@LAB

Architextile Laboratory: Electronic textiles in architecture

BY SARAH BONNEMAISON

With contributions by
Joanna Berzowska
Christine Macy
Robin Muller

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Institutional Proponents
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Participants in the team for the design and construction of each prototype (in addition to the two principle Investigators):

THE CULTIVATED EAR / A REACTIVE CEILING
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CANADA GAMES WINTER WARMING HUT
Anke Fox, Stephen Kelly, Alan Macy, Amélie Proux, Andrew Rabyniuk, Adam Read, Melissa Schwegmann, Greg Sims, and Shane Yates.

FLAMENCO FAN /
THEATRICAL COSTUME AND BACKDROP
Kate Delmage, Anke Fox, Stephen Kelly, Adam MacKinn, Deborah Montgomery, Adam Read, Masaki Shuette, Barbara Sutherland, Greg Sims, and Shane Yates.

CRICKET, A RESPONSIVE MASSAGE ENCLOSURE
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LUMINOUS SCREEN
Jacob JeBailey and Greg Sims.

GLOWING CURTAINS
Leola LeBlanc and Greg Sims.

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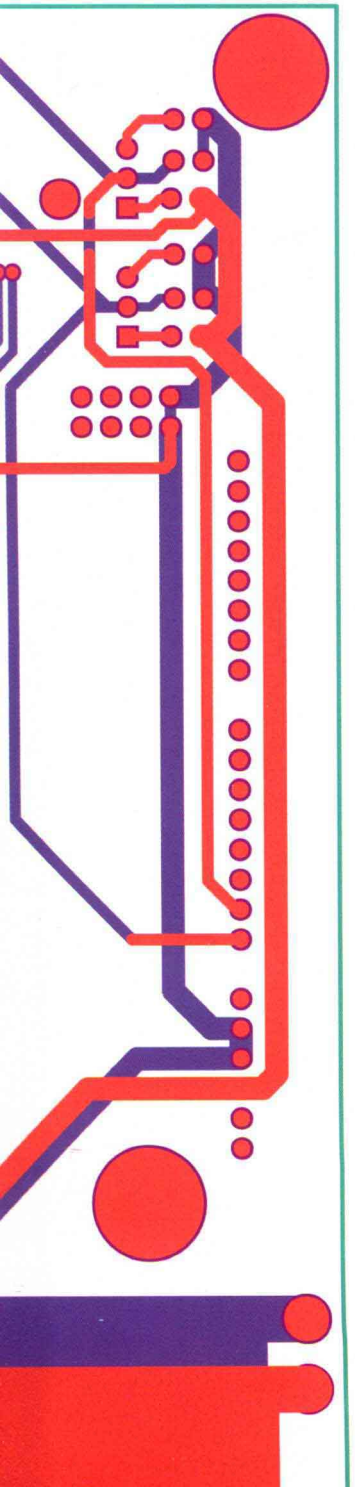

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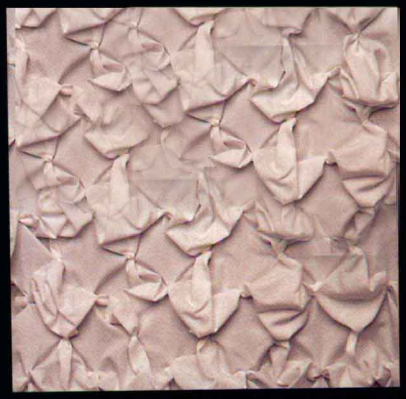
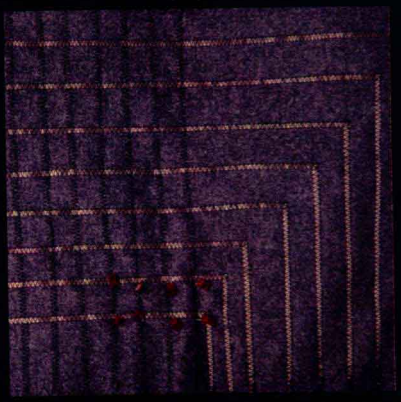
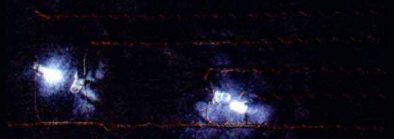

