

# Empowering Electronic Divas through Beauty Technology

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**Abstract.** The evolution of Wearable Computers is making it possible for wearers to move and interact freely with the world with nearly invisible technology embedded into clothing. Our aim is to create technology that is not just in clothing but on the skin surface as removable and hidden electronics. In this paper, we introduce the term ‘Beauty technology’ as an emerging field in Wearable Computing that hides electronic components within beauty products. This work outlines the technology used to hide electronic components in eyelashes, make-up, tattoos and nails, and it presents examples of the use of Beauty Technology in everyday beauty products.

**Keywords:** Wearable Computers, Beauty Technology.

## 1 Introduction

Wearables add more than physical, social and psychological variables. The accessibility, reliability and miniaturization of technology gives the opportunity to embed sensors and actuators into wearables to increase the possibilities of interacting with the world. Nowadays we cannot think of Wearable Computers just as an exploration of the capabilities of devices into clothing but also about breaking through barriers of technology to make them useful to us in a way never imagined.

Our ‘Electronic Divas’ could keep secrets, amplify our stimulus, reveal their personality and activate the world. They shake their secret nails and doors are opened. They wink with their special make-up and objects are levitated. They play music on imaginary instruments with their fancy nails. Beauty Technology was embedded into their enhanced products to amplify their capabilities, sense the world and highlight their personalities.

This paper introduces the term Beauty Technology and discusses the materials and processes used for developing the first prototypes. It also presents some examples of the use of beauty technologies in everyday beauty products.

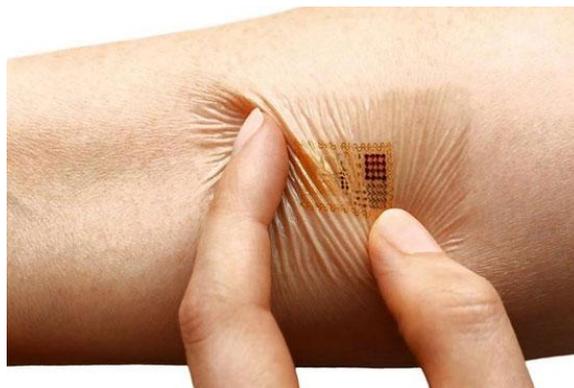
We used conductive makeup that connects sensors and actuators by the use of conductive materials that stick to the skin as well-defined eyeliners and eyebrows. Removable tattoos were used as aesthetics lights on the body skin and for enacting with the world by skin capacitance sensitivity. We also used black false eyelashes that

were chemically metalized to react to blinking. As an example, Blinklifier is presented as a communication interface to amplify blinking and create expressions commanded by the user. Superhero is another example of the conductive false eyelashes used to levitate objects just by blinking. Beauty Technology Nails embed RFID tags into false nails in order to preserve privacy and give special permissions to the wearer and also to create personalized gestures and musical instruments. These nails could contain embedded magnets for amplifying the wearers' capabilities by giving the sense of reading magnetic fields but also give them access to different objects with magnetic switches.

## 2 Related Work

Wearable Computing had changed the way individuals interact with computers, intertwining natural capabilities of the human body with processing apparatus [1]. But most of this technology had been designed just for clothing or accessories, it is still flat and rigid, and circuits visibly appear through the wearables. There are some efforts for crossing the border in designing other kinds of wearable technology, mainly for healthcare, fitness and medicine.

Wearable electrochemical sensors are a new sensing paradigm developed for healthcare [2]. Advances in this technology when integrated into clothing could be considered as non-invasive but they cannot easily be attached and adapted to the body for extracting data [3]. Temporary Transfer Tattoo [4] are electrodes that were printed directly on the epidermis realized by dispersing carbon fiber segments within the tattoo ink and having more than 12 hours of continuous wear without degradation. These electrodes could be designed in artistic tattoo patterns, but still a true integration with wearable computers and an attractive way of hidden sensors is expected.



**Fig. 1.** MC10 Inc.'s flexible electronic sensors are about the size of a postage stamp [5].

Mc10 is proposing smart sensing stickers for medicine, therapy and healthcare in a bandage-like device [6]. They printed electronic mesh into a flexible and thin plastic that is malleable and adaptable to the human skin as a removable tattoo in order to obtain signals from the heart, muscle, body temperature and motion, signals from the brain, and even hydration levels. Figure 1 shows an example of this technology [5]. Mc10 stickers containing different sensors, wireless communication and a thin-film battery inside are expected, however, this technology is still in development and while the circuits are designed in an attractive shape they are still shown.

