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Development of Human Body Measurements Size System for Clothing

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ABSTRACT

Measuring systems for clothes size have to be up dated from time to time, therefore this study aims to develop the human body measurement without any direct contact using image technique to decrease time of measurement, to increase accuracy of measurement and to compare between manual measurement and image technique measurement for human body measurement. Manual and image technique measurements were taken to Fifty subjects (male and female) students. The general data of the subjects which includes the age, weight and height was recorded.

The image technique measurement had taken a period of 0.96 minutes whereas the manual measurement had taken 3.8 minutes for every subject, which indicates that the measurement by image technique needs a shorter time. Images of the subjects were captured using a digital camera. These images were fed to a computer and processed using Adope Photoshop program. Measurement calculations were transferred to Microsoft Excel program and equations were developed for size measurement.

Concerning the difference in size measurement values for both techniques, the results had shown no difference in these values. Statistical calculations including the mean, standard deviations and correlation coefficients were done to the values of the measurements for both image and manual techniques.

Keywords :Accuracy; Image technique measurement; clothing

INTRODUCTION

Human life permits, and in fact requires, that the human should be careful about his appearance, dress decently, maintain his dignity, and enjoy for the purpose of clothing. From the human life point of view, clothing has two purposes: to cover the body and to beautify the appearance. Verily, the clothing is to cover your shame as well as to be an adornment to you.

Clothing is one of the most intimate objects associated with the daily life of individuals, as it covers most parts of our body most of the time.

Consciously or unconsciously, our physiological/biological status and psychological/emotional feelings are closely associated with the clothes we wear. A significant proportion of modern consumers understand the importance of clothing and they demand apparel products with higher added values in terms of functional performance to satisfy various aspects of their biological and psychological needs in communication, protection, healthcare, medicine and sensory comfort during wear. Naturally, engineering apparel products for biological and psychological health has become an integrated part of the concept of bioengineering(Dai et al,2006).

Body shape and proportions may differ significantly. Body shapes vary not only from country to country but also within countries. It mightnot be feasible to construct a single set of body size which could be universally applied. What has been developed is a systematic format which is sufficiently open and flexible to cater for this variability applicable. This commonality will make sizes recognizable and comparable around the world (Wicks, 1991). Although the standards were reissued and updated periodically, manufacturers preferred having flexibility to change measurements quickly to suit consumer needs without reference to rigid standards (Simeon, 1973).

The goal of any sizing system is to choose size group in such a way that a limited number of sizes will provide ready-to- wear clothing which fit most individuals in the population. Although sizing system developed by different countries vary in the body dimensions chosen to divide the population, the basic structure of most sizing systems is very similar.

Therefore, sizing systems have to be updated from time to time in order to ensure the correct fit of ready-to-wear appareL Many countries have been undertaking sizing surveys in recent years. (Fan et all 2004).

Body image is a term which may refer to the perceptions of a human's, own physical appearance or the internal sense of having a body which is interpreted by the brain. Essentially a person’s body image is how they perceive their exterior to look, and in many cases this can be dramatically different from how they actually appear to others. The internal representation of one's own outer appearance, i.e. perception of ones own body, is termed body image. Body image is important as it is strongly related to self-esteem and the development of personality attributes. A positive view of one’s own looks may heighten one 's self-esteem and leads to bold, successful interpersonal or business ventures, whereas a poor view of the physical self may weaken one -s confidence. Research on body image can be traced back to the beginning of the twentieth century, when the association between body image and brain damage was identified by neurologists and neuropsychologists. All body scanning technologies use optical devices for non-contact measurements. Before the development of 3D methods, various types of 2D photographic

methods, such as silhouetter, were commonly used to present a complicated body profile. Since the 1980s, 3D body scanning technologieshave grown rapidly and they can be grouped into four categories: structure light, laser, infrared and photogrammetry (Fan et al, 2004).

The classical terminology and methods of body measurement for the clothing field were first published by the Joint Clothing Council. A standard reference for body measurements was later made available. Body stature, segment length, measurements were divided into four groups: body breadth and circumference. In 1996, Beazley suggested a procedure for undertaking a size survey using International Organization for Standardization (TSO) 8559: 1989 (E) which included a natural sequence of body measurement comprising three types of data: horizontal, vertical and others. (Beazley, 1997).

