patterns, auditory information through pre-recorded audio-samples, and/or vibro-tactile information by means of varying frequencies and amplitudes of two vibration motors [5].

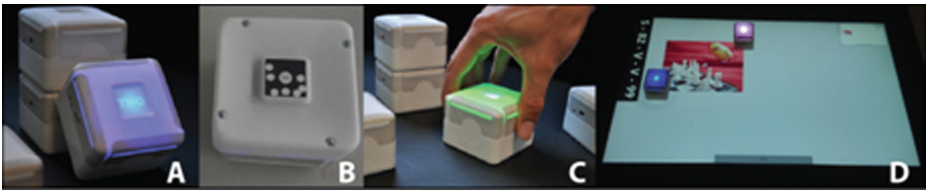

Fig. 1. Sensators (A) with markers for recognition (B) and touch-sensitive input areas (C) applied as research tools in a tangible interaction task on a multi-touch device (D).

We discern five goals for Sensator interaction on digital tabletops: (1) provide system feedback, (2) strengthen the interaction and collaboration between users, (3) display additional abstract and/or personalized information, (4) display touch properties of objects, and (5) support interaction styles and techniques.

2 Demonstration

We will demonstrate our latest generation of Sensators and provide insights in how Sensators have been applied as research tools in different user studies. Visitors can experience Sensators in different (multihanded) tasks. We would also like to present our ideas on possible extensions of the Sensators (e.g., heat as a form of communication, or sensing physiological data as means of system input), as well as on possible future application areas of active tangible objects (e.g., research on social interaction or higher level cognitive aspects of multi-sensory information).

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