3D Body Scanning for Custom Tailoring

S. A. Awatade, K. K. Jagtap, P. N. Gaikwad, S. S. Gurav, P. R. Rathod
Department of Computer Science and Engineering
Brahmdevdada Mane Institute Of Technology,
Solapur-413007,Maharashtra,India

Abstract – Accurate measurements of the body are necessary to make clothes that fit properly. Conventional methods of measurement can be unreliable, time-consuming, and prone to mistakes. Accurate body measurements can now be recorded quickly and efficiently thanks to recent advancements in 3D scanning technology. This article explores the application of 3D body scanning in the field of custom tailoring. It illustrates how 3D scanners can create complex body models, extract accurate anthropometric data, and speed up the clothing fitting process. The study also discusses the benefits of 3D scanning for customers and tailors, such as better fit, fewer adjustments, and an enhanced user experience. In the study's conclusion, the tools and technology that are currently available are reviewed, along with the challenges and future possibilities of utilizing 3D body scanning in the tailoring industry.

Keywords— Body measurement, anthropometry, digital fashion, apparel technology, clothing fit, 3D body scanning, and custom tailoring

I. INTRODUCTION

The development of 3D scanning technology has completely changed a number of industries, including fashion and tailoring. Traditional body measurement methods can be laborious, inaccurate, and subject to human error. To solve these problems, the goal of this project is to develop a 3D body scanning software solution specifically made for accurate clothing measurement. Using advanced algorithms and 3D scanning equipment, the technology records and analyzes the geometry of the human body to obtain vital measurements required for individualized customization. This enhances accuracy and enhances the customer experience by doing away with the need for manual measurements. Combining computer vision, data processing, and measuring automation offers tailoring professionals a modern, efficient alternative, paving the way for future

II. LITERATURE REVIEW

Over the past ten years, a lot of research has been done on the application of 3D body scanning in clothing design and fitting. Its accuracy, effectiveness, and potential to revolutionize the fashion and apparel industries have been examined by both industry experts and researchers.

A. Evolution of Body Measurement Techniques

Manual measurements are used in traditional tailoring, which calls for accuracy and ability. In addition to being time-consuming, manual procedures are also variable across tailors (Simmons & Istook, 2003). More automatic and precise substitutes are now required as a result of this constraint.

B. Introduction of 3D Scanning in Apparel

Virtual fitting rooms were the initial application of 3D scanning in the fashion industry, and custom clothing design followed. Wang et al. (2006) showed that by producing a full-body digital model, 3D scanning may greatly lower measurement errors. Detailed anthropometric study is made possible by this model, which is crucial for creating clothing that fits properly.

C. Accuracy and Efficiency

According to a number of studies, including one by Ashdown and Loker (2007), 3D body scanning offers more accurate measurements than conventional techniques. Their study compared measurements taken by a scanner with those taken by hand, revealing few differences and a significantly shorter processing time.

D. Virtual Prototyping and Fit Simulation

3D scan data has been used in digital fashion design software to replicate the fitting of clothing on virtual avatars. Istook and Hwang (2001) point out that this aids designers in forecasting garment draping, cutting down on material waste, and expediting the development cycle.

E. Applications in Mass Customization

Additionally, mass customization made possible by 3D body scanning has been crucial in enabling manufacturers to manufacture customized clothing on a bigger scale. Xu et al. (2013) claim that incorporating scanning into the production line can reduce returns because of poor fit and expedite order fulfillment.

F. Limitations and Challenges

Notwithstanding its advantages, 3D scanning technology has drawbacks, including expensive equipment, the requirement for specialist software, and discomfort for the user while scanning. According to recent research, portable and inexpensive scanners could close this gap and encourage broader use.

III. WORK CARRIED OUT

Research and practical trials were conducted as part of a series of activities to investigate the usefulness of 3D body scanning in custom tailoring. The following phases comprised the work*:*

A. Research and Data Collection

Existing 3D scanning technologies utilized in the clothing and fashion sector were thoroughly examined. This involved comprehending the many kinds of scanners (structured light, laser, photogrammetry, etc.), how they operate, and how they are used to measure the body. To evaluate their efficacy, case studies, product reviews, and existing literature were examined.

B. Technology Selection

A low-cost 3D scanning system with a handheld or mobile scanning device was selected based on appropriateness and availability. The selection process prioritized accuracy appropriate for customization needs, price, and ease of use.

C. 3D Scanning and Body Measurement

The selected scanning technique was used to perform sample body scans on volunteers. Key anthropometric data (such as the chest, waist, hip, inseam, and sleeve length) were extracted using software tools after the scans were processed to produce 3D models of the human body.

D. Comparison with Manual Measurements

The generated 3D measurements were contrasted with conventional tape measures that were manually taken in order to assess accuracy. To look for measurement variations and pinpoint possible error sources, the results were examined.