In the latter part of the eighteenth century, most clothing was custom- made by tailors. Various measuring methods were developed by professional dressmakers and craftsmen. Their techniques for measuring and fitting their clients were unique. In the 1920s, the demand for the mass production of garments created the need for a standard sizing system. In the 1930s, mail-order houses became popular. This led to frequent returns of ill-fitting garments. Hence, a large anthropometric survey of 10,042 women was conducted to develop a sizing system for women's apparel (Devarajan et al, 2002).

The recent technology utilizes image processing and modeling techniques for the digitization of the human body. In this case, 3D measurements are not performed, but 3D information is generated and extracted from 2D images. Two examples are described to explain this technique: the 2D full body scanner Contour of Human-Solutions and the face modeler of Singular Inversions. By the first example, three images of a person are acquired (two from the front and one from the side). By using the symmetry of the human body, the most important sizes of body are computed with sufficient accuracy from the silhouettes of the body. The extracted body sizes are used, in this specific example, for the production Technologies used commercially for the of made-to-measure dresses. digital measurement of the human body can be divided into five different groups. (a) laser scanning, (b) proj ection of white light patterns, (c) combination modeling and image processing, (d) digital manual measurement, (e) technologies based on other active sensors (Nicola, 2007).

Early in the fifteenth century, Leonardo da Vinci (Roshhem, 1997) was fascinated by the survey of the human body. The idea was adapted, and the methods were assimilated into the possibilities of today. since the late 1800s, anthropologists used tape measures and calipers which are still being utilized for measuring the human body (Detong et al, 1993). These methods are time consuming and often not accurate. Therefore, many researchers all over the world have directed their efforts towards obtaining more reliable measurements and 3D profiles of the human body using

various techniques. These developments are described here in three geographic categories: Asia, America and Europe.

During 1997-1999-2000, 2800 women from East, North and South China were surveyed up until 2002, using traditional Martin measuring techniques. Sixty-two body positions were considered and 12 body parameters were drawn of the female torso. A silhouetter and the American TC2 non-contact body scanner were also applied in the survey. A specially- made Voxelan 3D laser scanner was also installed in 2004 for the detailed measurement of the bust region. (Zhang et al, 2002).

The general objective is a digitization of the human body for more efficient measures and to develop personality attributes for clothing size.

The specific objectives are to commence anthropometric measurement with non-contact body, to decrease measurement period of time, to increase accuracy of anthropometric measurement and to compare between manual measurement and image technique measure.

MATERIALS AND METHODS

Materials

A random selection of fifty subjects (23 males and 27 females) were made for the purpose of experimental work. All the subjects are under graduate students of batch (27) in the Faculty of Textile, University of Gezira,

A measuring tape and balance were used for taking manual measurement for different areas of the human body and the weights of the students. A digital camera with its accessories was used in conjunction with a computer, associated with Adope Photoshop software (Cs version 8.0) and Microsoft Excel for the image measurements.

Methods

Manual measurements

The general data of each student gender was recorded and given a model ID together with his/her age and weight, and measurement of structure. Data from the front of human body as linear dimensions were measured by using the measuring tape and recorded for each subject manually for (height, shoulder, arm length, shoulder-to-hip length and waist-to-ankle length). Beside circumference measurements of (breast, waist and hip). Also the same measurement was taken from the side view of human body.

Image techniques measurement

The digital camera was calibrated and adjusted to actual picture dimensions of (195 x 126) cm. Front image was captured, while the side image was captured by rotating the body 900 (Fig. l). These steps wererepeated for fifty students.

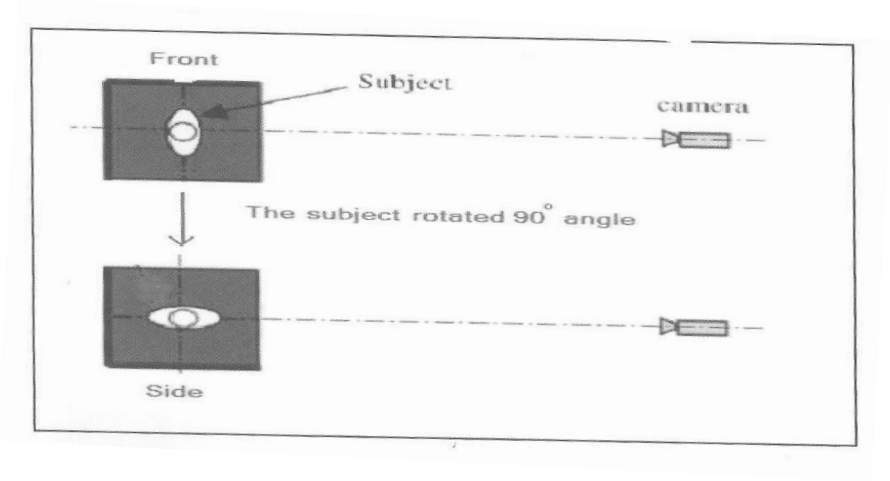

Fig. 1: Front and side views

The two pictures (front and side) were fed to the computer and processed by Adope Photoshop software imaging system. The front images were transferred to a new file in the program (Fig. 2). The same procedure was repeated for the side images.