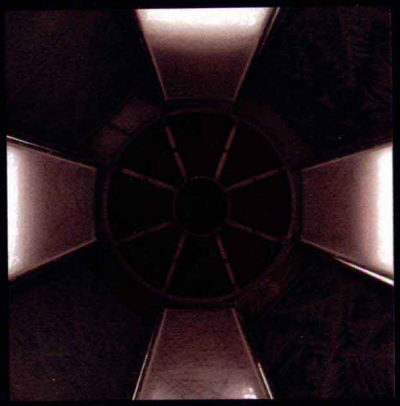
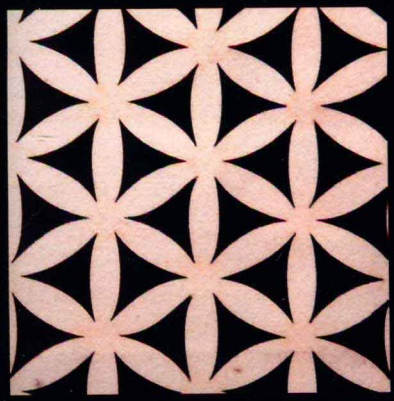

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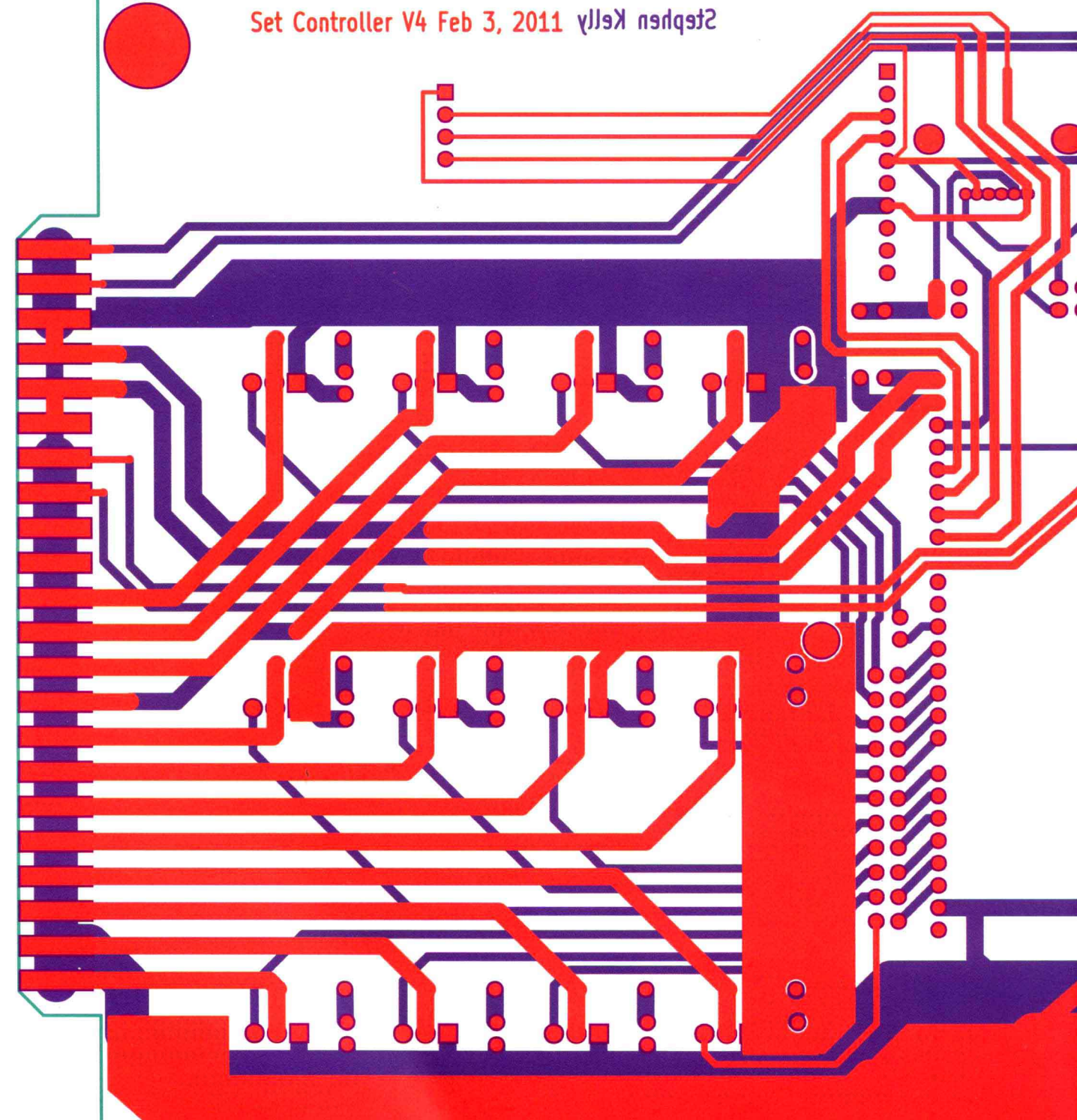
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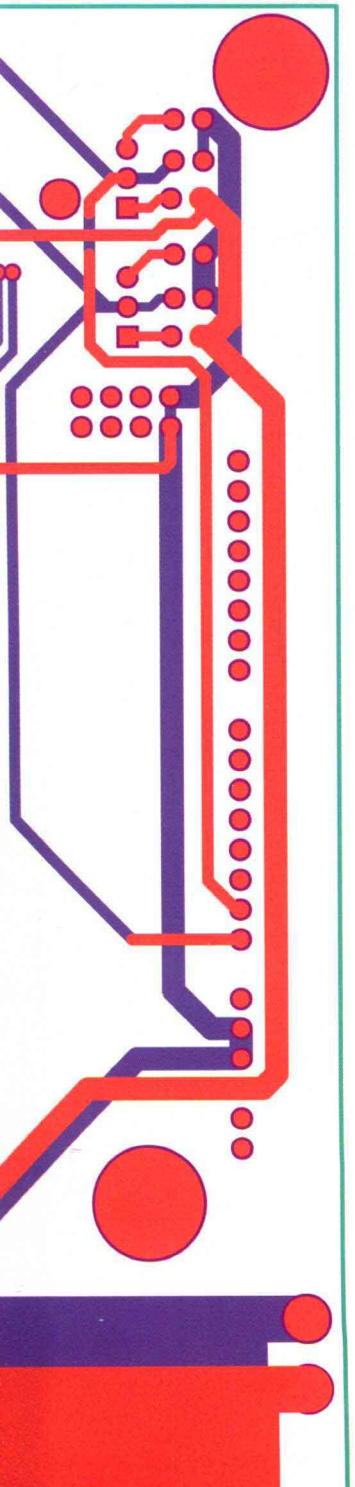

