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# **Fashion E-Commerce in the 3D Digital Era**

A 3D Interactive Web User Interface for Online  
Products

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# Fashion E-Commerce in the 3D Digital Era:

## A 3D Interactive Web User Interface for Online Products

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### ABSTRACT

Fashion brands have always been avant-garde in embracing new technologies and new formats of retail business models. The rapid development in 3D digital technologies, including 3D scanning, 3D modelling and 3D web rendering, have brought many new opportunities to the fashion industry, especially in shaping the future fashion e-commerce. The traditional 2D user interface and 2D media content have limited ability of displaying every detail of a product in full 360 degree, and the color accuracy of products in pictures is also a common problem. This thesis focuses on how to use 3D technologies to enhance the brand identity and to reduce return rate, by designing and implementing a web 3D user interface for fashion e-commerce. An interactive 3D product user interface were designed and used for test. The results presented the pros and cons of the designed 3D user interface, and evaluated to what extent can this approach help to solve the brand identity problem and the high return rate issue for fashion e-commerce. It turns out that indeed the 3D user interface is rich in detail storytelling and the product accuracy can be improved by using the Physically Based Rendering technology and dynamic virtual lighting environments. However, the results also indicate that there are still lots of technical constraints for developing the virtual showrooms and the 3D user interface.

### Author Keywords

3D Web User Interface; Fashion E-commerce; Customer Experience;

### INTRODUCTION

“Your website isn’t the center of your universe. Your Facebook page isn’t the center of your universe. Your mobile app isn’t the center of your universe. The customer is the center of your universe.”

— Bruce Ernst

The retail environment has been changing rapidly in the last decade. New types of store formats have emerged because of the development of new technologies and the rising of

internet usage. More and more traditional bricks-and-mortar fashion retailers have developed their online presences, from building their own websites to joining different e-commerce and social media platforms (Bonetti & Perry, 2017). However, the gap between stores’ online presences and their physical stores are still huge. Nowadays, it is hard for brands to provide the same level of customer experience online as they have in real life. Customers shop online mainly because it is convenient (Cai, Shen, & Guo, 2012). Today’s user interface designs for different mainstream fashion e-commerce platforms are quite similar to each other, and brands are getting used to developing their business models via websites and social media. However, it is important to remind that the services or systems should be designed in a customer-centered way, just like Ernst said. The online shopping experience should be improved so it is much more than just convenient. To improve the online shopping experience and to make their online presences stand out, lots of fashion brands have tried out 3D solutions.

3D modeling allow brands to create a brand new store format: virtual showrooms. It can blur the boundary between physical stores and online stores, and it is able to combine the advantages of both (Toma, 2017). However, most brands fail to realize the true advantage of it: the 3D digital space is a virtual world without physical limitations, it is not reality and it can be beyond reality. The space can be designed in a improvisatory way (Singh, 2016). The virtual space should serve as an expression of brand identity rather than a duplication of physical stores.

Under the influence of internet and social media, customers have been widely exposed to visual narrative media content from brands, usually images and videos. Most of them are in 2D and they have a lack of interactive elements. However, the visual narrative should be both explorative and communicative (Hullman & Diakoplous, 2011).

The 3D virtual showrooms can totally fulfill both these qualities. In real life, fashion boutiques are already offering customers the immersive storytelling environments.

Raffaelli described boutiques as “one of the few places where you can own that story and craft it in a three-dimensional world” (2016). Obviously, virtual showrooms precisely fit with this description as well.

The possibility of crafting the user interface in 3D will change the online shopping experience completely. Just like in physical stores, brands can build their own unique spaces online, design the in-store customer experience, and decorate the environment backgrounds for different collections of products. Besides, it is much more than that, the 3D user interface does not necessarily to be a replica of physical store, or a substitute of online stores. It could serve as a free-form online pop-up store which assists the current e-commerce services, or a creative propaganda method for the new arrival products.

The research is carried out under a fashion technology startup called Baetes. While doing my research, I worked as a UX designer for the company. All 3D models used in this project are from Baetes.

This document aims at exploring a new web 3D solution for fashion e-commerce with 3D products. The goal is to use interactive 3D models to change the way how brands display their products online in a more accurate, engaging and storytelling way, and thus to enhance brand identity and to reduce return rate by increasing product accuracy and user satisfaction.