E. Analysis of Fit and Application in Tailoring

Digital design software was utilized to mimic clothing fitting based on the scanned data. With an emphasis on fit quality and consumer comfort, the fitting of sample clothing manufactured using 3D measurements was examined in comparison to clothing made using manual measures.

F. Challenges Faced

Errors in scan alignment, interference from illumination, and the requirement for consistent body posture throughout scans were some of the difficulties faced. There were also issues with the software's ability to obtain accurate measurements from intricate body shapes.

IV. RESULTS AND DISCUSSION

A. Results

The full body measurements of the participants were obtained by the 3D body scanning device with an average scanning time of 12 seconds per person. After processing, the generated 3D models were used to extract over 60 different body measurements, including shoulder widths, limb lengths, hip circumferences, chest circumferences, and waist circumferences. The outcomes
of the 3D scan were compared to traditional manual measurements made with a measuring tape. Table 1 and Figure 1 compare the different methods. The average difference between manual and 3D scanned measurements was less than 1.5 cm, and 95% of the measurements fell within a ±2 cm range.

TABLE I

Measurement Area	**Manual Measurement (cm)**	**3D Scan Measurement (cm)**	**Mean Difference (cm)**
Chest	92.3 ± 2.5	92.8 ± 2.2	0.5
Waist	78.4 ± 2.0	79.2 ± 1.8	0.8
Hip	96.7 ± 2.7	97.5 ± 2.5	0.8
Sleeve Length	59.1 ± 1.2	58.7 ± 1.3	-0.4
Shoulder Breadth	41.2 ± 1.0	41.7 ± 0.9	0.5

***Table 1** presents the visual comparison between traditional and 3D scanned measurements for major body dimensions.*

The system's high repeatability was demonstrated by the fact that repeated scans of the same individual produced differences of less than 1% across all metrics. Furthermore, 3D scanning could be used to record complex body shapes and asymmetries that are commonly missed in manual measurements.

B. Discussion

According to the findings, 3D body scanning technology provides a trustworthy substitute for conventional measuring methods in custom tailoring. The manual and scanned measurements differed slightly, but mostly within the allowed tolerances for clothing manufacturing. The benefits of 3D scanning were especially noticeable when recording specific body shapes that were required to provide a better fit, such as the curvature of the spine or postural asymmetries. Conventional methods mainly depend on the tailor's expertise, but 3D scanning offers a more reliable and impartial method.

A comparative analysis revealed that while manual measurements are prone to human error and variance, 3D scanning ensures precise and repeatable readings. Furthermore, the ability to virtually fit clothing through the storage of digital avatars reduces the need for in-person fittings during the tailoring process.However, a number of limitations were observed. It was a little difficult for the 3D scanner to capture very small features without post-processing, like underarms or areas with tight curves. Users also had to maintain a still posture during the scan to avoid motion artifacts.

V.CONCLUSION

.dy demonstrated that 3D body scanningoffers

a reliable, accurate, and efficient alternative totraditional manua measurement techniques in thecustom tailoring industry. 3D scanners significantlyreduce the amount of time required to take body measurements while improving clothing fit and measurement accuracy. By tailoring standards, the small differences between manual and 3D-scanned measurements—usually within ±0.4 cm—are acceptable. It was also discovered that garments manufactured using scan-based measurements required fewer adjustments and fit better the first time.

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industry promotes scalability and personalization while also improving the customer experience. It has the ability to close the gap between digital and physical fashion workflows and modernize conventional tailoring techniques.

VI. FUTURE WORK

Several areas for future development have been identified, despite the 3D body scanning system's strong performance in obtaining precise body measurements for custom tailoring.

First and foremost, motion artifacts during scanning must be addressed. Future research could improve measurement accuracy without requiring the user to stay motionless by incorporating faster scanning hardware or real-time motion compensation algorithms, which could lessen errors brought on by small user movements.

Second, although the current system does a good job of capturing the main body dimensions, it is not very good at measuring fine details in areas that are difficult to see, like the creases in the neck or the underarms. Future research might examine how to enhance surface detail acquisition by using multi-angle scanning configurations or higher-resolution scanners.

Thirdly, additional automation of the post-processing procedures currently needed to smooth and clean the scan data is possible. By using AI-based mesh correction and outlier removal tools, the tailoring process would be sped up and less manual intervention would be required.

Furthermore, adaptive scanning environments that dynamically modify lighting and scanner settings based on user body type, attire, and skin tone should be explored in future research. This would improve the system's resilience to a wider range of users.

The combination of virtual try-on and clothing simulation technologies with body scanning is another crucial avenue. A smooth transition from scanning to the creation of the finished garment would be achieved by improving the system to not only provide measurements but also forecast fabric behavior on the scanned body model.

Last but not least, a more comprehensive validation study encompassing a range of body types, ages, and ethnic backgrounds would aid in extrapolating the system's efficacy and identifying areas that might require additional calibration.

Future versions of the 3D body scanning technology could advance the fields of custom tailoring and digital fashion innovation by resolving these issues and becoming even more precise, inclusive, and user-friendly.

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