International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 07, July-2022

Applications, Technologies and Challenges of 3D Body Scanning in Fashion Industry

Puja Kumari Punia, Harinder Pal, Sonia
Bhagat Phool Singh University

***Abstract*: The purpose of the paper is to explore various 3D body scanning technologies, which are prevalent in the market. Nowadays consumers are more fashion oriented; they want to experience how the garment will look like when they wear it before it is actually made. It has been reported many times that ordered product through e-commerce doesn't provide that level of satisfaction as consumer demands. This paper highlight various 3D scanning technologies like laser based, light based and stereo-vision & image processing scanning techniques which could be beneficial for customers who are looking for garments with a perfect fit. Literature review reveled that though consumer are appreciating the use of 3D body scanning technologies to scan their actual measurement but are apprehensive about the cost issues. This paper also highlights about mobile scanning technologies which may offer an alternative cost-effective solution for consumer who are interested for 3D body scanning technologies for better fit. Looking at the scope and adaptability of 3D body scanning technologies it is expected that with time, competency and advancement future seems promising for customize solutions through 3D body scanning.**

Keywords: 3D body scanning technology, Laser based scanning, Light based scanning, Stereo-vision and image processing.

I. INTRODUCTION

As time passes, people are moving toward the digital universe with advancements in technology (Ganatra. J, 2021). Peoples want to experience everything before they purchase at their comfort place. In the fashion industry, consumers want to experience the drape, colour contrast to body colour, patterns, different designs by using pocket, pleats, tucks and, length etc before it is manufactured (Steven. G, Christoper J.Parker, Gill.S, 2017). 3D body scanning is the only solution of expectations of consumers and to minimize the waste of capital. Nowadays challenges are increasing for the designer to have the particular software that can provide the different designs on a person with accurate measurements. Covid-19 has changed our lives and fashion industry completely (Borduas.J, Castonguay.A, Laurin.P, 2020). Technology has become an essential part of fashion. One of the most important emerging technologies of industry is creating 3D attire digitally on a consumer model.

3D body scanning technology is the only solution for all the consumers, which provides them to have contact less scanning within seconds and provides the measurement and create a human body model on which it can make the imagination by constructing the ideas of new apparel design and hence compare the imagination vs reality (Spahiu.T, Shehi. E, Piperi. E,2014).

3D technology is so beneficial that it saves time by eliminating handling a tech pack and making a sample. It allows overseas buyers and domestic teams to hold virtual fittings together and make changes in real-time. It also reduces the turnaround time for seeing the 1st sample by doing it virtually. It increases the likelihood of approving the fit of your garment once you see a physical proto. And main important factor of 3D body scanning is it saves money by cutting out the expenses of making a physical garment that will most likely not fit the first time around.

II. 3D BODY SCANNING TECHNOLOGY

3D body scanning is an instrument that creates a 3D model digitally with accurate measurements by using depth sensing, imaging technology, laser and infrared sensors. A vast amount of information is collected from the single scan related to shapes, angles, and relational data points. (Phoebe R. Apeagyei, 2015). To achieve perfect clothing, there are five elements to be considered: line, colour, shape, texture and pattern, but to understand how the dress will have an impact on someone's look, body figure and measurements perform the mandatory role (Marie-Eve Faust and Serge Carrier, 2009). 3D body scanning technology includes a scanner and measurement extraction software. After extracting thousands of cloud points from the scanner, the software automatically generates the scanned human body measurements in a second (Fiber to Fashion, 2008).

The first 3D body scanning technology was invented by the CAESAR (Civilian American & European Surface Anthropometry Research Project). The scanner was very complex because of the colour scheme, landmark detection scheme, lighting scheme etc.

It took about a week to collaborate the entire scan and to get final result. The weight of 3D body scanner reaches to 450 kg and the cost went to USD 350,000. Another company ViaLux which is German based company manufactured 3D BodyLux scanner combining phase-encoded photography and micromirror projection.

Figure 1: 3D body scanning instrument.
Source: https://eatsupplementstore.com/styku-3d-body-scanning-system/

With continuous development 3D body scanning technology all over the world, Artc 3D and Luxembourg companies introduced handle scanners in 2017 and where they were able to

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 07, July-2022

reduce their weight to 1 kg with reduction of cost to USD 22,000. Now the companies are trying to work on simulating 3D avatars through smart-phones with the help of AR technology and 2-dimensional photographs (Kiron.M, 2021).

