Programming Materiality

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ABSTRACT
XS Labs, founded in 2002, is a design research studio that develops innovative work in the area of electronic textiles and reactive garments. Our work is informed by the technologies and techniques of craft-based practices – weaving, stitching, embroidery, knitting, beading, or quilting – and by the exciting possibilities afforded by modern materials with various electro-mechanical properties. This involves the development of enabling technologies, methods, and materials in the form of soft electronic circuits and composite fibers. At the same time, our projects often critique the traditional task-based and utilitarian definitions of functionality in HCI. "We consider the soft, playful, and magical aspects of these materials, so as to better adapt to the contours of the human body and the complexities of human needs and desires. Our approach often engages subtle elements of the absurd, the perverse, and the transgressive. We construct narratives that involve dark humor and romanticism as a way to drive design innovation. These integrative approaches allow us to construct composite textiles with complex functionality and sophisticated behaviors." [2]

Our research agenda was originally motivated by a concern with the lack of softness in HCI applications and the desire to explore and exploit a wider range of material properties in the development of physical interfaces. We wanted to develop physical interfaces that could conform to the human body and explore the boundaries of "beyond the wrist" interaction. This is predicated on a deeper understanding of the materiality and the physicality of our computing technologies. "We are particularly concerned with the exploration of interactive forms that emphasize the natural expressive qualities of transitive materials. We focus on the aesthetics of interaction, which compels us to interrogate and to re-contextualize the materials themselves. The interaction narratives function as entry points to question some of the fundamental assumptions we make about the technologies and the materials that drive our designs." [2]

Accelerating progress in all branches of science research has been redefining our fundamental design materials. [1] Materials such as conductive fibers, reactive inks, photoelectrics, and shape-memory alloys are already shaping new physical forms and new experiences that are redefining our relationship with materiality and with technology [4]. Our design philosophy at XS Labs focuses on the exploration and development of these transitive materials and technologies as a fundamental component of our design research practice.

In the last three years, we have been working with Prof. Maksim Skorobogatyi to develop a new generation of composite fibers that are able to harness power directly from the human body, store that energy, or use changes in energy to change their own visual properties. The core technical innovation involves shifting this functionality entirely within the fiber itself. The goal of this project, entitled "Karma Chameleon," is to develop a prototype for an all-fiber based textile that can harness, sense, and display energy. Conceptually, this constitutes a radical deviation from the dominant model of a textile substrate with integrated mechano-electronics to a fully integrated composite substrate, wherein the fibers themselves (a) harness human-generated energy, (b) store the energy directly inside the fibers, and (c) use that energy to control a fiber-based actuator (such as fiber illumination and color).

The design implications of such new fibers are twofold. First of all, when a material integrates computational behavior, how do we "program" such a material? We do so by determining the length, the shape, and the placement of the material in a composite system (in this case, the textile). We program a functional fiber by cutting it to a specific length and positioning it in the cloth so as to deliver the desired functionality. Changing its shape or orientation will change its behavior, not only in

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how it behaves visually, but also in how it behaves computationally. The second, more profound, implication is that the language of aesthetics and design (parameters such as shape, color, or visual composition) becomes conflated with the language of programming.

Designers have historically been "programming materiality" in a metaphoric way, controlling physical and aesthetic parameters so as to give rise to emergent forms and interactions. Designers today, in addition, can program their materials and their objects in a computational way, which traditionally involves a non-material and non-intuitive set of processes. When working with a capacitive fiber, cutting a cloth not only changes its shape and the way it drapes on the body, it also changes the capacitance of the component. When working with photonic bandgap fibers, which have the ability to change color when illuminated with ambient or transmitted white light [3], cutting the length of the fiber will change the color of the light that is transmitted at its end. When working with shape-memory fibers integrated into felt, the exact shape of the felt will determine the subtle qualitative aspects of the movement: how gently will it slow down before coming to a full stop.

In addition, "programming materiality" is not only concerned with harnessing the material properties of a fiber (or other physical object) but it is intrinsically a performative act, which involves instructions and described behaviors. Just like in a stage production, there are scripts, scenarios, stage directions, lighting and sound… Designers need to consider the programmatic behavior of each material when making aesthetic decisions. The two can never again exist independently from one another. One of our great opportunities at TEI, the conference for tangible, embedded and embodied interaction, is to define a new language for talking about materiality, interactivity, and physical interaction design. This new language should integrate performative concepts so as to provide roadmaps for the training of future designers who will unquestionably be working with materials that not only drive behavior through their physical properties but also through their computational nature.

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BIOGRAPHY

Joanna Berzowska is founder and research director of XS Labs, a design research studio that innovates in the area of electronic textiles and responsive garments. A core component involves the development of enabling methods, materials, and technologies – in the form of soft electronic circuits and composite fibers – as well as the exploration of the expressive potential of soft reactive structures. Her art and design work has been shown in the Cooper-Hewitt Design Museum in NYC, V&A in London, Millenium Museum in Beijing, various SIGGRAPH Art Galleries, ISEA, Art Directors Club in NYC, Australian Museum in Sydney, NTT ICC in Tokyo, and Ars Electronica in Linz among others. She lectures internationally about electronic textiles and related social, cultural, aesthetic, and political issues. She was selected by Maclean's Magazine as one of "thirty nine Canadians who make the world a better place to live in". She is Associate Professor of Design and Computation Arts at Concordia University