Even though the privacy and health issues are still evolving, wearers nevertheless seize opportunities to experiment with the sensation of being injected with tiny electronic devices – not just for health management, but also looking for new experiences and fashion, like tattoo implants for using the skin as a display [7] and chipping humans with RFID tags implants for tracking people's comings and goings [8, 9]. In the Arts field, there are some efforts too in including LEDs next to the eyes connected by thin wires. They can simulate larger eyes [10] or act as eye shadow lights when the eyes are closed [11].

The work presented in this paper differentiates from the aforementioned work for using wearable computers in a different field where electronic components are not visible, are removable, enhance wearers' personalities and are embedded into everyday products as beauty products.

### **3 Beauty Technology**

Technologies for sensing information in personal spaces like blinking, pulse rates and respiration monitoring have been increasingly progressed in recent years. In parallel technologies for communicating with smart spaces, smart objects, wearable devices, virtual worlds and social networks have also been developed. These technologies empower human capabilities and the use of wearable computers became a key component for interacting in that world. With this evolutionary technology and our aim of hidden embedded electronics in everyday life objects, we visualized 'Electronic Divas', individuals empowered with 'Beauty Technology', enhanced techno sensual objects that could sense and enact in the world.

'Beauty technology' are wearable devices that act as removable and hidden electronics attached to body surfaces enabling wearers to interact with the digital world without interfering in everyday activities. In particular, the term includes electronics embedded into beauty products. Common beauty products are easy to attach and remove, are designed ergonomically for human bodies, are widely available and their main goal is to enhance physical appearance. This work adapted beauty products and embedded electronics for increasing the possibilities for wearers to interact with the world.

Wearable computers sense the wearer's personal space and the space that they interact with. They could be used for the wearer to understand himself, as a reflective tool to stimulate and modify positive or negatively his behaviors thereby becoming a feedback loop [12]. Beauty Technology could also sense the personal space, keep

personal data and act as a feedback loop tool. For example, blinking exposes psychological and physical states: a low blinking rate is indicative of a bored or uninterested state [13]. One can easily envisage the benefits of a natural and unobtrusive makeup that understands this blinking rate, returns this information to the wearer enabling her to modify her posture and behavior.

False eyelashes, false nails, conductive makeup and capacitance tattoos are some examples of beauty products that were adapted with electronic components in order to create actuators that communicate with the wearer, other objects and the virtual world. For example, instead of using a staff card for opening the office door, a special finger movement with RFID TechNails could identify employees and grant them access.

Beauty technology gives wearers the opportunity to experiment in the customization of these techno-sensual objects, highlighting their personalities and even more, keeping the mystery of hidden technology, changing its appearance each day. They could play changing the makeup color and eyeliner intensity, nail polish and decoration but the functionality is kept.

Unlike other facial expression wearables, beauty technology products do not make use of video cameras, electromyogram or galvanic skin response. They minimize the use of intrusive devices on the face, giving the wearer the possibility of motion and without distracting the wearer's attention away from their daily life activities.

## **4 Technology**

We used everyday beauty products and attached circuits or electronic components, or transform them in order to create this Beauty Technology. This technology will be used for develop different wearables and interact with other smart objects. This section presents our first prototypes in Beauty Technology.

### **4.1 Conductive Makeup**

Conductive makeup connects sensors, actuators and their connections in an attractive way that the wearer's observers would not notice the hidden circuit. Our first step [14] for using conductive eyeliner was using conductive ink [15]. We faced the issue that though the ink we were using is a safe material to have around the body, it is not specifically approved for use on the skin. Even more, for using it as eyeliner as this product is soluble to water, the humidity of the eyes and skin could cause issues for the wearer. Thus, we move to create some stickers that look like makeup, they are conductive and easy to remove from skin. We used a thin conductive fabric tape and cut it in a makeup shape and covered it with different common makeup inks for giving it the appearance of normal makeup.

## 4.2 Black false eyelashes

In order to avoid using any electronic device on the wearer's face, skin conductive material was applied as black eyeliner to connect conductive false eyelashes to the wearable device. These eyelashes were chemically metalized in order to maintain the natural black color of the eyelashes. Figure 2 shows one of the phases of the electrochemical process.

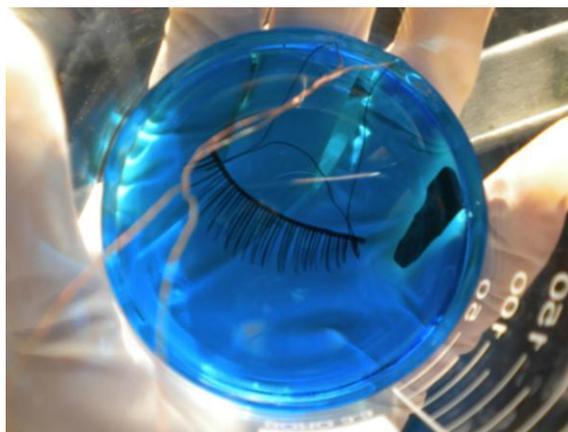


Fig. 2. Chemical process for metalizing false eyelashes.

