

WO.DEFY – DESIGNING WEARABLE TECHNOLOGY IN THE CONTEXT OF HISTORICAL CULTURAL RESISTANCE PRACTICES

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Abstract

This paper presents the design process and technical development of Wo.Defy, an interactive kinetic garment that explores a suffragette cultural critique of the ‘Self-Combing Sisters’, a group of women in early twentieth century Chinese society who challenged and questioned the role of women’s agency.

Through elements of self-connection with hair and breath, Wo.Defy investigates intimacy with natural materials and technology that are close to one’s skin, and provokes self-actuation through critique of social expectation within one’s culture. We gathered feedback from participants at 5 exhibitions through open-ended interviews. Self-reported experience illustrated that wearable interaction can support self-reflection contextualized through cultural artifacts such as interactive clothing.

Keywords: wearable technologies, breath interaction, kinetic garment, feminist design, human hair, critical cultural design, somaesthetics.

Transformation through Resistance

Zì shū nǚ (自梳女) is translated as the ‘Self-Combing Sisters’ in Chinese. This group of women resided in the rural regions of China’s southern Canton province [1]. They pursued celibacy as a political resistance to arranged marriage from the late 19th to mid-20th century. The Self-Combing Sisters signified their pursuit of economical and personal independence through their controversial stance against societal expectations regarding women’s domestic roles and arranged marriages [2, 3, 4].

Their name signifies the social practice of combing one’s own hair into a braid or bun, which differentiated them from other single Chinese women who left their hair loose and unbound [5]. The women’s bound hair represented an inverted aesthetic. This self-binding and its concealment of a traditional female expression of beauty, sensuality and desire signified the desire for freedom from being tethered by marriage.

The Self-Combing Sisters challenged the cultural norm of submission by trans-

forming their domestic roles. They were favored over married women in the silk-making industry due to their freedom from family structures and duties [6], and their financial and labor contributions within their families and communities enabled them to redefine women’s role in society, re-presenting them as independent and self-sufficient individuals.

Our Cultural History

The design process of Wo.Defy reflects the designers’ own cultural origins, while its representation is a living process. The research and development are based on material and body exploration integrated within contemporary DIY wearable technology practices. The cultural and historical research references patterns, materials, and forms associated with the Self-Combing Sisters, which provided a foundation for the design and construction of the dress.

Inspired by the Somaesthetic [7] framework, the research and design integrate the values of 1) the wearer’s own experience; 2) poetics inspired by cultural appropriation, style and history; 3) the materiality of silk and human hair; and 4) interaction semantics [8]. Based on this framework, Wo.Defy explores a feminist construction of agency and self-reflection [9].

The design practice of Wo.Defy exemplifies these principles by revealing, questioning, and transforming the act of wearing and modifying garments through interaction with the work.

By questioning historical examples of identity construction through clothing and hairstyle, the Self-Combing Sisters transformed societal conventions by implementing changes on themselves, and thereby creating an impact on others.

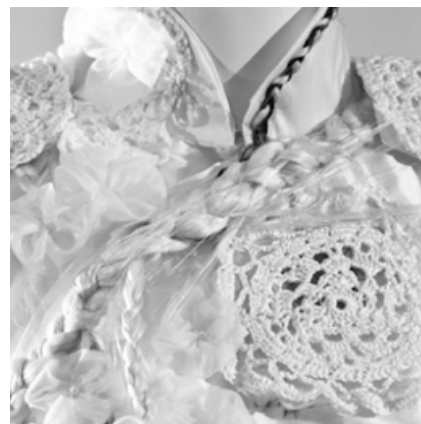
The design of Wo.Defy reminds both designers and wearers of critical questions and reflections that act as catalysts for change, transforming assumptions and norms within cultures.

Blurring Identity

Wo.Defy is situated within a history of feminist art and soft sculpture involving materials, domestic processes, and technologies that have democratized art making. The combination of female-connoted and male-connoted art practices within wearable technology blurs the gender associations in art. This blurred line is expressed within Wo.Defy by selecting narrative wearable design tropes of the Self-Combing Sisters.