## RELATED WORK

This section introduces the technical background of the related 3D technologies and the corresponding fashion cultures, from fashion e-commerce, fashion e-marketing, offline fashion showroom experience to existing 3D related solutions in fashion industry.

### Bring Products online in 3D

Photogrammetry 3D scanning and Physically-Based Rendering (PBR) technology has been widely used in video game and film industry in recent years to achieve impressive and unforgettable user experience (Ratcliffe & Simons, 2017). The same technology can totally be applied to fashion industry as well. Real fashion products can be reconstructed into photorealistic 3D models and textures after 3D scanned and manually retouched by a 3D artist.

Today's WebGL and HTML5 technology allow us to render high quality scenes and add interactive controls to the virtual world. Most modern browsers support WebGL, making the WebVR applications highly accessible (WebGL Wiki, 2018).

### Brand Identity in the Digital Era

The concept of Brand Identity Prism was brought up by Kapferer in 1992. In his model, the brand identity was

represented as a hexagonal prism: physique, personality, relationship, culture, reflection and consumer mentalisation (Kapferer, 2003).

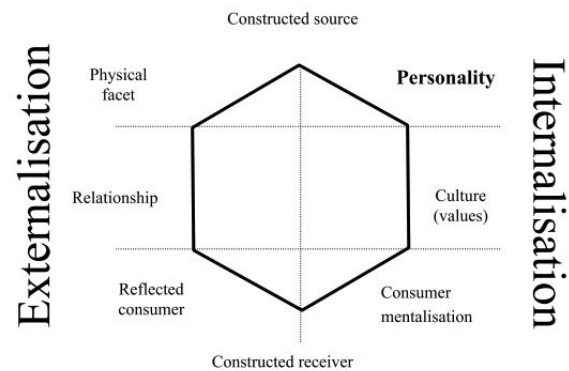


Figure 1. Brand Identity Prism (Azoulay & Kapferer, 2003)

Luxury fashion brands have been highly creative in digital marketing campaigns and digital storytelling. Mekonnen and Larner used the phrase “exclusivity dared” to describe such phenomenon in this new digital era (Mekonne & Larner, 2017). Besides pictures, videos over websites and social media, brands have been using interactive webpage as a new approach for digital marketing campaign, especially in China, where HTML5 pages is the most popular campaign type thanks to WeChat. Big fashion brands usually create campaign webpages for a new serial of products or a fresh season collection, and these websites provide links back to their official websites or specific product pages, for example, recently Gucci has released their Spring Summer 2018 - Hallucination Collection<sup>1</sup> in a format of a scroll-based interactive single-paged website.

### Pop-up Retail

Fashion exists in a time-based dimension, and thus has a temporal nature to it (Mekonne & Larner, 2017). Pop-up stores are one of the most common retail formats, they are the temporary outlets of brands (Bonetti & Perry, 2017).

The purpose of the pop-up retail includes: 1) to get closer to a certain customer group to allow them “put a face to the online brand name”, thus to build deeper relationships with those customers, 2) to test before extending to a new area, in the meantime, to increase brand awareness and experience, 3) to try a new concept, or to test specific products (Bonetti & Perry, 2017).

We can see that compared to traditional physical stores, the virtual showrooms are actually much closer to this format. It's a temporal place where helps brands deliver their brand

<sup>1</sup> Gucci SS2018 Hallucination: <http://springsummer.gucci.com/>

identities, engage deeper with customers, test or market on certain products, and finally, lead customers to either their physical stores or online stores.

### Customer Product Returns

High return rates of online orders is also one of the biggest problem brands are facing with. Some fashion e-commerce big players such as ASOS, COS, Amazon and Zalando allow free product return, and they also offer to make up by delivering new products quickly (Bonetti & Perry, 2017).

High returning rate will lead to a considerable cost. One of the main reasons that customers want to return the product is because in real life, the product is not like what they've imagined from the online pictures, especially because of the color difference (Tang, 2017). From the image capturing to final online displaying process, the color communication between input and output devices usually leads to color discrepancies, not to mention the influence of the light environment when capturing the photos.

### Highlights in Fashion Web 3D Technology

ASOS, one of the largest fashion e-market, launched a online showroom app together with Trillenium in 2015<sup>2</sup>. Users can choose to browse in the virtual store in either the VR mode or the normal 3D mode in case users don't have any VR headset. The virtual store looks like a physical store, with products on shelves or tables.

