

Autobiographical Design through Digital Transformable Fashion and Textiles

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To promote a resilient user-product relationship for sustainable fashion, design methods for emotional durability are required. Digitally transformable fashion design can be seen as a practical approach that enables dynamic, sensory, experiential, and emotional interaction.

[fashion product design](#)

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[emotion durability](#)

1. Introduction

With the mass production of low-quality and inexpensive fast fashion products, the absence of enduring emotional attachment between the user and the product caused people's frequent disposal of items [1]. To improve the product's life and maintain its time of use [2], researchers developed the emotionally durable design to enhance the emotional connection between the user and the product, thus promoting a resilient relationship [3]. There is a need to explore sustainability through emotional durability because the lifespan of fashion products is determined by aesthetics, meanings, user behaviours, and the ideology of use [4]. In particular, the user's psychological and emotional responses towards the design of a product need to be investigated due to their dominating role in the user's decision-making [5].

With the aid of emerging technologies, digitally transformable wearables and e-textiles have shown the emotionally durable capacity to enable body extension, sensory experience, and flexible customisation [6]. The emerging somatic turn in the third-wave of HCI brings forth rich design methods focusing on self-inquiry and body exploration for their potential to enhance emotional experience [7]. During the design investigation, technological tools are utilised to access or affect the user's emotional experience. For instance, physiological sensors are used to measure user behaviours and emotional responses towards external stimuli [8]. Actuation technologies such as haptic wearables provide affective, immersive, and entertaining experiences through compressive sensations [9]. Besides, research shows a growing interest in designing interactive fashion technologies from an artistic perspective to stimulate users' emotional experience [10]. The reason is that the attractiveness of products can positively influence consumers' emotional and cognitive responses, which accordingly influence consumer behaviours [11]. Thus, this study uses an open, artistic, and experiential framework instead of a problem-solving model to afford personalised narratives, emotional attachment, tangible interaction, and pleasant experiences [12].

2. The Emotionally Durable Design

The emotionally durable design strengthens the psychological and emotional connection between the user and the product to encourage long-term use [13]. While most endeavours at determining durability start with an interrogation of the material composition of products, research shows that longevity does not depend on physical properties but immaterial properties [14], as items are discarded not merely due to material damage but the lack of the user's attachment to them [15]. Thus, Haines-Gadd et al. [3] suggested that designers need to create product identity and embed narratives and imagination into user-product interaction to promote the emotional connection.

Users' emotional and cognitive processes, including emotions, feelings, attention, and memory, can influence their choices and behaviours, and understanding a product's positive and negative elements can facilitate effective design strategies [16]. The emotionally durable design requires designers to interrogate through the experiential and performative layers of materials, where the sensory properties and embodied meanings lie [17]. Furthermore, Fletcher [18] pointed out the significance of improving the fashionability of users. Fashionability refers to the individual's capacity to make better use of the garment to

create pleasant wearing experiences and fulfill self-expression through arranging fluid looks. Fostering this skill requires the user's appreciation of material qualities, learning the use of potential tools, understanding how to initiate body movements, or knowing the stories behind the garment [13]. However, the traditional fashion design process is weak in accessing and influencing the user's lived experience as fashion is socially constructed by complex human activities rather than merely material objects [13]. To tackle this, designers should explore emotional durability individually and then seek to produce larger-scale influence [15].

3. Digital Transformable Fashion and Textiles

In the conventional sense, transformable fashion refers to garments that can vary in functions or aesthetics through manipulative methods such as twisting, gathering, folding, or reversing [18]. With the development of emerging technologies, smart materials have facilitated HCI researchers to explore new forms of interactive, transformable structures that enable dynamic material experience and personalised expression [17]. The mechanisms of transformation include shape-memory materials [19], deployable structures [20], pneumatic actuation [21], and so on. The parameters of shape change include orientation, form, volume, texture, viscosity, spatiality, adding/subtracting, and permeability [22]. Researchers have developed novel sewing methods by linking shape-changing techniques to traditional fashion manufacturing methods. For instance, a shape-changing technique called Filum was created by incorporating various fabric-gathering sewing patterns into automatic textile behaviour control [23]. Similarly, traditional Zigzags stitches have been explored to form complex sewing patterns to trigger creases in digital self-morphing fabrics [24].

From a technical perspective, pneumatic textiles can provide continuous and easily mouldable deformation, and shapes and volumes can be actuated by the inflation and deflation processes to afford many forms [25]. From the experiential perspective, soft pneumatics is usually perceived as non-threatening, engaging users in tactile interaction. The soft material qualities can induce positive feelings in users that might improve psychological well-being [26]. By altering the density of the stitches in the knitted patterns, they induced different ranges of bending and twisting motions in pneumatics. However, apart from knitting, other fashion construction methods can constrain or facilitate movements, which remain underexplored in pneumatic textile systems. One potential approach is the sewing technique, which can transform the shape of fabrics through manipulation such as gathering, Shirring, pleating, and darts [27]. Besides, the sewing technique is more flexible in the prototyping process. By using merely threads and different stitches, designers can vary the patterns and shapes of fabrics [23].