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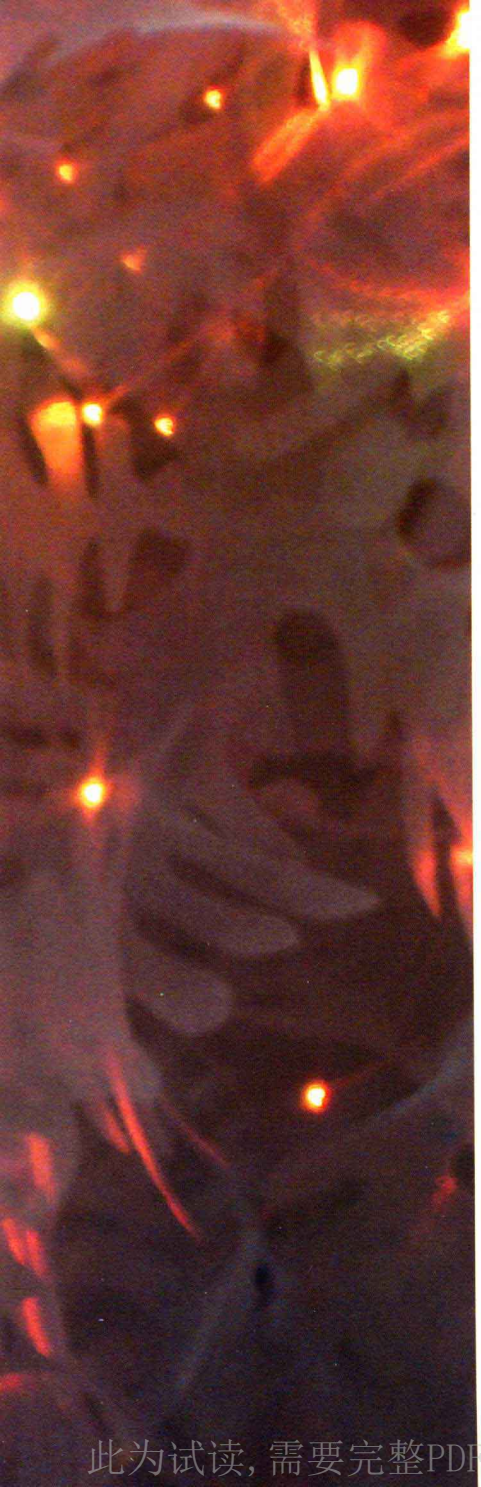

