CuddleBits: an iterative prototyping platform for complex haptic display

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Abstract. Complex interactive haptic machines are hard to design and control, especially when their object is expressive behavior that cannot be specified *a priori*. Simple 1-degree-of-freedom (DOF) devices support rapid iteration, but reduce expressive space. We are developing complex robots and their interactions by iterating rapidly on simple proxies. With rapid prototyping techniques and an easily extendable behaviour editing system, we decomposed the design of a complex haptic robot into single-DOF 'CuddleBits' [1]. Each Bit is a functional, self-contained robot with which we can fully explore the expressive capacity of a single movement (e.g. breathing, hunching, orienting) in form, movement and feel. In this demo, we present the CuddleBits, their construction, and real-time robot behaviour improvisation and editing tools Voodle and MacaronBit.

Keywords: Haptic Robots · Rapid Prototyping · Design

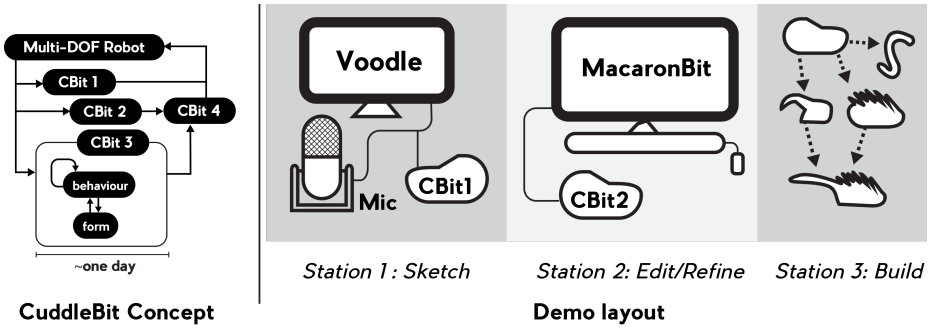
1 Introduction

We are moving from the challenges of building and rendering compelling but isolated haptic sensations to those of creating haptic *interactions* where a machine's form and its responsive behavior are inextricably coupled in the quest to generate a specific user response. This is especially difficult in multi-DOF devices with fuzzy specifications like haptically rendering affective states or aesthetic nuances and altering user emotions. Hardware and code changes cascade across the system, escalating iteration costs. Instead, we are deconstructing a complex robot into low-DOF mockups, rapidly iterating both hardware and behavior to refine our specifications, then synthesizing these into a new complex machine.

We will demonstrate the iteration-accelerating potential of this approach for both hardware and behavior with a family of full-function "CuddleBits", with which we have already investigated a broad design space of form, materiality and behavior. We will show elements and artifacts of our physical *sketches* [2] – functional mockups created in hours with rapid prototyping techniques like 3D printing and laser cutting. When each DOF's iterations have converged, integration is a far simpler matter of combining and fine-tuning proven components.

On the software side, we will show two tools: voice input as a natural sketching [4] input for motion and feel, and a web-based tool, Macaron [3], for keyframe-based behaviour *editing and refinement*.

Using both in tandem, we have found even these simple Bits to be viable interactive displays in their own right, able to capture the ineffable qualities and responsive behaviors we seek.



2 Demonstration Description

We will bring and run a selection of CuddleBits and their supporting design tools. A demo attendee will be able to use her voice to control (sketch) CuddleBit motion in real-time, use MacaronBit to *edit and refine* behaviours with keyframes, to touch and feel a variety of CuddleBit hardware, and through a collection of artifacts, see how they are physically constructed. Demo video available at http://bit.do/cuddlebitsEH2016.

Set-up and Technical Requirements:

We require a table (for two computers, a microphone and several CuddleBits), two chairs and two powerbars.

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