4. Correlating Digital Transformable Fashion and Textiles with Emotional Durability

With embedded digital technological innovations, transformable fashion and textiles can influence user perceptions, monitor bodily changes, and enhance performance, which has been well-developed in sportswear, functional wear, and medical wearables for fictional and psychological needs [28]. However, in fashion design, only a few designers have attempted to explore the experiential and psychological layers of transformable fashion, such as Hussein Chalayan, Issey Miyake, Iris van Herpen, and Pauline van Dongen [28]. Furthermore, there have been no systematic design strategies for incorporating emotionally durable ideas into transformable fashion design.

4.1. Design for Versatility and Adaptability

With the capacity to change shape, digitally transformable fashion offers multiple styles and functions in one garment to adapt to various scenarios, thus satisfying the wearer's hedonic, social, and functional needs [29]. Furthermore, versatile and recirculated use can lengthen the product's life cycle for sustainable use [30]. When designing for the product's capacity to be modified by the user to extend its usage [31], designers must investigate the wearer's needs, such as preferences for garment transformation (e.g., pattern, silhouette, volume) [29]. Besides, the methods or tools used to modify and customise the wearables should be easy and accessible. Otherwise, the users will be frustrated and hindered from using the product [29]. For instance, Cao et al. [2] made a low-tech transformable fashion prototype by creating attachable and detachable parts with fastenings for the user to easily change the layering or matching of the garments to realise multiple looks.

4.2. Design for Perceived Quality

Garment disposals are not always due to low technical qualities that fail to meet measurable standards, while the perceived quality, in other words, the user's subjective perceptions and evaluations, determine the lifespan of the product's usage [32]. To enhance the perceived quality of the product, designers need to explore the connection between user perceptions and attributes of products (e.g., form and properties) to inform design choices [33]. For instance, many designers utilise material shape transformation to correspond with the user's movements and sensations [34] to mediate bodily responses. During design exploration, qualitative methods such as design diaries, drawings, photography, and self-reflection can be used to evaluate the designer's subjective feelings toward prototypes during autobiographical research. For instance, Tsaknaki [35] designed the Breathing Wings, a transformable pneumatic wearable that offers haptic embracing experiences and triggers caring feelings. The designer explored the material experience by putting the prototype on her own body and playing with different shapes, locations, and timing of inflation according to ongoing feelings. Design elements can be evaluated and iterated through the designer's affective engagement with materials for better-perceived qualities. In HCI, tangible interactions or contact with the skin can alter or augment the user's perceptions and direct or disrupt their bodily attention to affect their moods. For instance, the Soma Carpet designed by Höök et al. [34] can offer heat feedback according to the body movements of the user who lies on it, thus providing a soothing and caring experience. Although there have been abundant sensory approaches in HCI to improving the perceived qualities of products, it remains unknown how to utilise fashion's potential to construct an emotional, affective, and expressive second skin.

4.3. Design for Biomorphic Forms

Sgro proposed the concept of Metamorphic fashion to refer to fashion that simulates transformation in biological metamorphosis and emphasises the metaphors and imagination of transformation [36]. Existing research reveals that biomorphic form can positively influence people to reach a therapeutic, attentive, and pleasurable psychological state [37]. For instance, the biologically analogous soft interface pheB [38] can sense human respiration and initiate organic breathing movements through varied inflation patterns to calm users down and evoke fascination and mystery. Similarly, the digital garment Caress of Gaze [39] mimics animals' social behaviours. It has an auxetic cellular-structured system such as the scales of animal skins, which can sense the gaze of onlookers and change shapes to attract the wearer's attention and self-awareness expressively.

4.4. Design for Aesthetics

Aesthetics is the primary reason people choose certain products, which should be incorporated into design practice [40]. The aesthetic dimension of fashion includes communications, meanings, metaphors, and symbolism, along with the user's identities expressed through the clothes [41]. With the aid of technological transformation, aesthetics can be expressed in an innovative, hybrid, and posthuman way. Hussein Chalayan, a pioneer in fashionable technology and transformable garments, revolutionised the form and meaning of fashion through spatial dynamics, fluid space, geometric structures, and architectural proportions to amplify the symbolic relationship between the body and its surrounding [42]. In his Remote-Control collections, the digital garments connect the wearer with other people and agencies through wireless technologies, which mirrors how the dress is shaped by the wider society and loaded with communicative and symbolic values [42]. Iris van Herpen is another typical example who intertwines the dynamic characteristics of human bodies with morphing art and entangles nonhumans (e.g., materials and technologies) to express avant-garde aesthetics. The transforming garment she produced engages the wearer and the viewer in the becoming process by shifting their focus on the material movement [43]. While she works closely with technologies, intuitive and artistic hands-on craftsmanship intertwines with technologies to manifest a sense of posthumanism. Material juxtapositions involving solidity and fluidity, as well as materiality and immateriality, add expressiveness to technologies [43]. This study will also discuss how textile crafts and technology influence each other to merge boundaries and bring forth novel aesthetic expression.

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