Adidas has been providing a new customization service for sneakers since 2017<sup>3</sup>. Users can use a 360 user interface to customize different parts of a sneaker. It is a product stand-alone user interface, without any background environment.

Another product stand-alone user interface is from a French ski brand called Wed'ze. It designed a 3D product page for ski goggles in 2017<sup>4</sup>. Users can select color and size for the product, they can also check how the goggles looks when they are combined together with a helmet in 3D.

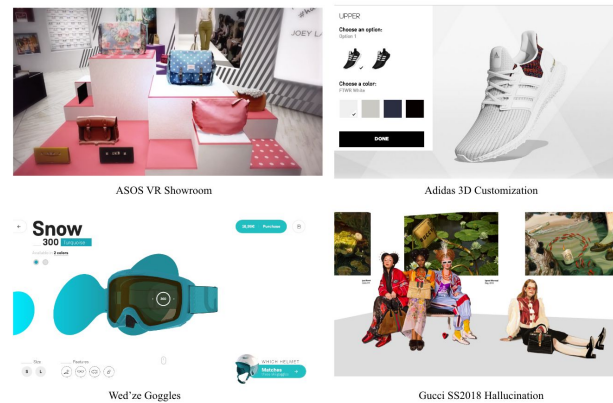


Figure 2. Highlights in fashion web 3D technology

### METHODOLOGY

The two key purposes of the virtual showroom is to enhance brand identity and to reduce return rates. The showroom design derives from there, and as a user-centered product, its ease of use is also an important criterion to think about. The measurement criteria of the result are first, has the designed solution fulfilled the two purposes, and second, while the usability evaluation, is there any obvious confusion for users.

### Hypothesis

The highly customizable virtual showroom will give brands the opportunity to craft a 3D storytelling space online, thus will be able to communicate the brand identity better compared to the traditional e-commerce platform. By using interactive photorealistic 3D models and allowing users to check the products under different light environment settings, the accuracy of products' online presence online can be improved.

### Theoretical Concept Design

#### Virtual Showroom Design

The virtual showrooms serve as temporary online outlets, they are an extend of brands' existing e-commerce system. Similar to pop-up stores, they are temporary and exist to increase brand awareness and experience. Each showroom has a specific collection from the brand, and has its style according to that specific period of time. One brand can possibly own multiple showrooms in their timelines.

The virtual showrooms are also considered as backgrounds for products. Different from the physical world where the showrooms are the physical space containers for products, in the digital world, the virtual showrooms are more like just backgrounds in 3D. Each product can has its own 3D space as a background environment.

<sup>2</sup> ASOS VR Showroom: <http://www.trillenium.com/vr-showroom.html>

<sup>3</sup> Adidas Customization: [www.adidas.com/us/customize](http://www.adidas.com/us/customize)

<sup>4</sup> Wed'ze Ski Goggles Collection: <http://goggles.wedze.com/winter-2017-2018/en>

### Product User Interaction Design

Due to the fact that the 3D products are virtual, and the interface will still be on a 2D screen, limitations do exist, for example it's hard to get physical feedback from products. However, other fundamental interaction designs should be included. Customers should be able to take a close look at the product, to know the design details and the surface texture materials. They should be able to play with the product to check each corner of it. The existing basic features of current e-commerce services should also be included.

### 3D Product User Interface Design

#### Background Environment Design

Unlike the traditional user interface, when the user interface is in three dimensions, the design strategy could be drastically changed. For instance, the background design for the product could be extended to a 3D space instead of just a 2D block on the page. Similar to commercial photographs, the background could be pure color so that the object itself can be emphasized. The background can also be anything from everyday scene to special setups to set off the product.

The virtual showroom can be designed as the background environment for the 3D products. In order to craft the brand and product stories in three dimensions, the first step is to build that space. Although the virtual showroom shares the natures of pop-up shops, it doesn't need to be visually alike. In the beginning, the showroom was designed as a small closed space around  $22m^2$ . Then via testing, the results showed that, the navigation of the showroom would be hard to use, and the room could be visually depressing. "It's like a jail", a user said after been tested with a small showroom without windows. Since it is all in the virtual world, although crafting details takes time and effort, the cost of material, space and any other physical elements is almost free. When it is possible to build a whole museum, why would we build a tiny shop? A spatial space is preferred when designing the virtual showrooms.

