OnObject: Gestural Play with Tagged Everyday Objects

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ABSTRACT

Many Tangible User Interface (TUI) systems employ sensor-equipped physical objects. However they do not easily scale to users' actual environments; most everyday objects lack the necessary hardware, and modification requires hardware and software development by skilled individuals. This limits TUI creation by end users, resulting in inflexible interfaces in which the mapping of sensor input and output events cannot be easily modified reflecting the end user's wishes and circumstances. We introduce OnObject, a small device worn on the hand, which can program physical objects to respond to a set of gestural triggers. Users attach RFID tags to situated objects, grab them by the tag, and program their responses to grab, release, shake, swing, and thrust gestures using a built-in button and a microphone. In this paper, we demonstrate how novice end users including preschool children can instantly create engaging gestural object interfaces with sound feedback from toys, drawings, or clay.

Author Keywords Gestural object interfaces, tangible interfaces, end user programming, ubiquitous computing.

ACM Classification Keywords H5.2 [Information interfaces and presentation]: User Interfaces. – Input devices and strategies.

General Terms Design, Human Factors, Algorithms, Experimentation.

INTRODUCTION

Past and present Tangible User Interfaces (TUIs) have incorporated common physical objects, from Marble Answering Machine, musicBottles, to I/O Brush, reacTable and Amagatana+Fula [1, 2, 3, 4, 5]. However, it is difficult to adapt and reconfigure TUIs for varying environments, user contexts and needs because the physical objects often serve as custom housing for the hardware as in I/O Brush and Amagatana, or it requires a construction of a sensing platform as in musicBottles and reacTable. It is even harder for end users to create TUIs informed by their particular needs, as the complex process of building a functional interface prohibits timely validation of the interaction idea and motivation. The goal of OnObject is to provide a way for novice end users to rapidly transform situated physical objects to gesture interfaces to their liking in the very context of use, without a lengthy development process.

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Figure 1: OnObject system involves RFID tags and a sensing device with RFID reader and accelerometer.

ONOBJECT SYSTEM

The OnObject device employs a short range 13.56MHz Radio Frequency Identification (RFID) reader to recognize tagged objects the user is holding in her hand, and a single tri-axis accelerometer to recognize the motion gestures a user makes with the tagged object in hand. The device then sends the RFID tag and accelerometer data to a nearby computer, where the tag ID, gesture ID and the button status is used for various applications. In addition to the grab and release of a tagged object, a gesture recognizer has been developed to detect shake, swing, thrust, tilt, and circle motions with a combination of decision tree and Hidden Markov Model. For a given tag, the user can program the desired output for each gesture trigger by demonstration. For example, to program a wooden alphabet M to say "monkey" when shaken, the user first attaches an RFID tag to the M, grabs it by the tag and demonstrates the shake gesture, which produces a built-in sound feedback (Fig 2, left). She then presses the button on the device and records her own voice saying "monkey," overriding the default sound output for the shake gesture (Fig

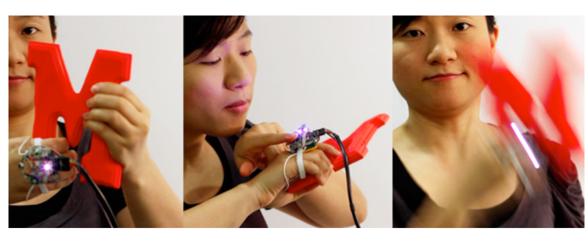

Figure 2: Programming an M to say "monkey" when shaken.

2, center). Now when she shakes the M, it produces the "monkey" recording (Fig 2, right).

APPLICATIONS

Using OnObject, we have demonstrated and documented the following applications for children (Fig 3):

Learn languages and concepts: It takes 9 seconds to program the letter M to say "M is for" when grabbed, and "monkey!" when shaken. Similarly, a stuffed frog is programmed to say "what does a frog say?" when grabbed, and "ribbit!" when swung, engaging children in interactive, participatory learning activities. The sound feedback can be re-recorded or mapped to a different gesture trigger at will.

Storytell and role play: Stuffed animals, cars, and makeshift characters can now have a voice and sound effects. A frog asks for a name when grabbed, user records a name into the frog, and a kangaroo can subsequently call the frog by that name when shaken.

Interactive books: Children can draw stories on a piece of paper, tag the characters and scenes, and record narrations and voices for each, effectively creating an interactive storybook on plain paper similar to Jabberstamp [6], but without the need for a tablet or computer underneath.

Figure 3: Roleplay (left) and interactive book on plain sheet of paper (center, right) with OnObject.

RELATED WORK

OnObject relates to variety of previous research, yet differentiates itself in its scalability and instant gratification of TUI creation. Its architecture and gesture recognition implementation resembles activity recognition systems including Wockets/MITes, ReachMedia, Berlin's toolkits among others [7, 8, 9]. However, unlike activity recognition systems, OnObject is designed for interactivity and extemporaneous end user programming. Compared to other sensor-based prototyping tools such as Examplar, Thumbtacks, and aCAPpella [10, 11, 12], OnObject offers significantly more abstracted representation of the gestural language and rapid in situ object programming—its palette-based approach is usable by casual users, such as parents and children, without switching context for low-level activities like writing code, wiring, or watching raw input. OnObject relates to the gestural programming by example pioneered by Topobo, and the definition of *Gesture Object Interface* introduced with Picture This! [13, 14], while scaling the gestural interaction to any situated objects in our environment with the design principle of *appropriation by attachment* introduced by Zhang and Hartmann [15].

CONCLUSION

OnObject's defining contribution is that it enables novice end users to create salient and dramatic Gesture Object Interfaces similar to musicBottles or Amagatana using any objects, on the spot, to their liking. Using the metaphor of tagging, it invites laypeople to participate in TUI creation via programming by demonstration. It can be further developed to provide even richer interaction by incorporating other output modalities, multi-user applications, or by providing abilities to add grammatical elements such as conditionals and sequential contingencies to existing applications.

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