A Comparison of Body Measurement Method of 3D Scanning and Manual Method for Female Clothing

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Abstract

It suffices to say back in the past, for garment measurement, traditional anthropometric methods had generally been selected for fitting garment; however, 3D body scanning systems, nowadays, have been widely accepted and preferred by many scholars and researchers due to its speediness in terms of body size measurement and this could productively be as part of improving fitting garment production process. The purpose of this study was to compare 3D body scanning measurement of sense^{TM}2 3D scanner and terminology with a traditional anthropometric method in this case, tape measurement. Concerning this research procedures, the experimental work was conducted by determining point marks based on EN 13402-3 standard on the upper part of a female mannequin and capturing mannequin images ten times by sense^{TM}2 3D scanner and end up by using the Blender software to analysis and compare the body measurement. Based on the data collected from testing, 3D scanner had the Coefficient of Variation (CV%) range approximately 0.10-0.33%, while the measured girth results had CV% double higher than the results from 3D images. Nevertheless, values of body measure results between two methods are significantly close ranging 0.20-0.41% of error. It could be found from the results that 3D scanner was more precise than the tape when measured and this could lead to a conclusion that 3D body scanning method of female body was found to be more accurate in terms of measurement than the traditional anthropometric one.

Keywords: Body measurement, 3D body, 3D body scanning, Anthropometric, Body shape and Body scan.

INTRODUCTION

The body scanner as a tool offers the opportunity to capture a snapshot of an individual in time, in a fixed pose, and to then create a 3D image representation [1-4]. The female human body has complex shape and difficult to find out its precise measurement by means of manual method especially when female body possesses different positions of body curves including bust, underbust, waist and hip parts. With this reason, a 3D scanner as one of the suitable solution for analyzing body measurement for accurate fit when making clothing patterns is offered [5-6].

The aim of the study is to conduct an experiment on measuring body size of female mannequin by applying two sets of methods including manual measuring tape method and calculation method provided by 3D image sense^{TM}2 3D scanner and then compare their results for the best method of body measurement. The method will assist establish landmarks on the female mannequin and takes the measurements should be established so that standardization of the data capture can be realized [7].

Referring, the EN 13402-1[8]. the experiment defines a standard list of body dimensions on upper part of female body which were used namely bust girth, underbust girth and waist girth. However, the upper bust girth is not in their list of the standard, and therefore the focus of experiment will base its analysis and comparison on the upper bust girth. Concerning the unit for measuring the body size EN 13402-2 standard species a primary dimension, a body measurement in centimeters [8] and use on language-neutral clothes labels, EN 13402-1 species a pictogram for each body dimension as shown in the Figure 1 which represent the pictogram base on European standard sizing system 38.

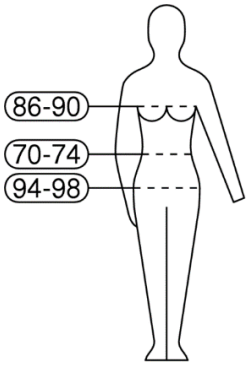


Figure 1. A pictogram for each body dimension [9]

MATERIALS AND METHODS

Materials

This research will focus its study on body measurement of female and hence, mannequin according to European standard sizing system 38 of upper part female body will be selected for testing. Referring to its properties, mannequin will be in full female body size with rigid surface texture that has geometric characteristics of human female body. This life-size model of the human body will be selected for investigation by applying 3D capturing technologies Sense^{TM}2 3D scanner so as to find out the somatotype of the body which can further provide more details of the body measurement.

Methods

The procedure of this research determined the importance point marks on the mannequin according to the standard method of body measurement EN 13402-3 on the upper part of a female body [8]. Subsequently, the first method used a manual measuring tape to measure the mannequin body size base on the point marks were fixed on it. The second method used the 3D scanner for capturing the mannequin in order to analyses the 3D body images and calculate the mannequin body size by using Blender software. Those methods used ten times of measuring body by a manual measuring tape and ten times of 3D scanner for capturing a mannequin. Last but not least, the study investigated the results of body size measurement between the measuring methods and calculating method by sense^{TM}2 3D scanner method their calibration with the statistic.

The procedure during scanning should be concerning with four mains tips and tricks as follows: 1) Lighting should set the light shines with equal intensity over the subject being scanned. 2) Positioning for scanning the mannequin should set the area 360° around it for capturing and keep the scanner within its optimal distance range of the subject, which is

approximately 0.45m - 2m. 3) A close observation on motion during scanning should be conducted with concentration and caution the 3D view monitor status should be checked in order to help a quality of the 3D image.