#### Photorealistic Rendering of Product Models

After photogrammetry 3D scanning of the product, 3D artists followed the PBR workflow to retouch the models and use PhotoShop to manual correct the details and white balance of the surface texture picture in order to reconstruct the products accurately.

#### 3D Product UX/UI Design

The OrbitControls library from ThreeJS was used to assist the interaction implementation. The interaction design was planned based on it.

Besides normal functions of a e-commerce user interface, there are four main functions: 1) the interactive 3D product

itself, 2) detail information angle shortcuts, 3) automatic information display for corresponding area, 4) light switch

The user interface is responsive across platforms. On mobile version, the detail thumbnails are combined to one button and a progress bar.

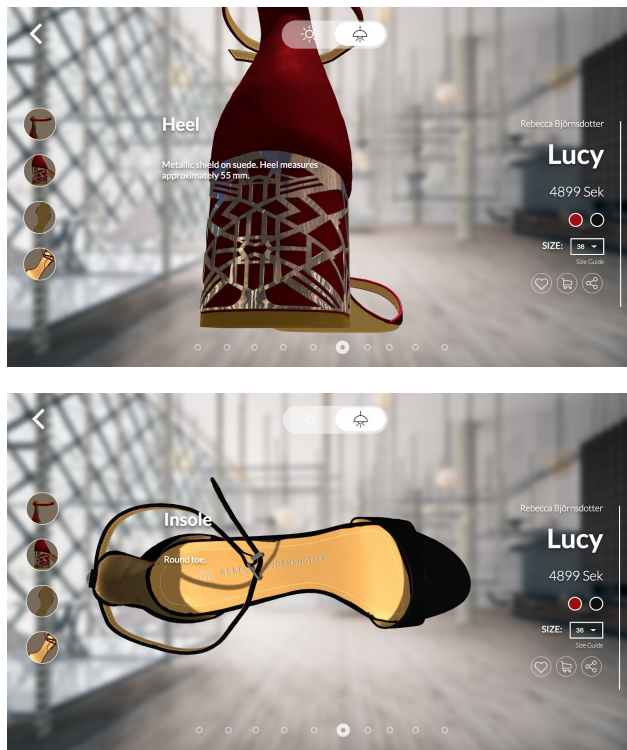
Common mouse or gesture actions are mapped to different functions. Besides simply clicking on buttons, users can scroll, zoom, single-finger click and drag, double-finger click and drag to interact with the product.

User interaction / inputs		Mapped functionalities
Computer	Smartphone	
Click & drag	Press & drag	Single-finger: Rotate the 3D model Double-finger: Move the 3D model
Scroll down	Pinch out	Zoom in
Scroll up	Pinch in	Zoom out
Click on one of the detail thumbnails		Rotate the 3D product to the corresponding position; Show the information about the detail; Reduce 3D product auto-rotation speed to almost zero.
Click and drag the product to a certain position that shows one of the detail areas		Show the information about the detail; Reduce 3D product auto-rotation speed to almost zero.
Click anywhere outside of product	Tap anywhere outside of the product	The product loses "focus": Recover the 3D product auto-rotation speed to default; Close the information display.
Choose light environments		Change the virtual lighting
Choose product color		Change the surface albedo texture map for the product

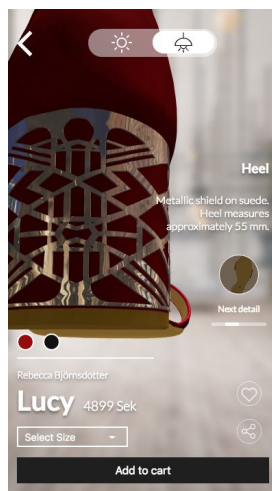
**Table 1. Interaction mapping table for 3D product user interface**

1)The interactive 3D product: Users can interact with the product in multiple ways, and the product can automatically adjust itself according to the interaction. First, when entering the user interface, the product is automatically spinning in a low speed. By using moving object, the user interface can lead users' attention to the product (Franconeri & Simons, 2003). Users can click and drag to rotate the

product so that they can check different angles. By using two fingers, they can move the product around. There are two ways to zoom in or out, depending on which type of devices users are using. With a laptop or a stationary computer, users can either use a mouse to scroll or use a touchpad to pinch. If it is on a smartphone, users can pinch the screen to zoom in or out. Similar to the traditional e-commerce product page, users can select different colors for the product. The 3D model will change its surface texture according to the user's option.