FOREWORD

This catalogue details an exciting research initiative in which NSCAD University and Dalhousie University teachers and scholars headed by Professors Robin Muller and Sarah Bonnemaison partnered to push the boundaries of textiles and technology. Begun in 2008, the interuniversity, interdisciplinary collaboration known as the Architextiles Lab, or @Lab, has successfully concluded the first phase of research funded by the Atlantic Innovation Fund (AIF).

It has been exciting for me as NSCAD's President to witness textile artists, architects, and engineers gathered at the @Lab, bringing their collaborative ideas to fruition. Suggestions were raised and talked about, 'what ifs' explored and 'why nots' encouraged. Prototypes were built and tested; some were built again and refined, and some like the Warming Hut enjoyed wide public exposure at the 2011 Canada Winter Games.

@Lab research is literally transforming the conventional understanding of textiles. Products from the lab are known colloquially as 'smart textiles' and we are delighted at NSCAD to be associated with the extraordinary creativity and imagination these products represent. Smart textiles respond to various stimuli, by altering shape or changing colour, by reflecting or absorbing sound. Textiles can be used for so much more than adorning the body or draping on a bed, lightweight and durable, when married with electronics and brought into the architectural scale the possibilities are limitless.

As @Lab transitions in its funding and takes new forms, the spirit of ingenuity that fired the core team and was fanned by numerous students along the way remains vital. With this catalogue, we celebrate the first four years of @Lab's creative output and imagine what's next.

DAVID B. SMITH
NSCAD PRESIDENT

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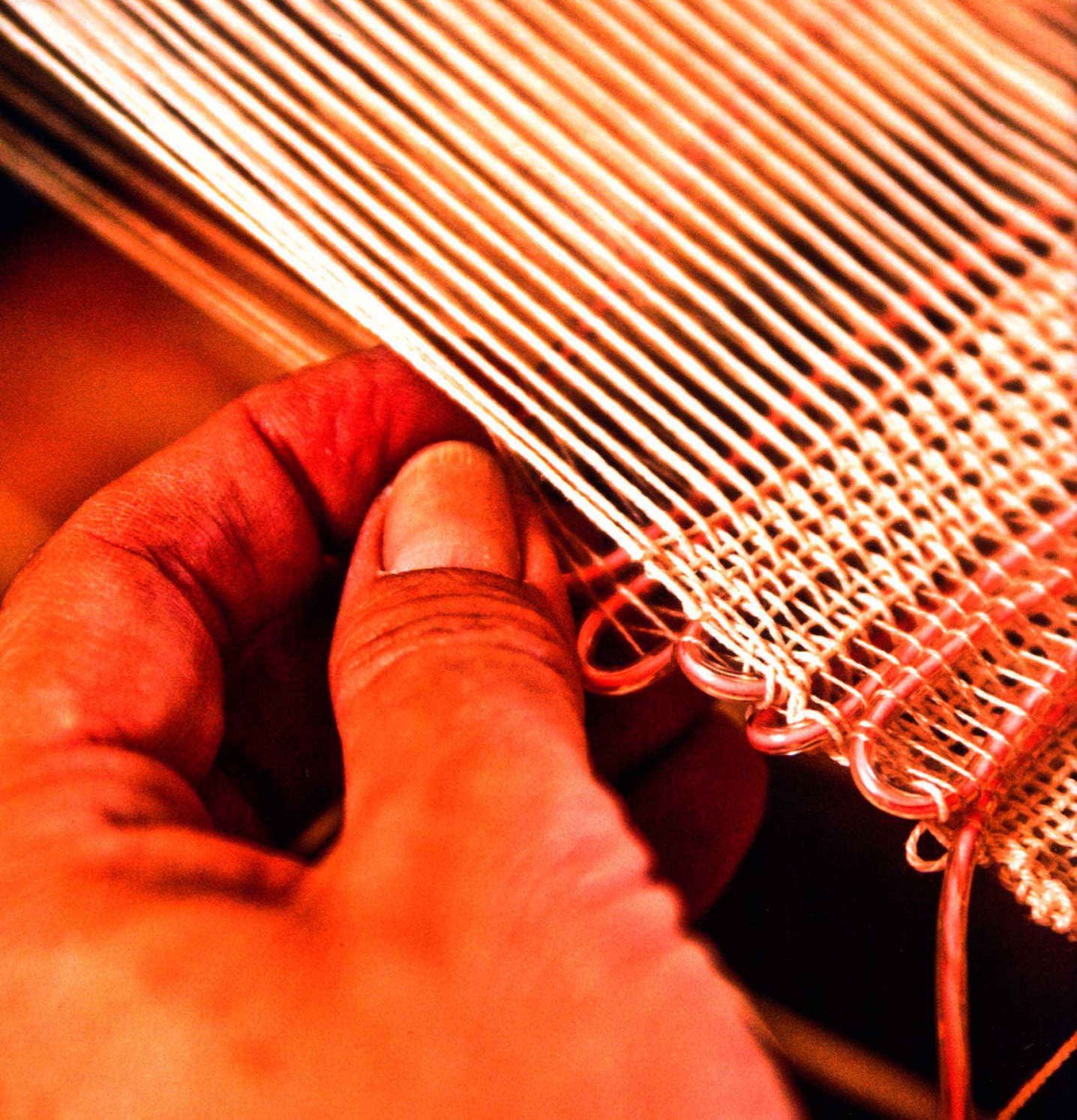


