I am Not an Object: Reframing 3D Body Scanning for Co-Design

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I am Not an Object: Reframing 3D Body Scanning for Co-Design

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ABSTRACT

3D scanning technologies provide designers with tools to generate a digital representation of the human body that can be used in the design of ultra-personalized apparel and wearables. However, prior work shows that the body scanning process can be an uncomfortable experience for users. In this work, we take a first-person perspective to identify frictions in the experience of being body scanned compared to having one's body measurements taken by a professional tailor. Based on our findings, we offer a reframing of body scanning as a collaborative process, and discuss implications for the design of tools and processes that shift agency in the generation of body data towards users. Our paper is relevant to design researchers and practitioners interested in taking a co-design approach to ultra-personalization.

Author Keywords

3D body scanning; wearables; personalization; autoethnography; co-design; 3D body data visualization; personal data.

CSS Concepts

•Human-centered computing~Collaborative and social computing~Collaborative and social computing design and evaluation methods~Ethnographic studies •Human-centered computing~Interaction design~Interaction design process and methods~Participatory design

INTRODUCTION

3D body scanning technologies offer designers tools for the personalization of apparel, accessories, and wearables. The generation of a detailed digital representation of a users' body enables designers to create a fit bespoke to the individual wearer, and has the potential to realize

customization and ultra-personalization at a mass scale [10]. 3D body scanning data has been used in the manufacturing of made-to-measure, mass customization and ready-to-wear size, shape and fit solutions [e.g. 1, 5, 17]. In HCI, for instance, it has been used in the personalization of 3D printed shoes [9], parametric modeling of personalized orthopedic casts [19], and personalized smart textile solutions for prosthetics [16].

User participation is essential in ultra-personalization as designers rely on users being willing to have their bodies scanned and to share their body shape data with manufacturers. Prior research shows that some users who were willing to be scanned perceived body scanning and viewing own image in 3D as an uncomfortable experience [6, 13]. This indicates that users' needs and concerns remain unrecognized during 3D body scanning. However, in targeting retailers rather than designers, this work offers few details on how the scanning technology contributes to users' discomfort, or how they might be addressed through design. Drawing on principles of co-design, where users are seen as a partner or co-designer in the design process [15], we see an urgent need to not only mitigate discomfort, but to give users a voice in a design process that aims to create products that are personal to the user.

The aim of this paper is to examine experiences of body measurement so as to identify tensions and opportunities for co-design. We took a first-person perspective to gain an intimate understanding of the bodily experience of being 3D body scanned as compared to having one's measurements taken by a professional tailor. In engaging a professional tailor we were interested in how far discomfort featured in a situation that was largely produced in a setting where traditional measurement tools are used. We use insights from both accounts to suggest that body scanning should be reframed as a collaborative process and argue that tools and processes used to generate user body shape data should shift the agency towards users.

The contribution of this work is twofold:

- We offer first-person accounts of felt experiences of being 3D body scanned and measured by professional tailors.

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- We highlight tensions in the scanning process from a co-design perspective, and discuss implications for the design of tools and processes used in design for ultra-personalization.

BACKGROUND AND RELATED WORK

3D scanners are continuously developing and their applications can be found in both HCI research and (mostly apparel) industry. In the apparel industry 3D scanners are used for made-to-measure, mass customization and ready-to-wear size, shape and fit solutions [e.g. 1, 5, 17]. In HCI research scanners are used, for example, for personalization of 3D printed shoes [9], parametric modeling of personalized orthopedic casts [19], personalized smart textile solutions for prosthetics [16].

In all of the above-mentioned work, users' digital body shape data is a central element for personalized product creation and the design process requires users' direct participation in the sense that they need to be present. This process is known as "ultra-personalization" and it is captured in the Ultra Personalized Product Service System (UPPSS) model [10]. While users are essential for an ultra-personalized product creation, their roles and experiences in the process are rarely discussed and mainly concerned with collecting user data. Thus, work [9, 11, 16, 19] describing body scanning application for product personalization are mainly focusing on user's body geometry extraction.

We see an opportunity to bring a co-design perspective into the design of ultra-personalized products. Co-design sees users as partners in the design process [15] and sharing control with users is seen as a core value [18]. The role of the designers is then shifting towards "configuring stakeholder participation" and configuring the experience of this participation [18]. This configuration requires, among others, to consider the degree of control in the design process that is shared with users.