**Figure 4. Different angles and different colors**



**Figure 5. Mobile version**

2) Detail information angle shortcuts: Brands are allowed to pick several top parts of the product that they want customers to notice and know more about. Hence, information point shortcut links are listed as little thumbnails in the user interface design. Once users click on a detail thumbnail, the product will automatically rotate to that position and show the information of that part. The reasons behind the design are, first, to help users not to miss out important informations, second, to save users' time.

3) Automatic information display for corresponding area: When the product is rotated to certain specific angles, for example, the heel of a shoe, the information of that part of the product will be automatically displayed for the user. In this way, not only can users get information correspondingly easily, they are also encouraged to explore the product more.

4) Light switch: This function is meant to solve the color difference problem. In this project, as a design approach, two types of light environment are used: the warm outdoor natural light and the bright indoor white light. The natural light is a combination of a ambient light, a hemisphere light and a directional light. The color hue of the lights are set to be slightly yellow. The ambient light and the hemisphere light are given a higher density than the directional light. For the artificial indoor light, it has only the ambient and directional light sources. The color hue is set to be white, and the directional light source makes up the main part of the light. Ideally, the PBR models would react well according to different light environments. Unfortunately, today's PBR technique is more of a concept than a strict set of rules, so the results are not guaranteed to be true to the actual lighting effect in real life (Wilson, 2015).



**Figure 6. Light switch for different light environment (With ThreeJS LightHelper illustration)**

## Measurement Method

### Brand Identity

According to Kapferer's Brand Identity Prism, the customer-perceived brand identity, i.e. the brand image,



was examined from two aspects: the externalisation and customers' understanding of the internalisation, that is, customers' impression on the brand's external expression and customers' personal understandings of the brand itself. For the externalisation part, mainly the physical facet was analyzed, which is, what concrete images that customers will remember the brand as. The aspects of "relationship" and "reflected consumer" don't vary too much from the existing e-commerce platform, so they weren't measured or analyzed since the virtual showroom are only to be compared with the e-commerce platform. For the internalisation part, all three sides were evaluated by interviewing customers' understanding of them.

The measurement was both qualitative and quantitative. Users are going to be divided into two groups, one group tries the showroom, the other one tries the e-commerce platform of the brand. After finishing the same task list, they were asked to list down or draw any concrete thing that they can remember about the brand or the product, for example, the logo, symbols, colors, or any kind of physical thing. They were also interviewed about their perceived image of the brand.

#### Product Accuracy

The same information text was used in the 3D product user interface. The virtual showroom group and the normal e-commerce platform group were asked respectively to take a same quiz regarding the product to see how well they can remember the product details. Users were also asked to rate the color precision of the online product based on personal judgement.

#### User Testing Plan

18 users were recruited for the test of the 3D user interface. All of them have had online shopping experience, age from 20 to 30, and are very familiar with modern laptops and smartphones. 6 other users were tested with the 2D product page of the same product in order to collect insights for later analysis and comparison.

For the 3D user interface, the user testing had three phases. Before the test, they were interviewed about fashion shopping habits, especially about their online shopping experiences. They were also interviewed about what browsers they use the most frequently and if they have any previous experience of using a 3D interactive interface.

During the test, they were given the task to use a 3D product shopping interface as if they were customers. They were also asked to use two different showrooms with different styles for different brands. How they used the interface, the order of how they tried different functions, the problems they've come across during the test were recorded or noted down.

After the test, the USE questionnaire is used to measure the usability of the 3D product shopping interface (Lund, 2001). They were encouraged to give open comments on the user interface, and they were interviewed about their opinions of the 3D product and the interaction. They were also interviewed about their feelings towards two different virtual showrooms.

## RESULTS AND ANALYSIS

This section will analyze the user testing results. The results will present the analysis about the pros and cons of the 3D product user interfaces, the general usability testing result of the user interface and the analysis about the virtual showrooms.