Wo.Defy reconstructs gendered elements of the Self-Combing Sisters by appropriating the Qípáo (旗袍), the traditional Chinese dress. The design choices reflect these re-designs of the original Qípáo, which are: 1) The neckline is inverted from a left side closing to a right side closing, thus appropriating the male neckline to indicate a shift in cultural perception agency and responsibility. As the women had neither husband nor children, they had more time to amass financial resources through working full-time in silk weaving factories, enabling them to contribute financially to their own nuclear and extended families. By taking on roles in society inhabited primarily by male counterparts, the mirrored direction of the collar represents the blurring of gender identity. 2) The broadened shoulder design of the dress, characteristic of male fashion, represents the Self-Combing Sisters’ ability to ‘shoulder’ and support additional expectations and financial responsibilities, due to their personal and financial independence. (Fig. 1)

Fig. 1. The right-sided neckline and the broadened shoulder design of Wo.Defy. (Photo © Emily Ip)



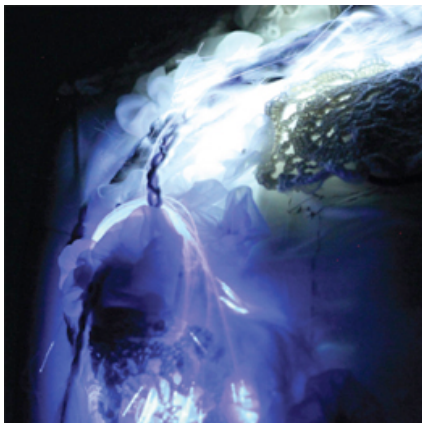
Defying Convention: Choice through Self-Grooming

The aesthetic choice and interaction design of Wo.Defy challenges the conventions of Chinese traditions. 1) Wo.Defy uses a palette of whites, which in Chinese culture is an explicit reference to death and mourning. This implication represents the death of the oppressed self, and also symbolizes opposition to societal norms of marriage. The Self-Combing Sisters' defiant act of self-grooming signifies women's choice to go against Chinese rituals. 2) The fluidity of the visual and kinetic responses embedded in the dress suggests a state of active transformation, contradicting social expectations of marital, financial and domestic roles (Fig. 2). This exposure of physiological responses challenges the creation and modification of identity through the use of social technology.

Attention, Breath, Corporeality

Body data, specifically breath, is used as an indicator of choice. Inspired by the embodied techniques in Noh theatre,

Fig. 2. The LEDs and fabric flowers on the garment respond to the breathing and kinetic changes of the wearer. (Photo © Emily Ip)



breath was selected as an input to the garment to reflect an autonomic body rhythm which can also be altered through self-choice [10].

In Eastern physiological mindfulness practices of embodiment and personal expression, breathing is understood to contain both behavioral and emotional information [11]. Behavioral breathing responds, and also adapts subconsciously, to new breath patterns affected by the environment or situation. This adaptation to a cultural situation or environment is referred to as emotional breathing, and occurs in order to adjust the physical body to the inner life of the body.

Wo.Defy demonstrates this shift from behavioral breathing to emotional breathing through kinetic and light responses which are made possible through a DIY breathing sensor worn around the rib cage, linked to microcontrollers...

To Express the Choice to Reveal or Conceal

Wo.Defy uses DIY interactive technologies to express the choice to reveal or conceal the wearer's state through breath. Inspired by the ability of breathing to effect change in body state [13], the perception of breath is magnified as the 'controller' for the glowing and dimming of optical energy and the opening and closing of silk organza flowers on the garment.

Input: A custom-made breathing band is worn around the rib cage of the wearer. The force sensor within the band collects the rhythmic pattern of expansion and contraction, while a tri-axis accelerometer collects the wearer's motion. These data are used as inputs to express the choice to reveal or conceal the wearer's state.