The exact posture in space is captured after taking both front and side images simultaneously (Fig. 2 and 3).

Fig. 2: The open pictures (front and side) with Photoshop Software.

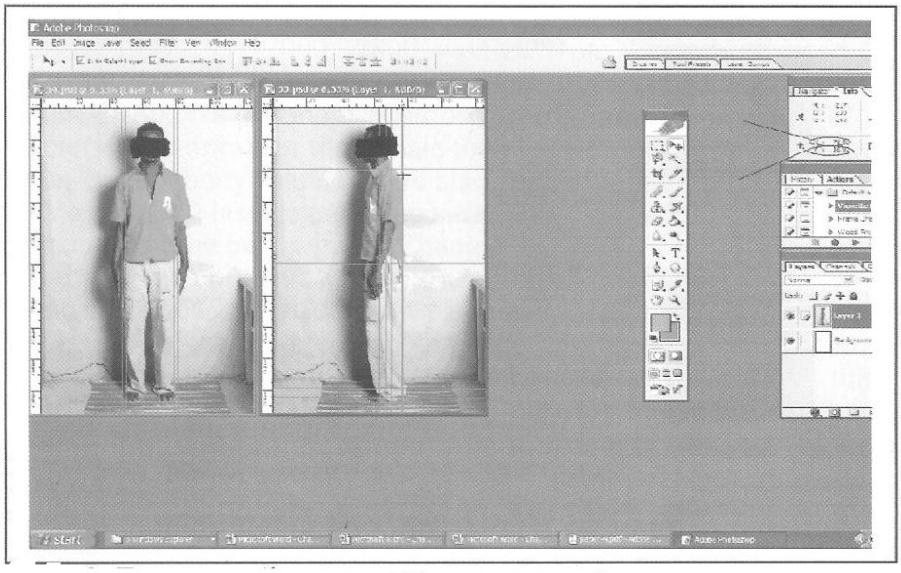

Fig 3 : Front and Side image with landmark

Reference to calculations

The location of the landmarks (Fig:4), were identified after image processing and landmarking. This is due to the cross-pairs, and the distance between the cross-pairs development (Table , 1)

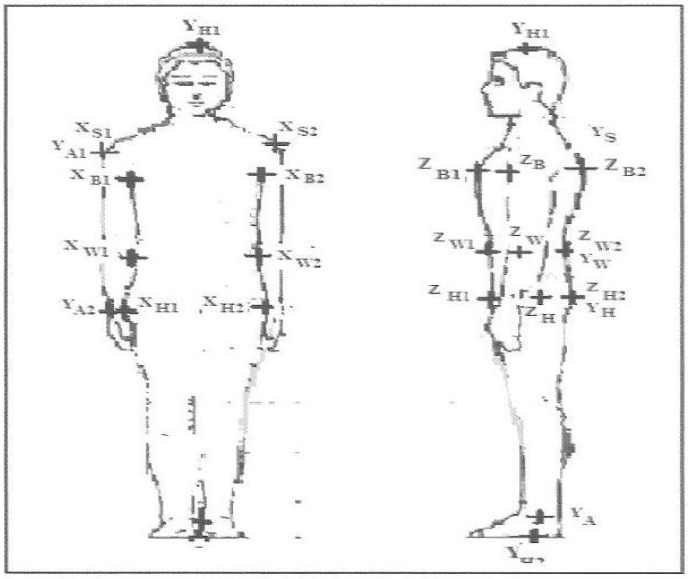

Fig 4 : Front and Side silhouettes with landmark

Table (l): The parameters to be calculated and the cross-pairs identified by subtraction and multiplication