III. TYPES OF 3D BODY SCANNING

There are varieties of Scanning devices but to scan the human body measurements, it is categorized into three different categories they are (Arbutina.M, Dragan.D, Mihic.S & Anisic. Z, 2017)

- Laser-based scanning.
- Light-based scanning.
- Stereo-vision and image processing.

Table- I: Number of companies manufacturing 3D body scanning in different continent.

	LIGHT BASED SCANNING	LASER BASED SCANNING	STEREO VISION AND IMAGE PROCESSING	TOTAL
ASIA	3	4	0	7
AMERICA	7	7	5	19
EUROPE	22	0	7	29
TOTAL	32	11	12	55

Table I shows number of companies which manufactures 3D body scanning all over the world to grow technology in the field of fashion and apparel industries (Apuzzo. N, 2007).

A. Laser-based scanning

A Laser scanning technology uses a single laser or laser line project onto the human body. The laser beam used for scanning is eye-safe while scanning the human body. Lasers and mirrors are placed in such a way so that it follows the simple geometrical rules while measuring the human body. The movement and number of the laser beam depend upon the human body parts that are to be scanned. For full human body scan Germany Company Vitronic Gmbh has manufactured the laser-based scanner, where three scanners are moved vertically to human body for scanning process. For head scanning and foot scanning, different scanner are developed by Cyberware Inc. (USA) and Vorum Research Corp (Canada) companies (Apuzzo. N,2007). RGB color values help to extract color-coded landmarks, which is the advantage of technology (Kiron.M, 2021).

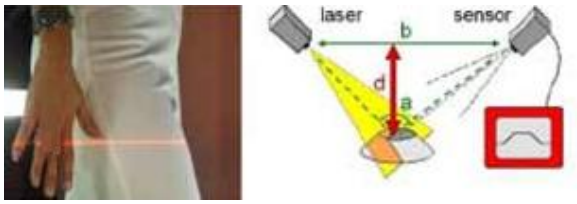

Figure 2: laser based 3d body scanning.
Source: https://www.hometrica.ch/publ/2007_videometrics.pdf

The disadvantage of laser-based technology is the high cost of hardware production, and the other important reason is the time required for digitization. Laser-based scanning devices can scan small body parts easily like hands and feet in seconds, but while scanning full-body and head it becomes difficult as they can't remain stationary for a reasonable time as required for better accuracy (Arbutina.M, Dragan.D, Mihic.S & Anisic. Z,2017).

B. Light-based scanning

The limitation of laser-based scanning devices which involves continuous moment of whole scanning unit is overcome by light-based scanning technology. This technology involves light projector which remains stationary, and consists of a light projector and a sensor that gathers all the data to digitize the measurements of the human body by a similar method, same as laser scanning. The most complex surface uses two to three projectors to get accurate results (Apuzzo. N, 2007).

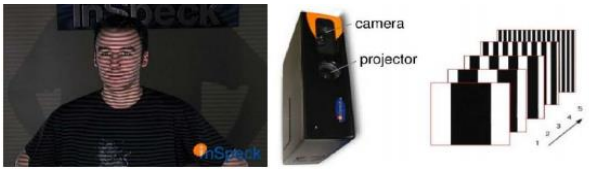

Figure 3: Light based 3d body scanning.
Source: https://www.hometrica.ch/publ/2007_videometrics.pdf

Light based systems are further categorized as:

a) Shadow scanning device has the ability to scan shadows due to that there is no effect of skin color on scanner. The requirements for scanner are a camera, pencil, desk lamp, and a board with the grid. YMCA by Telemark and LASS (Loughborough Anthropometric Shadow Scanning) are the companies that develop based on shadow scanning. (Fiber to fashion, 2008).
b) White light scanning uses PMP (phase measuring projection) technique. It detects body and deformed light strip with the help of a software, and the final output of scanned body is created by collaborating all the phases together. Tc2, Wicks and Wilson limited companies are developing the white light scanning instrument.
c) Light-emitting diode scanner uses infrared light-emitting diodes, which provide the widest dispersion to cover a large circumference. It collects the data from light reflected from an object by collecting it in a detector lens. Hamamatsu produces light-emitting diode scanner (Arbutina.M, Mihic.S & Dragan.D, 2016).

C. Stereo-vision and image processing

Stereo-vision and image processing technology generates the 3D human model by 2 dimensional photographs instead of scanning the human body with 3D body scanner. It collects data from three pictures, two from the front and one from a side view.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 07, July-2022

Figure. 4: Image processing 3d body scanning.
Source: https://www.fibre2fashion.com/industry-article/1693/3d-body-scanning-technology-with-application-to-the-fashion-and-apparel-industry

With the help of the symmetric human body, computer calculates the shilloutes of the body with accurate measurements, and details are further used in the production of ready-made garments. This method is comparatively cheaper compared to the 3D body scanning technique (Apuzzo. N, 2007).