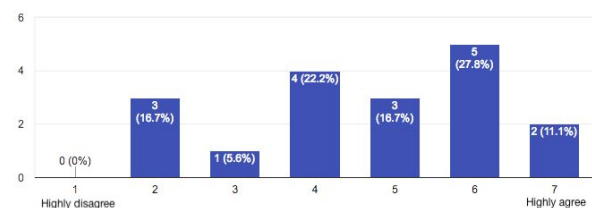
### 3D Product Models vs. 2D Pictures

According to the pre-survey, the responses from users indicated that besides size problem, the surface material, color difference, and unexpected details are the three major reasons why they return or want to return products.

To solve those problems, a photorealistic 3D model with detailed surface material and accurate color is used for the test. The testing result is interesting when users being asked how real do they feel about the 3D product. The overall result showed that the product is quite real, but the feedbacks were very diverse. For users who have tried zooming in and viewing closeups, their feedbacks are more optimistic. Two users specialized in architecture design were very critical about the surface texture rendering because themselves are very familiar with 3D modeling and rendering. One of them directly expressed the concern about the authenticity of the 3D models, because the photorealistic appearance merely means that the 3D model itself has high quality, it doesn't guarantee that the real product will look like the 3D model. The retouch process could alter the facts about the real products.

The 3D product is indistinguishable from the real product

18 responses



**Figure 7. Feedbacks regarding the authenticity of the 3D models**

Besides the questioning of the artificiality of the 3D model, users have also pointed out that "I want to see how the shoe looks like when put on a foot.", "It would be nice if there

were some half-body or full-body model pictures, so I can have a little bit inspiration about the overall outfit.” In this project, due to the web development limitations and the fact that we are 3D scanning merely the products, not human bodies with the products on, it is hard to show products on a human body in 3D. Fashion model images is rich in expression and have a huge impact on how users perceive the characteristics of a brand, it makes up a large part of the consumer culture (Black, 2012). For 2D media content, it is easy to photograph or film models with different poses. The stand-alone 3D products lack the ability of storytelling. In addition, according to Kapferer’s Brand Identity Prism, the use of human models will vitalize a brand’s personality, and it will also affect the reflection of the consumers (Kapferer, 2003). Although 2D pictures are static but they might have a lot more to say.

The true advantage of a interactive 3D model is its ability to accurately show 360 degree of the product, and to have information points attached to the right positions in 3D. It also encourages users to engage with the user interface more so to leave a deeper impression. In the after-test quiz about the product detail information, most users who have been tested with the 3D user interface remembered the shoe surface materials and the heel shape, some remembered that the shoe sole is branded with the logo. For users who used the 2D webpage of the same product, most remembered basic material details vaguely as well, but some details were ignored by most users such as the logo at the shoe sole and the metal button at the back of the shoe upper. The product information text in the description section was also ignored by some users. Hence, the list of detail thumbnails not only provides shortcuts for users, but also help users go through the details that the brand want customers to notice.

#### **Users’ Preferences over Different Features**

The interactive 3D product is most users’ favorite feature, mainly because it is the core feature of the 3D product user interface. Besides it, the product detail shortcuts is the second most voted feature, and the information auto-display comes the third. However, because the information auto-display feature is a hidden function that will only be triggered when the product is dragged and rotated to certain positions, not all users discovered it without help during the test, which could potentially cause bias in their votes. The opinions regarding the environmental light switch vary radically from individual to individual. Since the color difference of the product under different light environments is not very obvious due to the limitation of the current virtual light simulation, it is hard to conclude is light switch actually the least useful feature here. 7 out 18 users had experiences where color difference of the product caused them to return it, the light switch was designed to solve this kind of problem. However, everyone seems to have quite different requirements and criteria when it comes to product

accuracy. 3 out of 18 users voted the light switch as the most useful feature, while most of the rest don’t think the light switch make a difference to their decision of whether to buy the product or not, they think it more as a cool idea rather than a practical function.

#### **Virtual Showroom Background**

By putting products in a virtual showroom, the purpose was to give customers an immersive experience and to leave a deeper impression on them about the brand identity or the design concept behind the products.

While half of the users said they liked the showroom experience, the other half find the showroom might be a little bit distracting. Some prefer no showroom at all. In the after-test section, when users were asked to describe their impression of the virtual showrooms as concrete things. The results showed that the physical facts such as room colors, room brightness, space arrangement and etc do leave an impression on users that allow them to link to the brand. When tested with the website, their impression were mainly about website colors, font styles, and content of pictures on the homepage. The showroom quality affects users’ subjective feedbacks towards the user interface. The result indicated that maybe the showroom should either be impressive and able to express the brand identity well or otherwise not exist at all.