ELECTRONIC TEXTILES FOR ARCHITECTURAL DESIGN AND WELLBEING

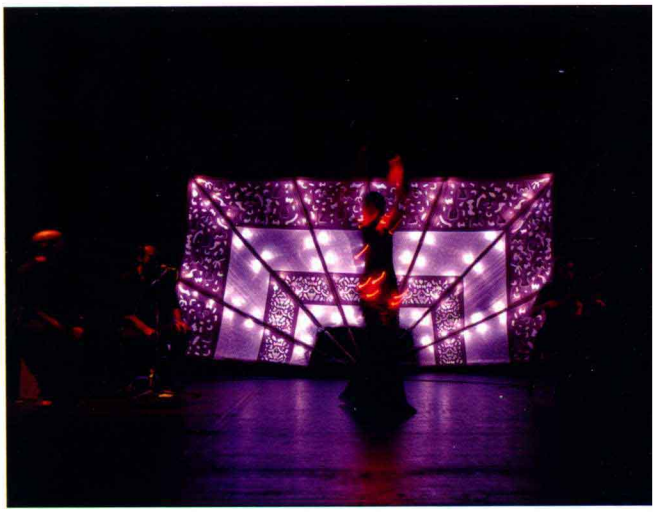
JOANNA BERZOWSKA

This catalogue presents six works that elegantly summarize four years of investigation, design, experimentation, and prototyping by the multidisciplinary research group @Lab.[1] The works present innovative research in electronic textiles and responsive environments, which includes illuminating woven curtains and paper screens, responsive enclosures for massage therapy and for the provision of heat, and textiles for theatre stages and modulating ceilings. The projects are a unique body of work, with their solid foundation in craft and technology, focus on architectural textiles, and strong interest in wellbeing and experiential design.

ELECTRONIC TEXTILES

Electronic textiles are textile substrates that incorporate capabilities for interconnection and communication, to allow sensors (biometric or environmental), displays (light, sound, color or shape change), and information processing devices to be networked together within a fabric. Interconnection is facilitated by yarns, either spun or twisted, that incorporate some amount of conductive material, such as strands of silver or stainless steel, to enable electricity to flow. Electronic textiles differ from 'smart' textiles that feature material science innovations so as to create better insulators, heat-resistance, or fabrics that resist stains. Electronic textiles allow computation to occur within a flexible substrate.[2]

Notwithstanding the proliferation of research in this domain, electronic textiles are still in their infancy, with many technical problems remaining to be solved, but they are