The chemical process was carried out in 2 phases: Activation and Electrolysis. During the first phase, the false eyelashes, being plastic non-conducting surfaces, require that activation to enable them to be used in an electrochemical process. The first activate was made using Hydrogen and Tin Chloride and then a silver nitrate solution was added in the second activate, setting up the eyelashes as catalysts of electron transfer reactions and ready for metalizing. The electrolysis phase deposits a layer of nickel on our activated eyelashes to plate them. It made use of copper for making the eyelashes electrically conductive and black nickel for the natural black effect of the eyelashes.

## 4.3 Beauty Technology Nails

Beauty Technology Nails are false plastic or acrylic nails that embedded RFID tags, small magnets or conductive polish that enables the wearer to interact with their own wearables and other objects in the environment. RFID glass capsule tags were embedded into false nails so a RFID reader could understand each tag and different application could be created with the combination of the fingers movement and timing next to the reader like special gestures and musical instruments. Magnets were embedded into a nail to amplify the wearers' capabilities by giving the sense of reading magnetic fields but also give them access to different objects with magnetic switches in smart objects and smartphones.

## 5 Projects

In this section, three Beauty Technology projects are presented. Blinklifier and Superhero projects use black false eyelashes and conductive eyeliner for amplifying blinking and for enacting world objects respectively. TechNails embedded RFID tags into false nails.

### 5.1 Blinklifier

Blinklifier [14] is a wearable computer that amplifies human blinking and minimizes the use of intrusive devices on the face such as heavy glasses and electromyography. It follows the natural eye muscles' contractions, extending that motion into a visible light array that changes pattern depending on the blinking gesture. Figure 3 shows Blinklifier pattern when both eyes are closed.



**Fig. 3.** Blinklifier, a wearable device that amplifies human blinking [14]

## 5.2 Superheroes

TEI 2013 Design Challenge [16] students were challenged to celebrate TEI creativity with a game or performance. Superhero project was presented. It made use of conductive makeup and black false eyelashes that the wearer could levitate objects with blinking. Eyelashes worked like switches that were connected to a circuit that sends signals via a Zigbee radio to a nearby Superhero Handbag. This bag contained the Zigbee receiver radio for understanding the Superhero blinking. Accordingly, animated images were displayed (POW, Bam, Zap) or infrared commands, decoded from a remote controller's protocol, were reproduced in order to make an object fly. Figure 4 shows the superhero levitating the object by blinking the right eye.

## 5.3 Abrete Sesamo

This project was inspired in the Ali Baba story [17] that a cave that has a treasure just could be opened with the words "iftah ya simsim" (commonly written as "Open Sesame" in English and "Ábrete Sésamo" in Spanish). In our project, a secret combination of finger movements could open the door. RFID glass capsule tags were inserted into gel nails and they were hidden with nail polish and decorative crystals as it is shown in Figure 5. A RFID reader gets the combination and transmits to the microprocessor that controls the door. If the combination is correct, the door is unlocked.



**Fig. 4.** Superhero blinks for levitating objects.

## 6 Conclusion and Future Work

This paper introduces the term ‘Beauty Technology’ as an emerging field in Wearable Computers. We propose the use of products on the skin surface that hides electronics, are easy to attach and remove, are ergonomic to the human body and highlight the wearer’s personality.

The first technologies developed for Beauty Technology are conductive makeup for connecting sensors and actuators in the face skin, black false eyelashes that were chemically metalized for acting as switches for understanding blinking and false nails (plastic, acrylic and gel) that hide components like RFID glass capsule tags, magnets and conductive materials.

Blinklifier, Superhero and Abrete Sesamo were presented as examples that made use of Beauty Technology. Blinklifier uses false eyelashes and conductive eyeliner for understanding blinking and amplifying the blinking to an artistic head dress that has a microprocessor and a LED matrix that change the lights depending on the wearer’s blinking. Superhero uses also false eyelashes and conductive eyeliner for understand the wearer’s blinking and change the environment like shift the images displayed and even, levitate an object. Abrete Sesamo is a Beauty Technology project that unlocks the door when a secret combination of fingers move is read from the wearer’s nails that have RFID tags embedded.

Future work will include the evaluation of materials for creating new Beauty Technologies like a colorful conductive eye shadow that is flexible and adaptable to the eyelid. A Beauty Technology Framework that could be customized to use these products with smart objects, smartphones and virtual world protocols will be developed.



**Fig. 5.** RFID tags hide into gel nails. Abrete Sesamo project.

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