The fact that the virtual showroom is only visually accessible not physically accessible makes the immersiveness of the user interface not as high as expected. The virtual showrooms in this project also serve only as static 3D background environments. Although users can click to walk around in the room, the interaction doesn’t offer too much value for users. Users got confused when there is no direct feedback while walking around. The “just browsing” scenario seems to work a little bit differently in the digital world. Users would like to be given clear instructions or hints when navigating around in the room.

In addition, one user brought up an interesting point: “I am the only one in the room. It feels a little bit strange for a shopping experience.” Indeed to create a shopping experience, the customer environment should also be considered as part of the entire store environment. The showrooms used for test clearly lack the social facet and the human context.

#### **General Usability of the 3D UI**

During the user testing, no instructions were given to users unless they sought for help. Generally, there wasn’t any trouble for users to use the user interface, but some users missed one or two features of the interface. One user had the problem with using the touchpad.



For users had previous experience with 3D user interface, they are more familiar with how to interact with the 3D object. They didn't spend time trying around. They know how to rotate and zoom in or out, and they interacted in a smoother way than others so it is easier for them to discover the hidden information auto-display function.

However, as mentioned, some users didn't discover the hidden feature of information auto-display because they didn't interact with the 3D model enough. One user was a little bit nervous and didn't even try to zoom in on the product. In the USE questionnaire result, the ease of learning was rated as 4.2 out of 7. Hence, it seems that for the first time users, a short tutorial on the 3D product might be needed.

## **DISCUSSION**

3D user interface is new, and designing it has lots of challenges, especially when trying to solve the fashion customer experience problem with it.

### **Challenges**

#### **Different Shopping Habits**

Everyone has different shopping habits, and the shopping needs change from time to time. Some users are explorative, and they are interested in knowing more about information behind a product or a brand. For some users, they don't linger. The loading time of a 3D model might affect them to choose 2D pictures over a 3D user interface. They don't value the interaction with product highly.

#### **Different Backgrounds of Users**

Users come from different backgrounds, usually they have different levels of experiences with 3D technologies. It will not only have influence on how they use the user interface, it will also affect their perceptions of the 3D products. Users who are familiar 3D modeling will potentially question about the authenticity of the product, because indeed lots of retouch work is involved when producing the final product models. Nowadays, the 3D scanning technology is not mature yet. The raw models from the 3D scanning usually have many flaws, especially the surface textures. The following PBR retouch work is inevitable.

#### **Different End Devices**

As a e-commerce platform, it should be highly accessible and be able to adapt to different devices. It is hard to give instructions accordingly. Although the browser can know the device type, it is impossible to know which system it is, or to know if the users are using a touchpad or a mouse. The interaction design is complicated, so does how to give correct instructions.

### **Different Value System of Product Accuracy**

Some users are more strict about the online product accuracy, from product color, fabric material details to sizes of different parts. Different people also have different priorities about it. The goal is to make the 3D products that can please even the most hypercritical users. However, the limitations of 3D scanning and 3D object online real-time rendering make it difficult to achieve such goal. To ensure the smooth user experience, 3D artists will reduce product polygons and compress surface texture map images. Hence the artificiality of the 3D products is inevitable, which as mentioned, might leads to the doubts about the authenticity of the final 3D product models. Apart from this, the color precision of the surface texture highly depends on the personal judgement of 3D artists. The products can only be 3D reconstructed in a human perceptual level with potential individual biases.

### **Limitations of Physical Accessibility**

The lack of try-on possibilities is still an unsolved problem in this case. The virtual fitting is possible but the 3D fitting algorithm has high time complexity, and the 3D scans of customer bodies will be needed (Shepherd, Kaminski, Naor, & Tertman, 2017). However, users do want to be able to physically interact with the products. Not only do they want to see how the products look like on their bodies, but also more importantly, they want to feel the weight and the texture of the products. It is hard to imitate those haptic feedbacks precisely via computers or mobiles these days.

### **Recommendations**

However, based on the contemporary technologies, certain solutions can be taken to make up to those technology constraints.