When it comes to the experience of being scanned studies show that the 3D body scanning process may negatively affect people who experience it. For example, work related to whole-body scanning shows that viewing their own 3D image can negatively influence people's perception of their own bodies [13] and make some of them feel threatened, vulnerable and shocked [6] showing that body scanning process unfolds a range of personal sensitivities. We see that the experience of being scanned is not yet well researched from a co-design perspective and this paper aims to contribute to this area of research.

METHODOLOGY

Our approach is inspired by autoethnography with the aim of gaining an understanding of the felt experiences of being 3D scanned by a scan assistant in comparison to a traditional way of body measurement done by professional tailors. In HCI, autoethnography is a first-person research perspective that grants a central point to the researcher's experience with a system [4]. A first-person perspective allows researchers to

investigate the lived experience with a system uncovering detailed and subtle understandings, generating rich insights. Autoethnographic studies are used in HCI work [7, 8, 12] to extract themes from researcher's personal narratives that then are used as insights for designers, design implications or identifying gaps in research literature.

In this study the first author, a design researcher, went through three body measurements – one body scanning process and two measurements done by professional tailors. Body scanning took place at Eindhoven University of Technology with a help of the off-the-shelf handheld scanner (Artec EVA model) that is typically used by our researchers and students for scanning purposes (see figure 1). The scanning process took approximately 20 minutes. The experience of the tailor measurement process happened on two occasions at Eindhoven University of Technology and in an atelier located in Maastricht. The measurements were done by two tailors (14 years and 16 years of tailoring experience). Both tailors were asked to take measurements for a shirt, dress and trousers and each measurement process took approximately 15 minutes.

The first author documented her experiences in three diary entries that described in rich detail the experiences of 3D body scanning and being measured by two different tailors in terms of her actions, thoughts, and feelings. After about two months the diaries were revisited by the first author. The first author read and re-read the material to re-familiarize herself with it and identify "pain points" or the most uncomfortable experiences such as exposing her own body or body parts. These "pain points" were then aggregated into four clusters, namely the role of clothes, sensitivities related to exposing body or body parts, interaction with the scan operator/tailor, and sensitivities related to viewing own data. The clusters and the diary entries were handed over to an independent researcher to find whether the identified tensions clusters were sufficiently describing all "pain points" mentioned in the diary entries, no new "pain points" were found. Then the four clusters were scrutinized together with the second author and were revised into three clusters to reduce some of the overlaps between the original four clusters.

THE FELT EXPERIENCE OF 3D BODY SCAN

The first author initially approached the research from the position of an interaction designer interested in obtaining body data to understand how it may inform a co-design process. Below we present the first author's account of her experience being scanned.

Preparation to Scan

My intention was to obtain a 3D body scan for a design research project that captured the surface of my body as precisely as possible, thus it was necessary to wear tight fitting clothes. I was aware of 3D body scanning technologies, but had not been body scanned before. I knew that there would be a scanner assistant (an employee of the university who was known to me) involved in the scanning process and that the resulting scan image will be shown to

my colleagues. Therefore, I looked for clothes that would allow me to look good and not too revealing. Since I avoid wearing tight clothes in public, especially after I became a mother and my body outlines have unflatteringly changed, and I chose clothes that allowed me to feel relatively confident about my body. I chose to wear dark ballet leotards and black leggings that allowed me to keep most of my skin covered and made skinfolds less noticeable.

Scanning the Body

The scanning was done with a handheld scanner by a scanning assistant (see Figure 1). The scanning assistant briefly explained the process and instructions that I had to follow. During the scanning I stood unmoving on the rotating base and the scanning assistant slowly moved the scanner along my body to capture the data. The process of scanning made me feel that my body was suddenly in the center of attention and I felt exposed. I had to stay still and I could not change a posture or turn towards the person who scanned me. It was rather unusual and unpleasant experience of another (barely known) person being behind my back and focusing on my body and I could not turn towards him. During the process my attention was focused on my body and my thoughts about body related insecurities. Although I felt that the scanning assistant was doing his work tactfully, the interaction between us was determined by the technology and resembled the scanning of an object rather than a human being.

Figure 1 and 2. Handheld body scanner used in this study and an example of the detailed scan image produced.

