

Smartphone-Based Precision 3D Body Scanning Applications in Apparel and Footwear Markets

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Abstract

We present an overview of current 3D scanning technology and how it could be of help to the apparel and footwear industry to reduce the return rate, increase conversion, and improve future product development. We further discuss the traits of smartphone-based 3D body scanning solutions.

Keywords: 3D body scanning, smartphone, apparel, footwear, suggested-fit, mass-customizations, return rate, online conversion

1. Introduction

In the last 15 years, applications of 3D body scanning have been attracting great attention and have been gradually growing in all industrial sectors, especially in the area of apparel and footwear. Consumers can be 3D scanned and apparel companies can produce custom apparel for the consumers. The 3D scanning was done by hardware-based scanners in general, until recently, a few smartphone-based solutions became available, where consumers can conduct the scanning at the comfort of their homes. In this article, we'd like to discuss the details of the market needs for 3D scanning solutions in general, as well as the traits of the smartphone-based scanning solutions.

2. History of Apparel

Until the mid-1800s, all apparel was custom-made for the intended wearer by an outsourced seamstress or tailor, if money allowed, or was sewn by the women of the house to clothe the whole family [1]. This long-time tradition of apparel making slowly came to an end with the invention of the sewing machine and other tools. These inventions helped give rise to the idea of standard sizing and ready-to-wear clothing [2].

2.1. Introduction to standard sizing

Standardized sizing stems from the need to produce batches of similar garments. This need became increasingly larger as the need for armies and navies heightened during times of war in the 19th century. Due to this, it is believed that military tailors were the original source of standard garment sizing and systemized grading of patterns [2].

Garment sizing is known as the division of standardized dimensions for the body and wearable garments into categories, aiming to fit the maximum number of people within a minimal amount of sizes [2,3,4,5]. The study of anatomy, of body proportions and ratios and their application to pattern drafting are what contributed most to the development of standard sizing [6].

2.2. Rising demand for ready to wear clothes

In addition to the growing need for military uniforms, the increase in administrative jobs and urbanization led to the demand for formal clothing, particularly from the years of 1841 and 1871, in which the numbers of employed bankers, insurance agents, and public administrators rose from 93,991 to 598,579 [6].

By 1860, companies had figured out a way to mass produce ready-to-wear garments. Four factors contributed to this success, including (1) standard units of measurement, (2) practical processes for cutting patterns, (3) viable systems for grading patterns up or down based on body measurement proportions, and (4) the engineering of new production technologies such as the band knife cutter which could cut through multiple layers of cloth and the steam press [6].

2.3. Current sizing processes

Present-day brands and manufacturers in the ready-to-wear apparel industry usually base their sizing systems on their perceived ideal customer. The average size is developed using a fit model whom has the body shape and measurements most similar to that of the ideal customer. Using this original size, multiple other sizes are created by defining the proportional increases and decreases of the base pattern [7, 8, 9].

3. Problems the industry currently faces

These sizing processes and resulting standards are very outdated. Up until the 2000s, body data from the mid-20th century has been widely used as the standard for clothing development and sizing. The problem with this is that human's bodies continually change over the years due to our sedentary lifestyles, dietary habits, migration patterns and the impact of trends that affect body shape ideals [2, 3, 10, 11, 12, 13]. Furthermore, recent studies using 3D body scanning technology has confirmed that even within specific size categories, there exists several different body shapes [2,3,4,5]. This can be seen in lack of standard sizing across brands, the high rate of returns, and unsatisfied customers [2].

3.1. Lack of standard sizing across brands

The collection of body size data has forever been complex in methodology, including many rounds of trial and error to collect accurate information. This is not only time consuming but usually has large financial implications as well. Due to this, retailers and manufacturers often treat this body and sizing data as proprietary, causing customers to be faced with a wide array of sizing standards across brands. This becomes confusing to the consumer and can also lead to further financial implications for the brands [2].

3.2. High return rates and the economical and environmental impacts

The confusion in sizing across brands as well as the lack of updated sizing standards to fit the current bodies of the human race are just two reasons that lead to the high return rates of today's apparel industry. The increase of online shopping and lack of trying on garments is another significant factor in the increase of return rates.

In Shen and Li [14], the authors imply that the cost of physical returns is significantly affecting both economic and environmental sustainability factors. Specifically, they discuss that when the cost of physical return is higher, the expected quantity of goods leftover is lower, but the ratio of expected quantity of goods leftover and the expected rate of return on investment are higher.

3.3. Customer dissatisfaction

Return rates and customer surveys in the apparel industry indicate that between thirty-five and fifty percent of female consumers do not feel satisfied with the fit of their clothing. Additionally, a Kurt Salmon Associates study reported that fifty-percent of women cannot find apparel that fits and these fit problems are the reason for a majority of catalog returns [7, 8, 15, 16, 17].

Unfortunately for the consumer, sizing has become a marketing scheme that companies use to try and differentiate themselves in the market. Instead of asking companies to create standard sizing across brands and ultimately giving customers less fit options, [8] suggest that each company should aim to improve each company's unique sizing system to fit more customers within their considered target market [8].

4. 3D scanning as a solution

The stated issues with today's current sizing and ready-to-wear garments, specifically, the increasing change in human bodies, makes it necessary for the regular monitoring of human body shapes and measurements. With the rise of 3D scanning technology, it is becoming increasingly easier to attain this information.