IV. LIMITATIONS OF 3D BODY SCANNING

3D body scanning technology produces the accurate results within few seconds. This helps tailor and consumers to extract infinite number of measurements in very short time and provide the customer fit comfort garment. But this technology is still not at adaptable stage to reach to the consumer because of some technical issues and expensiveness.

A. Cost

The manufacturing cost of 3D scanner generally exceeds more than USD 128,000 which discourages startups to get into this technology. Further COVID-19 pandemic aggravated this problem due to financial crises. Hence it is a challenge for companies to develop advance technologies at affordable price (Pardes. A, 2019).

B. Scanning Obstructions

There are certain technical issues which obstruct the accuracy while scanning the human body. Some body parts are not adequately visible, like the top of the neck, crotch, top of the shoulder etc. Apparel creates reflections for light and laser scanning. Loose garments make large measurements, and intimate apparel produces measurements shorter. Hairs and different colors of skin hair create reflection and disturb scanning (Apuzzo. N,2007).

These two factors are the primary reason for creating challenges to 3D body scanning technology. The researchers all over the world are trying to create alternate solution to overcome these challenges. Mobiles are coming with inbuilt AR technology, which are helpful in scanning the human body.

V. APPLICATION IN THE APPAREL INDUSTRY

A.Virtual try-on

A virtual try on is a method which is implemented on 3D modal created with the technology, by attiring the different style apparel Where a consumer can experience about the garment texture, fit, color contrast on her body, a drape of the fabric, and a view of the garment in 360 degrees on her virtual model. In the same way, this technology can be used for the virtual makeover where it can check different hairstyle and different makeup on her face, without wasting the time on actual applying makeup or on trying different hairstyle (Apeagyei. R,2010).

B. Size surveying

Nowadays, human body size surveys are as important as upgrading fashion from time to time. Anthropometric data also improves product quality, services, and usability in the fashion industry and in other sectors. National surveys have been conducted in the past in the United Kingdom (SizeUK, 11'000 people scanned, 130 body measurements per individual), the United States (SizeUSA). The standard survey stance has the human body's legs and arms slightly apart, with the elbows and hand joints slightly bent. This will allow the important anthropometric measurements of the human body to be determined automatically (ISO7250). Additional sitting and standing postures have been introduced to recent size surveys (Sweden and France). New surveys in China have included 3D measurements of hands and feet (Apuzzo. N,2007).

C.Mass Customization

It involves high cost to manufacture customized garments, only the wealthier class can afford it. 3D body scanning technology aims to produce mass customization at low price to satisfy the consumer aspiration for customization apparel. (Idrees.S, Vignali. G, Gill.S, 2020).

VI. FUTURE OF TECHNOLOGY

Globalization is challenging for the apparel industry. It has to cover a variety of styles, and quality in-store with a broader range of sizes which is a challenging task looking at sustainability and cost-effectiveness. With 3D scanning technology, there seems to be a promising global scope in the apparel industry. This technology will provide a drastic curve change in the apparel industry and business (Fibre to fashion, 2009). Modernization is also growing in the fashion industry; everyone wants to complete task quickly with accurate results.

MAIN SUPPLIER	SOFTWARE /TECHNOLOGY	ORIGIN
Gerber	Software	USA
TC2 labs TC2-21B	Technology	North Carolina
Fit 3D ProScanner	Technology	USA
Lectra	Software	France
Gemini	Software	Romania
ArtecShapify	Technology	Luxembourg
Clo 3D	Software	Korea

Table- II: Major supplier of 3D Software/Technology.

3D body scanning presently is available for the elite class who can afford it. Table II shows some software and technology which are developed by the industries in different parts of the world.

CONCLUSION

Innovations are happening all over the world at faster phase in fashion industry which involves the change in style & trends and moving from traditional to digitization. The 3D body scanning technology with lot of functionally and adoptability

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 11 Issue 07, July-2022

by consumers, who are fashion conscious, can give a push in the market. Though there are challenges which need to be worked out for 3D body simulation technologies to sustain in the market. With time, competency and advancement in digital technologies it is assumed that these issues will be resolved soon. The future of 3D body scanning technology seems promising in time to come to benefit for the fashion and apparel industry.

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