Processing the Data

After the scanning was finished, the scanning assistant was merging collected data sets into one 3D visualization. The scanning assistant worked on the scan visualization on the computer screen. He was zooming in, out and rotating the visualization. Several times the assistant zoomed in to specifically sensitive areas on the body (chest area, abdomen) and it made me feel confused. It was frustrating to see the other person working on the image of my body, especially because I did not expect the scan image to have such a high level of detail. There were several uncomfortable moments when the program required to work on a zoomed-in visualization and I saw that scanning assistant was rushing in finishing his work to avoid us feeling embarrassed.

Viewing My Own Image

The 3D visualization allowed me to see an image of my body under angles that I never saw before (See Figure 2). I was

confronted with the very honest image of my body where I could see real proportions, posture and asymmetries. The visualization of the scan turned out to be very detailed. Moreover, tight clothes made outlines of underwear noticeable and I was not aware that the choice of the clothes might have such an effect making me regret my specific choice for clothes. I considered such details to be very delicate and private and would not like others to see it. In all, I found that seeing my own body in such a detail is a very intimate experience and sharing that moment with another (barely known) person brought me a feeling of embarrassment and awkwardness.

To sum up, the overall experience of scanning was unsettling as well as frustrating. Even though I achieved my goal in capturing digital body shape data, I felt being overly exposed in the process and had a little opportunity to influence it. Due to these frictions I would rather avoid undergoing similar scanning processes in the future.

THE FELT EXPERIENCE OF MEASUREMENTS TAKEN BY TAILORS

Below we present the first author's account of her experience being measured by professional tailors.

Preparation

While making the arrangements of the measurement appointments both tailors recommended me to wear tight clothes. They explained that tight clothes allow them to find reference points for measurements. To be able to find those points tailors need to see them, otherwise they need to find reference points manually. I felt considerably less worried about the choice of clothes, since information about clothes would not be recorded or shown on screens, as happens with 3D body scanning.

Taking the Measures

Both tailors explained me what to do during measurements (how to stand, when to lift my hands, when to breath in and out). The tailors were taking measurements with a measurement tape and made notes on each measure. In this process my level of comfort differed depending on the measurements that tailors were taking. For example, during bust circumference and leg length (measurement between groin area and an ankle) measurements I felt considerably uncomfortable. Both tailors anticipated this and offered me to participate in the measurement process and help holding the measurement tape. They commented that clients often do not feel comfortable with some measurements and tailors try to minimize their discomfort by explaining what they are going to do and, depending on the reaction of the client, offer a client to take an active role in the measurement (e.g. hold the tape measure).

Reading the Measurements

During the first tailor encounter, annotated tape measurements were written down in the tailor's notebook and during the second encounter notes were taken on a printed-out measurement guide. Although the measurements described the shape of my body, the measurements did not

evoke a significant emotional response in me as I did not have references related to them. Only three circumference measurements (bust, waist, hip) interested me in relation to the well-known proportion 90-60-90 and I tend to compare my measurements with that proportion. Overall, I did not mind tailors to view and store my body shape data, since data resolution was very low (see Figure 3 and 4).

Figure 3 and 4. Data sets collected by tailors.

To conclude, I felt that being measured by tailors was a much more comfortable process. The fact that both tailors were attentive to me and my reactions, anticipated discomfort during the process and offered ways to reduce it made me feel that the encounter was a collaborative effort.

TENSIONS AND LESSONS FOR DESIGN

Below we highlight three tensions areas that we came to identify from the first-person accounts: (1) curating own body through clothing, (2) being an object of social of gaze, (3) agency in data set management for making the body visible. Based on these further we offer opportunities for design.

Curating the Body

To obtain accurate body measurements the contours of a user's body need to be exposed to 3D scanners and their operators or tailors and their tape measures. Conscious of this technical requirement, the researcher chose tight clothing that would make her body contours visible in the scanning and measurement process. At the same time, she was aware that she would have to present herself to the technician and tailor. Feeling uncomfortable showing her body due to a recent pregnancy she carefully chose dark clothing that would cover most of her skin, visually obscure details (absorbing light), and made her feel looking good. In doing so, she drew on broader cultural practices of using clothes to artfully conceal or reveal parts of the body for self-presentation with an intention to control impressions made on others [14].