RESULT AND DISCUSSION

The results of the experiment consider the female mannequin according to European standard sizing system 38 and the second method of the experiment used 3D body scanning using sense^{TM}2 3D scanner for capturing the body measurement as shown in the Figure 2.

(a) Front view (b) Back view (c) Side view

Figure 2. The 3D images with fixing point marks using 3D scanner

Referring in the Figure 2 the small dots on the mannequin were called mark points where determined the important parts of study namely Upper bust, bust, underbust, and waist. Then the 3D image used the blender software to analyses the body cross section with different part of the body as shown in the Figure 3.

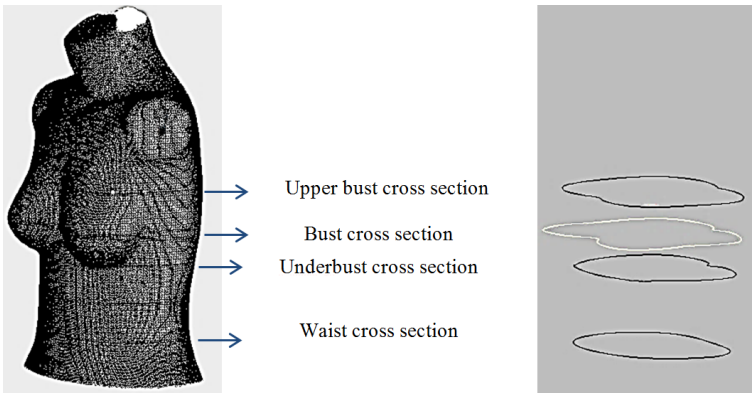
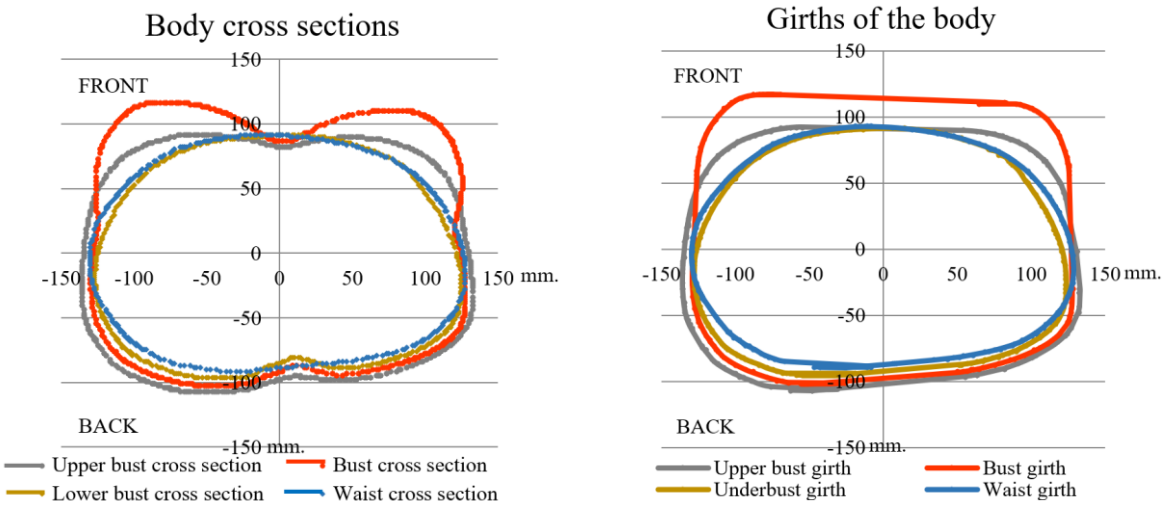


Figure 3. The images processing of body cross sections

Concerning procedures of producing line graph of body cross sections as shown in Figure 4(a), blender software in Figure 3 was used to analyze cross sections of body and those lines were then transferred to Microsoft excel for creating line graph. It could be assumed from the analysis that body cross sections will be very helpful to analyze the pattern construction for the future work. Through this experiment, the measurement of body girth using the convex hall instead of the body cross sections was conducted due to the fact that the software created the girth line from the contact measuring of the body was similar to the one using tape measuring

method as shown in the Figure 4(b). At the later stage, the distance of the girth in Figure 4(b) was then calculated by applying the Euclidean distance between two points in 2 dimensional spaces which is a geometrically shortest distance on the straight line passing through both the points as mentioned in equation $D(x,y) = \sqrt{\sum_{i=1}^{n}(x_i - y_i)^2}$ [10].