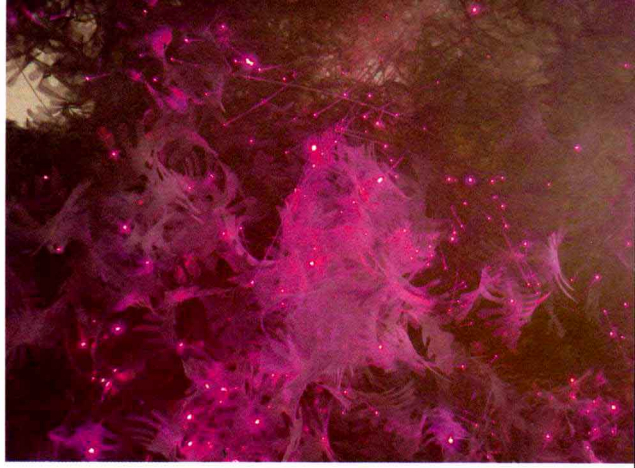


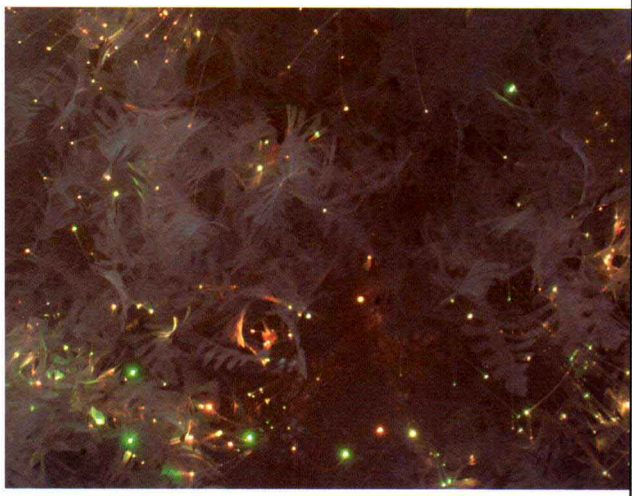
beginning to permeate the mainstream imagination through several high-profile projects for the fashion industry over the past few years. Hussein Chalayan's Fall 2007 collection at Paris Fashion Week showed cocktail dresses lit up from inside with 15,600 multicolored light-emitting diodes (LEDs), programmed to display an abstract video evoking seasonal change. In Spring 2010, Katy Perry wore a gown outfitted with 3,200 LEDs, designed by London-based CuteCircuit, to the Metropolitan Museum's Costume Institute Gala. Janet Hansen, an electronic textile designer, has created electronic accessories such as flashing sunglasses for Kanye West and light-up helmets for Daft Punk. Architectural and environmental uses of electronic textiles have not been highlighted as prominently in the press but include projects such as the recent color-changing, sound-absorbing, luminous textile wallpaper created by Phillips in collaboration with Kvadrat Soft Cells.[3]

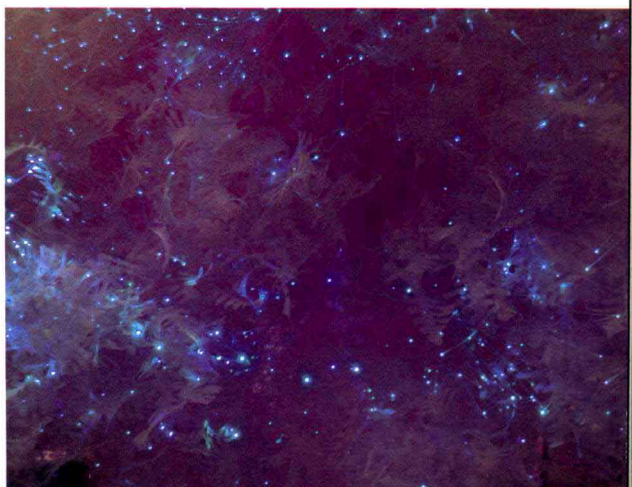
Despite the focus on illumination in high-profile projects, research labs and experimental design collectives have been exploring the social and cultural dimensions of electronic textiles, both in a wearable and architectural context, delving into areas such as memory representation, tactile communication, remote intimacy, and social critique. Because this work is inherently multidisciplinary, the multiplicity of research methods, which include empirical as well as design-led explorations, has given rise to a rich landscape of electronic textile projects. This landscape includes the more traditional concerns with productivity and task-based applications, but more importantly, also allows artists and designers to highlight the more subtle, complex, and potentially problematic qualities of these materials and technologies. Projects such as Captain Electric from my own research group, XS Labs, push the boundaries of technical possibilities while asking crucial questions about the implementations of these technologies. XS Labs is a design research studio with a focus on innovation in the fields of electronic textiles and reactive garments. That innovation is driven firstly by the technical and cultural history of textiles (weaving, stitching, embroidery, knitting, beading, and quilting) and secondly by the integration of new materials with different electro-mechanical properties.[4]

Captain Electric is a collection of electronic garments

that harness kinetic energy from the body and use it to transform themselves through sound and illumination. The project investigates how emotions and aesthetics are expressed through design and how electronic technologies can help us articulate new questions about the relationship between soft electronic structures and the human body. While the project focused on conceptual explorations and speculative user scenarios, it also involved the development of custom circuitry and specialized solutions for integrating power generators into garments and wearable artifacts. The garments conceptually reference safety apparel and personal protection gear, as well as our fears of natural disasters and other states of emergency, personal phobias, anxieties, and paranoia. They pose questions about what kinds of applications are possible and desirable within this field.