Designers should recognize that users may have various body related sensitivities (e.g. extra/loss of weight, skin folds, conditions or features, deformities, etc.) they may wish to hide from others, and allow users to manage their appearance in preparation for the scanning process. We may think of a specially designed modular suit that offers users greater control in curating their appearance by selectively hiding or revealing parts of their body and skin. For example, when taking a scan of a particular body part, such as a shoulder, a

user could cover/mask physically or digitally the rest of the upper body (e.g. arm, chest, neck).

The Body as Object for Gaze

Interaction with the scanner assistant and tailors played a major role in first author's overall comfort during body measurements. What creates discomfort in the body measurement situation is that the body of a user becomes an object of attention of another person (scanner operator or a tailor). Professional tailors, we encountered, recognized this and they adopted ways of measuring client's body without making a client feeling being overly exposed. For example, they tried not to hold attention on the client's body when it was not necessary.

Designers should consider supporting the shift in agency from measurement technology and operator towards user/co-designer to alleviate discomfort. We can imagine a scanning process where a user becomes actively involved in the process by taking their own measurements. A new generation of body scanning technologies and interfaces could be developed to support users for self-measurements, for example by making own 3D scans. Moreover, apps for smartphones, that are already used to scan objects, could be designed in a way that allow users to make own 3D scan as easy as a selfie and in a location that is convenient for them. Another opportunity to offer a less intrusive way of scanning is to give users a preview of the scanning process and allow users to consent to proceed further with scanning prior or during the process.

Making Visible

3D scanning technology is designed to provide a high level of detail. A combination of a high amount of data points and particular rendering styles makes the body visible to users and others in such detail that they may alienate users and create discomfort. In the study the researcher shared her frustration with the very detailed 3D visualization of her body and the fact that it was seen by a scanner assistant. Users may consent to data grabs not knowing what data or level of details is required while high data resolution may not be necessary for design of personalized products. We see that there is a need to make explicit to users what data is required for a product personalization and even build product personalization opportunities based on the amount of data that users would be willing to share.

Users should retain ownership over processing and sharing of their body related data. For example, rather than sharing a full data set by default, there should be a possibility to allow data to be shared selectively on a per needs basis with third parties, such as technicians and designers. Designers can enable users to share partial data sets (e.g. an arm or a face) and retain a control over the level of resolution or number of data points being shared (e.g. allow sharing only several data points, a curve or a circumference). Such an opportunity to curate your own body related data may increase user's willingness to participate in body scanning process and be involved in the creation of personalized products.

Future work

This work shows that 3D body scanning may be experienced as an uncomfortable encounter that results in tensions. We see an opportunity to research further ways of gathering body related data for product personalization considering comfort of users as well as allowing a range of personal body related sensitivities and insecurities to take place and be respected.

In our future work we will co-design ultra-personal products and services paying a careful attention to the personal data collection approaches. We will use insights from this work to design (comfortable) experiences of gathering personal data for ultra-personalized products and test data gathering approaches with more participants. We see that collecting data and designing ultra-personal products and services based on personal co-designer's data may ask designers and co-designers to deal with aspects of trust, control, feelings of (dis)comfort and we intend to explore what role these notions play in UPPSS.

DISCUSSION AND CONCLUSION

Body scanning is a social situation where interactions between a scanning assistant and a person being scanned are mediated by technology that generates particular, new ways for the users to be seen and to see themselves. By taking a first-person perspective we have identified three tension areas associated with the 3D body scanning process from a user perspective: (1) curating own body through clothing, (2) being an object of social gaze, (3) agency in data set management for making the body visible.

We do not claim that our findings reflect the full scope of all possible experiences, or that every person going through a body scanning process will experience all the discomforts of our first author. We suggest that our findings and concepts can sensitize designers to a range of possible tensions and offer guidance in what ways they might be addressed. However, we emphasize that these are not meant to be prescriptive and may come to bear differently in different co-design contexts.

Tensions described in this work highlight the limited degree of agency in the scanning process that were artfully worked around in tailor measurements. Tailors adopted tactful, empathetic, anticipative way of interaction where needs and reactions of a client were heard and respectfully addressed giving a client a feeling of control and making encounters a collaborative process.

To engage users in co-design for personalized apparel and wearables in early stages of the personalization process a shift is needed from models of user body data 'extraction' towards a collaborative data collection process where the user has control over what data is collected (e.g. scanned) and shared. This shift will offer users a means of control over their own body measurement and shared body related data that will minimize frictions in the overall experience of personalization process.

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