Output: Reveal or Conceal to Reflect - An Arduino Lilypad and an Arduino UNO Microcontroller control the response of the kinetic contractions and the light response, through the use of two servomotors and a series of light emitting diodes (LEDs) (Fig. 4). Located on the frontal pelvic region of the dress are silk organza flowers, which are linked with two servomotors through a network of translucent threads. When activated, the rotating servos translate into the contractions (enclosing/withholding) and expansions (widening/revealing) of the flowers. The form and quality of movement represent the intimate relationship between the breath and the pubococcygeus muscles from within. Extending

from the series of LEDs, stands of fiber optics are interwoven between the silk doilies and fabrics. The stands produce a glowing response to the wearer's breathing pattern that reveals breath quality.

These characteristics of withholding and revealing personify the Wo.Defy garment, enacting metaphors of self-control and self-agency.

Tactile, Textile, Touch & Narrative

Material choices in Wo.Defy reflect tactile and textile responses to their proximity to skin. Materiality of body, garment and technology defines the designers' production practices. Human hair and raw silk were used to weave a narrative of choice, agency and human materials.

Human hair has a direct correlation with the memory and with health, and is used in Chinese medicine to indicate readings of the body's 'health and vitality' [12]. Like a memory capsule, human hair documents the life and death cycle. The transition from black to white hair portrays the generation and degeneration of traditional historical ideas of beauty, from black to white, life to death, external control to personal choice.

As the dominant material used on the garment, silk was chosen for its reference to the Self-Combing Sisters' economic independence. Various forms of silk, such as duppioni silk, silk chiffon and raw silk fibers, were hand sewn to make the 'body' of Wo.Defy, incorporating soft-circuits that are interwoven to express the narrative of the Self-Combing Sisters (Fig. 3), symbolizing the lives of these women.

Respond, Retract, Resist, Reconstruct

Wo.Defy uses the act of breathing, specifically the muscular contractions of the diaphragm, to gather continuous body data. The breath's physiological and emotional patterns are expressed through the pulsation of LEDs and the contraction of the soft fabric flowers located on the front and back chest to pelvic region of the garment.

These sensors and actuators reveal body states, and are poetically aligned to concepts of choice, vulnerability, sensuality and agency. We gathered feedback from participants at 5 exhibitions through open-ended interviews. Initial results from participants' verbal feedback indicate that the garment has a potential to shift the participant's attention to awareness of her own body responses.



Fig. 3. Wo.Defy is made of human hair and raw silk fibers. (Photo © Emily Ip.)

This included the participant's observations and reactions to wearing the breathing sensor, and her reflections on observing the garment's response. As one participant described: "I feel that this is an experience of history that helps me understand the strong choices that the self-combing sisters made." We also

Fig. 4. The Lilypad Arduino is one of the microcontrollers used in Wo.Defy. (Photo © Emily Ip.)



discovered that many participants wanted more clarity of interaction around the choice to reveal or conceal their body data. This was indicated by the fact that participants asked questions such as: "What if I don't want to show how my breath data which reveals my feeling?" or "What if I want to keep my privacy?" These initial findings helped us to design the next stage of interaction, particularly around the choice of revealing or concealing body data, and will be used for a more formal usability study.

The design process and interaction within Wo.Defy represent a growth in self-awareness and self-agency similar to those of the Self-Combing Sisters.

Outcomes and Future Work

Wo.Defy's design process provides insights that support our personal journey as designers. Through the use of anthropomorphic material, soft circuits and technology, we established an interaction that enables the wearer to reflect on their experience of self, which we have documented and analyzed in our preliminary study.

Collecting initial feedback from participants during conferences and exhibitions allowed for informal data gathering. Early results showed positive responses on the communication of historical references and personal agency. The preliminary study also revealed limitations and questions of privacy and self-control, which will be further investigated in our research study.

The Self-Combing Sisters have provided a historical and cultural marker and reference for self-determination during our design process. They were able to transform their own relationships, leading to changes within family and community.

As designers, we work with the design strategy that self-awareness is a significant phase in transforming others, community and culture. We plan to explore the influence of an interactive wearable on the wearer in a more formal usability study, the structure of which will be based on our preliminary findings.

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