Not only is 3D scanning making it easier to capture body shapes and measurements for better sizing for ready-to-wear garments, it is helping to shift the focus of apparel production from mass, ready-to-wear production, to mass customization with individualized sizing and design [2]. Although many companies have not yet figured out a way to easily and cost-effectively achieve mass-customization at scale, 3D scanning can also help in collecting customer data to recommend best fitting sizes and styles for that customer's body shape and measurements.

4.1. Benefits of 3D scanning technology

In comparison to the traditional way of measuring the body using hand measuring methods, 3D scanning comes with many benefits. For consumers who never feel fully comfortable with a tailor or salesman/woman taking their measurements, 3D scanning offers a solution that creates zero physical contact from an outsider. Additionally, hand measurements are subject to human error and subjectivity in where measurements are taken from, and 3D scanning eliminates this likelihood of invalid and unreliable measurements [2].

3D scanning has made it significantly easier to collect, aggregate and analyze anthropometric data and in turn, have made the collection of body measurements from a large group of consumers faster, cheaper, more accurate, and overall more efficient than a traditional population study, allowing for more frequent data collection [7]. Furthermore, the better a retailer can understand their current customers and their body types/fit preferences, the more informed they can be on what they buy from their suppliers, lessening the amount of returned products and lost profits.

4.2. Improving fit with 3D body data

The collection of 3D body data of customers of a specific brand can help to improve the fit of their garments by applying this information of not only measurements, but body shape [18]. In the past few years, there seems to be a larger push within these organizations to figure out a way to obtain this information at mass.

Another suggestion to improve current sizing from [7] is what they refer to as “mass customized target market sizing”, a term used to describe an extension of the paradigm for sizing systems based on the collection of measurements from consumers who represent a company’s target market. An example of this sizing system would be when you can find combinations of garment dimensions combining multiple variables such as jeans who come in number sizes, but also offer short, regular, and tall options within each size [7].

4.3. Custom-Fit

With the emergence of new 3D scanning technologies and their integration with CAD and pattern-making software have turned made-to-measure or custom-fit clothing into an actual possibility [19]. A handful of companies have started to offer custom-fit options, which has proven to be beneficial for both the brand and consumer.

Customers seem to seek out experiences that offer them the most personalization. With custom-fit, not only are customers getting this personalization, but are also guaranteed to receive clothing that fits them specifically, and not just the average consumer.

For brands, this type of interaction with their consumers holds many benefits. Brand loyalty, something that all brands strive for, can be achieved by (1) collecting customers 3D data once, almost forcing the consumer to continue doing business with them as to not have to share their data with anyone else or conduct a new 3D scan and (2) by offering a new, fun, and personalized experience that customers will remember.

Custom-fit also aims to achieve less return rates, something that every brand and manufacturer is in need of for both financial and sustainability reasons.

4.4. Suggested Fit

Not all companies have the processes and systems in place to offer custom-fit apparel. However, this does not mean that 3D scanning customers holds no advantage. Another way to ensure fit using 3D scanning technology is what some call fit recommendations or suggestions. Obtaining a consumer’s 3D body model and extracted measurements can be used to help recommend the best styles for that particular body shape and size and recommend the particular size they should buy in any offered garment.

5. Mobile solutions

In addition to the benefits of generic (hardware-based) 3D body scanning in the apparel industry discussed above, smartphone-based 3D scanning has further merits, including massive scalability, low cost, and ease of maintenance. However accuracy is a general concern.

5.1. Massive scalability

With the proliferation of smartphones in our modern lives, smartphone-based apps can reach to majority of the population, thus making this solution ideal for quick deployment of the 3D scanning technology. 3D scanning apps are usually offered in the Android and iOS platforms, rarely in the windows platforms thus far.

5.2. Low cost

Compared to the hardware counterparts, smartphone-based solutions have significant cost reduction, due to the fact that it is a software based solution and no hardware required. This leads to the lower initial cost for setting up the 3D scanning solutions for the apparel companies.

5.3. Ease of maintenance

Compared to the hardware counterparts, maintenance for smartphone-based apps can be as simple as an app update over the internet connection, which eliminates the involvements of all the hardware repair and maintenance.

5.4. Accuracy

Hardware scanners generally produce accurate results due to the help of hardware-based sensors, of course the degree of accuracy is usually depending on the quality of the sensors, which we do not go into details in this paper. Smartphone-based scanning app usually produce less accurate scanning results compared to hardware-based scanners.

However, a few companies [22] have had significant breakthrough in the art of computer vision technology on the mobile platform, and can produce 3D scanning accuracy similar to that of a hardware-based scanners. These solutions open up immense application possibilities for apparel brands and retailers.

5.5. Hardware v.s. Smartphone

Authors in this article do not believe hardware-based and smartphone-based solutions are in a competitive relationship in the market, on the contrary, we believe they are complimentary to each other. For example in the in-store environment, hardware-based solutions have significant advantage, since hardware solutions, if done right, could offer a fast, convenient scanning service with great presentation. At the same time, smartphone-based solutions are more geared towards consumer at-home applications.

6. Conclusion

Emerging 3D scanning technologies are helping to bring the apparel industry and their sizing standards into the 21st century. Having a way to easily and cost-effectively collect customer body data at a mass scale has numerous benefits for both the consumer and the brands/manufacturers themselves. These benefits include (1) better fit for the consumer, (2) the opportunity to offer custom-fit, (3) a decreased amount of returns due to better-fitting garments, (3) regular monitoring of the change in human bodies, (4) higher sustainability due to less waste in returns, (5) less loss of profit for the brands due to returns and more.

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