#### **Hybrid Solution**

Since the current 2D content still have some advantages over the 3D models, the user interface could be a hybrid 2D and 3D interface. There are lots of possibilities to integrate the 2D contents into the 3D space. For example, the background doesn't necessarily to be a fully constructed 3D space, the 2D contents can be positioned in the 3D space later. The background can also be a flat plate 2D space under the product. The fashion model pictures can be put on the walls in the virtual showrooms.

With the development of Augmented Reality and Mixed Reality technology, it will also be possible to just blend the user interface into the physical space.

#### **Embeddable Feature**

The virtual showrooms can be pop up stores that link products to the current e-commerce websites, or the 3D products user interface can be designed as an embeddable component for existing websites. The key thing is to take full use of the existing systems and to integrate step by step.

Making 3D product user interfaces become embeddable components will be the first step to help 3D e-commerce user interface happen in a wide range.

#### **Customization Service for Customers**

Everyone has different body sizes, hair colors and skin colors. The current e-commerce platform uses model pictures or videos with different skin colors and body sizes to allow customers reflect the images on themselves (David, Morrison, Johnson, & Ross, 2002).

When the fashion product is worn on a body, it becomes a part of the whole color palette of the body. Customers choose products that match with their personal coloring and temperament (Kuleshova, Slavinska, Zakharkevich, & Shvets, 2017). The user interface should be designed to cater to this kind of needs of customers. The user interface should allow customers not only to compare product colors under different light environments, but also to compare the product colors when matching products with different skin tones.

#### **Reflection on Testing Method**

The main testing methods for this project include observations, interviews before and after the test, and USE questionnaire. The interviews are semi-constructed. The purpose of using the USE questionnaire is to quantitatively measure the usability of the user interface in three dimensions: Usefulness, Satisfaction and Ease of use (Lund, 2001), and through the process, to inspire users to think from different angles and to collect users' subjective reactions to the usability of the product. Considering the project budget and time schedule, this method was chosen as one of the use-based test methods for this project.

In general, since advanced visualization technologies such as the 3D web user interface is used in this project, the final decision for the evaluation method is a mixed solution, thus to get multidimensional outcomes (Fonseca, Redondo, & Villagrasa, 2014). The evaluation method mainly focused on the qualitative comparison between 2D and 3D user interfaces, assessment based on the Brand Identity Prism, and the general usability of the newly designed 3D user interface. In the future, the user testings could be better-constructed by recruiting more users to parallel compare the 2D and 3D user interfaces, and iteratively develop and evaluate the user interface along the way. A less generic questionnaire, such as a questionnaire designed with specific measuring metrics based on this project itself, should be used for further testings.

#### **CONCLUSION**

The aim of the thesis was to explore how the designed virtual showrooms and the 3D user interface can help brands to express brand identity and reduce online shopping

return rate. The results showed that the interactivity of the 3D product, the new way to display informations and the improved product accuracy are able help fashion brands to display products online better. By providing given lists of product detail shortcuts and enabling users to interact with the product in 3D, users are able to notice details that they might would have overlooked, and have a higher satisfaction while using the product user interface. The dynamic virtual lighting environments also can help users to get a better perception of the product color, but higher accuracy is needed in order to truly solve the color difference under different lights problem. At the moment, there are some technical constraints for developing the 3D user interface and the loading time is inevitable for rendering the 3D models, but related research topics have been very hot in recent years, including high-quality low-polygon 3D scanning, virtual fitting and internet speed improvement. The technical barriers will vanish or reduce gradually. The traditional 2D content still have its advantages when it comes to expressing brand identity creatively by using stylish fashion model pictures and fascinating advertising videos. Hence, the approach to design the 3D user interface for fashion e-commerce nowadays should be a hybrid solution combining both the 3D and 2D contents. The virtual showrooms will potentially create a new type of store format as online pop-up stores, which focuses at creative commercial campaign and bringing users new online shopping experiences.

In conclusion, the 3D product user interface with a combination of virtual showrooms for fashion e-commerce can indeed allow brands to express brand identity in a more creative way, and the online product accuracy could also be improved for users. In the future, when human model pictures and even virtual fitting features are integrated in the design, this product stand-alone user interface could be further improved.

The proposals for further research are to try to bringing in more human context to the user interface, including content of fashion models and the personal preferences or body features of the customers.

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