Parameter	Calculating methods
Shoulder	$X_{S2} - X_{S1}$
Breast front	$X_{B2} - X_{B1}$
Breast half side	$(Z_B - Z_{B1}) \times 2$
Breast	$(X_{B2} - X_{B1}) + (Z_B - Z_{B1}) \times 2$
Waist front	$X_{W2} - X_{W1}$
Waist half side	$(Z_W - Z_{W1}) \times 2$
Waist	$(X_{W2} - X_{W1}) + (Z_W - Z_{W1}) \times 2$
Hip front	$X_{H2} - X_{H1}$
Hip half side	$(Z_{H2} - Z_H) \times 2$
Hip	$(X_{H2} - X_{H1}) + (Z_{H2} - Z_H) \times 2$
Arm length	$Y_{A2} - Y_{A1}$
Shoulder-to-Hip	$Y_H - Y_S$
Waist-to-Ankle	$Y_A - Y_W$
Breast full side	$Z_{B2} - Z_{B1}$
Waist full side	$Z_{W2} - Z_{W1}$
Hip full side	$Z_{H2} - Z_{H1}$
Height	$Y_{H2} - Y_{H1}$

The output data of this table for every model was built in a program From window with Microsoft Excel software (Fig. 5) and recorded the structure data (Elabid, 2009).

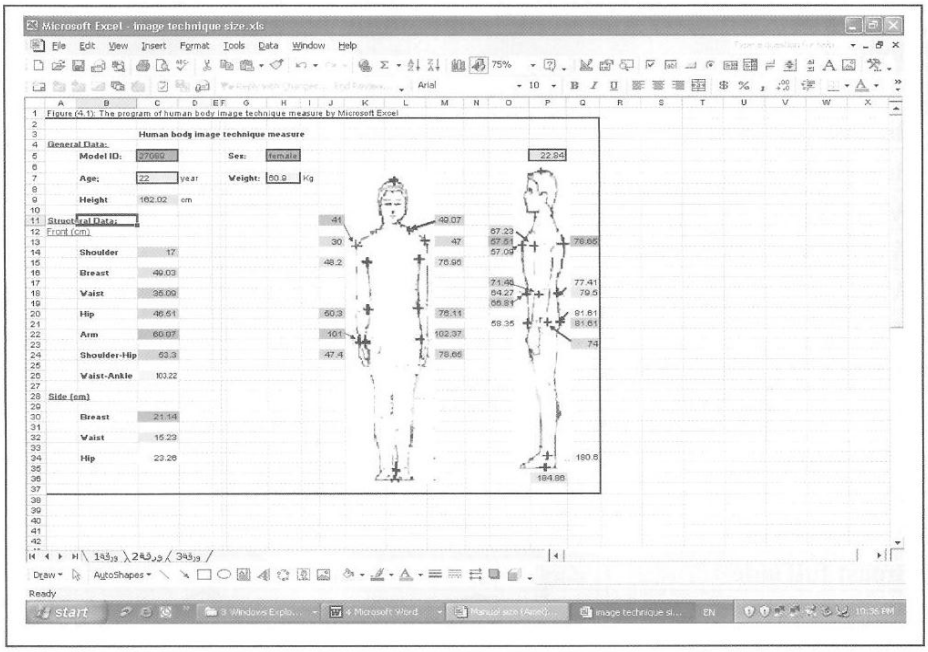

Fig. 5: Window with Microsoft Excel software

Accuracy assessment of image technique and manual measurement

The accuracy assessment of the image technique measurement for human body was assessed by comparing image technique measurement with the manual measurement for human body, taken by statistical analysis methods. The t-tests were performed to compare the means of all dimensions, and F-tests to compare the standard deviations. The means and standard deviation were calculated using the Microsoft Excel software.

Layout of image technique

The image technique can be found at each of the steps in the layout technique processes illustrated in (Fig. 6).

