Chapter XI
The Garment as Interface

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ABSTRACT
This chapter focuses on the surface of a smart garment as a dynamic interface. The use of the garment’s surface as an interactive display opens up an array of new applications. Novel developments in interactive and wearable textile surfaces for garments display data from input sources like sensors and cell phones. The integration of these surfaces into the garments is evaluated regarding wearability and the wearer’s interaction. This chapter provides a list of considerations for human interaction with smart garments and dynamic visual interfaces, which are an essential tool to design usable, smart garments.

ELECTRONIC TEXTILES
Electronic textiles or wearables result from the integration of technology into a textile, a garment, or a wearable object. Such objects or devices can either be embedded into the skin or into a textile or wearable material, or be portable. “An electronic textiles—or smart fabric/textile—refers to a textile substrate that incorporates capabilities for sensing (biometric or external), communication (usually wireless), power transmission, and interconnection technology to connect sensors and microprocessors to be networked together within the fabric” (Berzowska, 2005, p. 60). Wearable technologies are closely related to electronic textiles. The term wearable technologies covers in particular electrical engineering, physical computing, and wireless technologies. Electronic textiles and wearable technologies are literally interwoven. Intelligent garments have an enhanced functionality through embedded technologies. Integrated sensors monitor vital signs, built-in speech-recognition systems allow for an interface independent from a physical interaction, and embedded wireless systems enable hands-free communication. Intelligent garments is functional clothing constructed with textiles and materials that are considered smart. “Fibre sensors, which are capable of measuring temperature,
strain/stress, gas, biological species and small, are typical smart fibres that can be directly applied to textiles” (Tao, 2001, p. 4). Smart textiles are capable of reacting to a stimulus with or without the use of competition. Outlast explains that PCMs—phase changing materials—can absorb, store, and release heat while the material changes from solid to liquid and back to solid.

**H2: Dynamic Garment Interface**

What is a dynamic interface of a garment? Technologies enrich the cognitive characteristics of our second skin—the surface of our garments. Currently, the surface of a garment is mostly used for static displays of information or for safety features. An example is the glow-in-the-dark function of running and biking gear to warn drivers on the road. The dynamic information, the output, can either be real-time or static. It can be controlled through a microprocessor or a simple non-computational input like light. The dynamic character of the surface, its colors, animation, lengths of appearance, subject, speed of movement, and so forth is influenced by the input. Though, the interface of the surface is not limited to a visual output. Its effectiveness can be achieved through an array of outputs for example motors or speakers. The focus of this paper is on the surface of the garment as a visual output devices, the garment as interface. The inputs can be many, and the interactions may vary, though the output is pre-defined through the surface. The objective is to describe the considerations for the design of an intelligent garment regarding the human interaction with the embedded electronic components, their placement, and the breath of functions that need to be considered in this novel field. It furthermore describes the importance of aesthetics in the design of a very personal yet public surface of the garment fueled with numerous preconceptions. Today’s interface design in a ubiquitous environment is not restricted to two-dimensional displays stationary of computer monitors with the use of a mouse or mobile devices.

**Multidisciplinary Character**

The design of an intelligent garment is complex because of the breadth of disciplines needed for the development and because of the constraints the embedded technologies cause. A common vocabulary needs to be developed to allow for the many disciplines—like physical computing, fashion design, industrial design, wireless networking, software engineering, graphic design—to collaborate efficiently and fruitfully. Often the hands-on expertise of the craft—in particular garment construction—is not considered in the design process. A seamstress that understands the flow of electricity in a garment is rare and could soon be a know-how in high demand. “All too often projects covering this area fail fashion design—a flaw that often follows when engineers are dealing with the integration of technology in fashion. Conversely, where fashion designers who have no background in physical computing or programming work in the field, the actual technical integration is often flawed or absent” (Seymour, 2004, p. 13). A textile designer and an electrical engineer need to find a suitable common vocabulary in this novel field, as do all trades and disciplines involved.

The term wearable technologies covers in particular electrical engineering, physical computing, and wireless technologies.

**EMBEDDED TECHNOLOGIES**

Embedded technologies influence the wearability and comfort, the interaction system, and the aesthetic of the intelligent garment. If the functionality requires an active input by the wearer, the simplicity in understanding the technical features is key. Thus, the inclusion of wearable technologies know-how in the beginning stages of the design phase of a functional garment is central for its success. McCann, Hurford, and Martin (2005) describe the critical path during the design process of smart garments with end-user requirements on one hand and appropriate technology to fulfill such needs on the other hand. They identify the following items or processes: fiber/yarn, fabric,
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