(a) Body cross section with different parts (b) Body grit with different parts

Figure 4. The graphs of cross sections and girth of the body

The results of body size by manual measuring tape and 3D images analysis as shown the Table1 illustrates the comparison of the body girth values at the four parts of the body. It can be seen from mean values of the method 1 that it is slightly higher than mean values of the method 2. Moreover, the values of Standard Deviation (SD) and the percent Coefficient of Variation (CV%) from the method 1 are double times as wide as the method 2 when applying with 3D scanner.

Table 1. *The comparison the vales of the body measurement*

Body girth	Method 1 (Measured values: cm.)			Method 2 (Calculated values: cm.)		
	Means	SD	CV%	Means	SD	CV%
Upper bust	79.16	0.40	0.51%	78.84	0.18	0.23%
Bust	86.81	0.50	0.57%	86.64	0.18	0.21%
Underbust	72.91	0.53	0.73%	72.63	0.13	0.18%
Waist	71.75	0.36	0.50%	71.49	0.07	0.10%

In Figure 5, results of values in Table 1 were evaluated and presented as in bar graph. Obviously, values of the two methods were equivalent in terms of their girth values resulted from different parts of the mannequin. While the standard deviation error bar from method 1 were wider than method 2 in terms of their measured values. It could also be assumed from the results that taping method is not precisely enough as it is difficult to measure parallel lines along the horizontal axis and therefore, with the technique, the length of girth body was inconsistent.

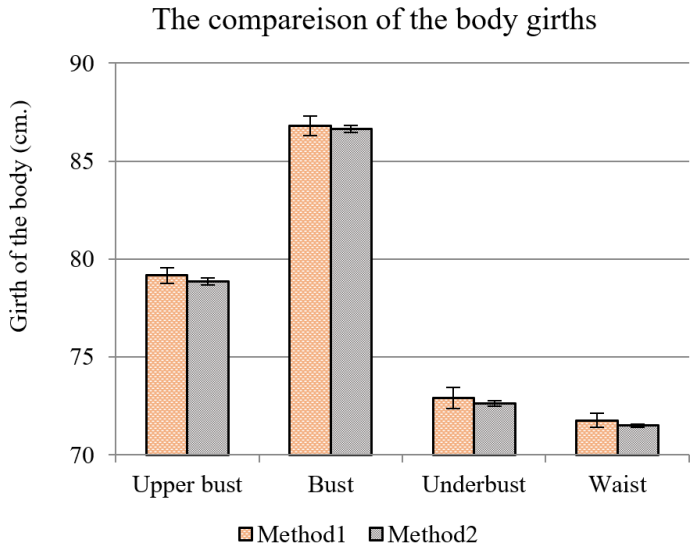


Figure 5. The graph comparison the results of two methods of the body girth values with different parts

For the second method, using the 3D scanner device and the Blender software and analyzing body cross section in order to create the girth body on the line graph tended to be more accurate as shown in the Figure 4(b) Those results of body girths in the line graph could be calculated from the width and the thickness of the body as shown in the Table 2. Moreover, presenting in the result table, the largest body width is at the upper bust part of the body. While, the width value at the underbust and waist parts possess very close values at 25.09 cm and 25.08 cm respectively.

Table 2. The body width and thickness of the body measurement

Body girth	Body width (cm)			Body thickness (cm.)		
	Means	SD	CV%	Means	SD	CV%
Upper bust	26.41	0.15	0.58%	19.83	0.06	0.31%
Bust	25.50	0.18	0.70%	21.29	0.06	0.30%
Underbust	25.09	0.18	0.70%	18.73	0.04	0.20%
Waist	25.08	0.14	0.57%	18.05	0.05	0.29%

The thickness of the female body of the mannequin at the bust part had the highest thickness at 21.29 cm. On the other hand, the waist part possessed the lowest thickness at 18.05 cm. It could be concluded from the results of this experiment that the 3D image method using the 3D scanner was applicable for analyzing the patternmaking for the future use of clothing.

CONCLUSIONS

Conclusively, it could be implied from the data shown in the results that both methods are comparable for measuring girths on different parts of the body and when compared the values from method 1 and 2 were found to have only 0.2-0.41% measurement errors. In case of the method 1, it is considered to be a basic form of measurement so called a manual tape method. This particular type is easier to conduct a measurement but the user must be cable of understanding and conscious of the definition of the standard body measurement in order to

achieve measuring parts of the body. For 2nd method, it could be concluded that 3D scanner used for creating the 3D image captured from the mannequin was too complicate in terms of their inputting and processing procedures to find out the results of body measurement. Nevertheless, with the method, precise calculations of values results of girth on different part of the body could be conducted as shown with 0.10-0.23 CV%. Overall, the efficacy of 3D scanner possesses more precision than anthropometric measurement and therefore, it is more applicable to be applied in garment industries.

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