DESIGN AND WELLBEING

Because of the richness and complexity of research in electronic textiles, its application domains are finally shifting away from military, medicine, and sports performance (involving biometric monitoring and tracking applications) towards wellness, quality of life, and entertainment. While there is obvious interest from design and technology companies such as Philips Electronics and fashion designers such as Hussein Chalayan, the true potential of electronic textiles is yet to be explored in consumer markets. We are poised on the edge of a new era rich with profitable near future applications that span a wide range of domains. Some of the more important and exciting efforts towards commercialization include applications that:

- present new structural and decorative solutions for artists and design professionals;
- create magical, sensor-enabled, and reactive settings and costumes for performing artists;
- provide environmental sensing and communication technologies for public spaces;
- aid in health monitoring through sensor-embedded

garments and environmental textiles that track, record, and display biometric data; and
- help improve athletic performance by analyzing sensor data in changing conditions and tracking performance over time.

The projects described in this catalogue present rich potential for all of these areas. In addition, building on the multidisciplinary profiles of the @Lab research team members, deeply rooted in craft and architecture, a complex multiplicity of questions and possibilities underlie their work. While I could argue that all six projects described in this catalogue focus on environmental design, on quality of life, and on wellness, their potential applications span entertainment, industrial design, sports performance, and health.

In *The Supermodern Wardrobe*, Andrew Bolton writes "clothing integrates social, psychological and physical functions."[5] This is not only true of clothing for the body, but also the clothing that we create for our spaces: the screens, curtains, furniture, and other architectural structures that clothe our physical world. Electronic textile interfaces can be imagined as a platform for creating the next generation of 'social media' that can breach the transitive space between the material and the immaterial. More than hand-held devices, textile interfaces (wearable and architectural) can engender new relationships and new insights into our physical and digital activities. At the center of all social media lies a preoccupation with identity, communication, pleasure, and a sense of wellbeing.

This focus on wellness, pleasure and communication is central to the designs of the @Lab, with kinetic illuminating forms that augment spaces and transform them over time to create different experiences for the people who inhabit or occupy them. Light becomes a metaphor for setting mood and instilling a sense of relaxation, and it allows the structures to take on multiple lives, depending on environmental lighting conditions. There is subtlety in these designs. Their form is considered and developed to work over time, as ambient lighting changes and as the structure itself illuminates. Most importantly, all the materials, electronic and traditional, are seamlessly integrated so as to create a composite form that does not distinguish between old and new technologies.

NEW MATERIALITY, NEW PRACTICES

The worlds of architecture/design and ubiquitous computing are rapidly converging. New and emerging materials that include efficient light-emitting components, shape-changing polymers, conductive fibers, and other material science innovations are now positioned to provide the underpinnings of truly ubiquitous interactivity. Seamless integration, informed by the rich knowledge built through craft traditions, will ensure our ability to create more cohesive computational systems that extend from the body to indoor and urban-scale environments, and can more meaningfully respond to our personal and social activities.

The Glowing Curtains are woven on a traditional loom, leveraging a deep knowledge of craft, and integrate Electroluminescent (EL) fibers that infiltrate the woven structure and illuminate when powered. The luminescent fibers are woven directly into the textile. They are not attached to the surface. Form, function, and behavior are seamlessly integrated; creating a kinetic behavioral sculpture that can modulate the aesthetic experience in a space by emitting colored light.

This work feeds current discourse taking place between researchers and professionals from the design and scientific disciplines in order to map out the possibilities and limitations of new material technologies. The discussions focus on the use of responsive materials as the physical and computational bridge between form and function, body and environment, structures and membranes.[6] The term 'smart materials' has been used extensively in popular media to refer to a wide range of materials with new, unexpected, or complex appearance and behavior. In the book *Smart Material and Technologies*, Addington and Shodeck define

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