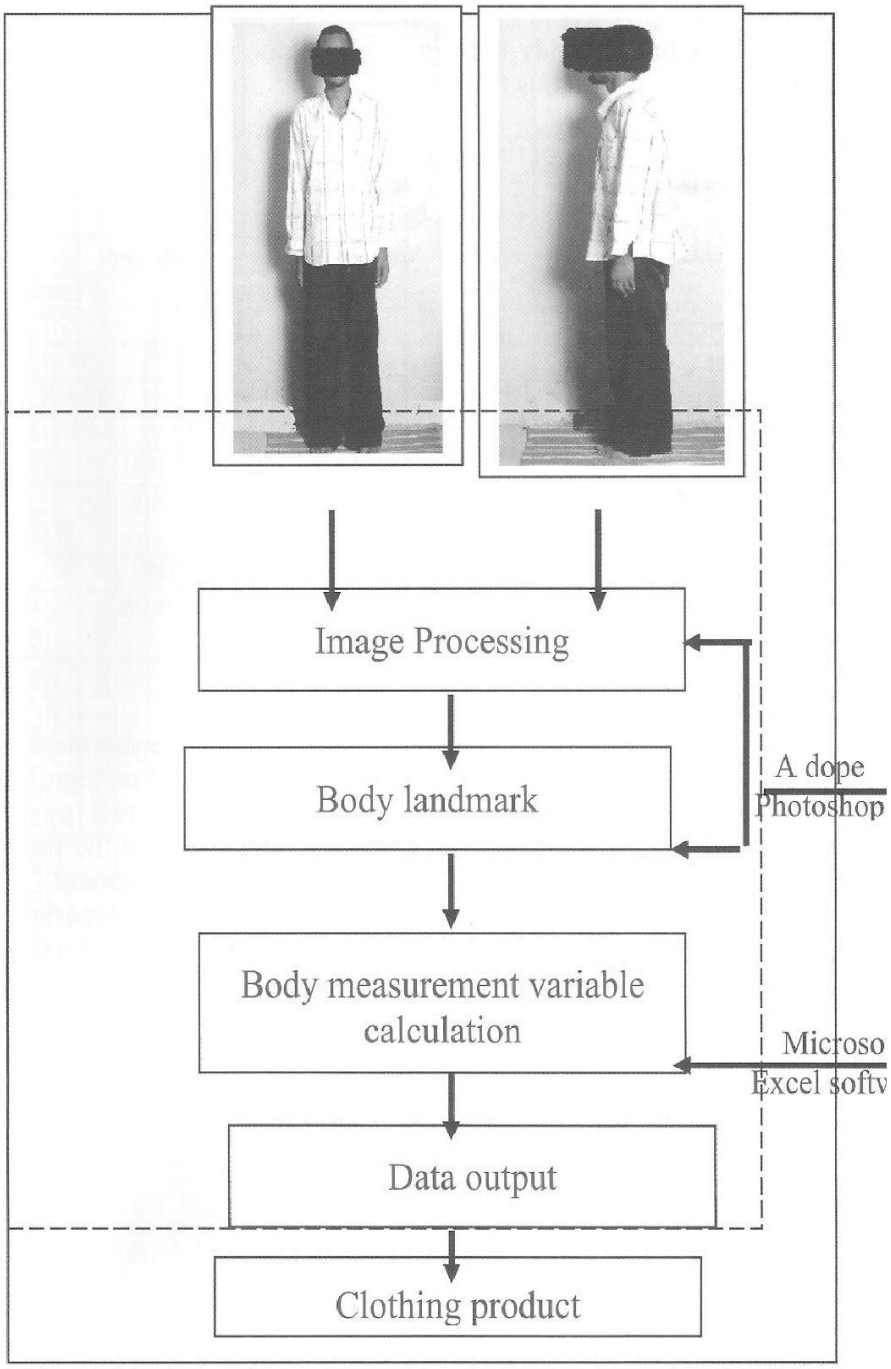

Fig. 6: Layout of image technique

RESULTS AND DISCUSSIONS

The results in Table (2), show that the image technique measurement for human body time is less than the manual measurement time, indicating that the time is decreased.

Table (2): The general data of the subject

		Subject	
		male	Female
Number of subject		23	27
Age range, year		21 – 25	20 – 24
Weight range, kg		46 – 84	42 - 87.6
length range, cm		161 – 183	149 – 170
Manual human body measurement time, min	Total	190	
	per subject	3.8	
Image technique human body measurement time, min	Total	48	
	per subject	0.96	

The results of t-tests applied for both, manual measurement and image technique measurement for human body size showed no significant difference between the two methods, indicating that the two methods provide similar result (Table (3)). This is not surprising since the indirect measurement methods of the image technique measurement were developed and optimized using the image technique. F-tests comparing the standard deviations and correlation coefficient of two types of measurements, also showed no significant difference, indicating that they were equally consistent in taking those measurements.

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Table 3 : The means, standard deviations, and correlation for the subjects measured manually and image technique

		Measurement		male			Female	
				Means	Standard deviations	Correlation	Means	Standard deviations
General data		Number of subject		23			27	
		Age, year		23.217	1.1661	-	21.96	1.19
		Weight, Kg		62.24	8.46	-	57.51	11.38
		Height, cm	Manually	169.26	6.39	1.004695	159.6	6.44
			Image technique	169.46	6.42		160	6.43
Structure data	Front (cm)	Shoulder	Manually	43.26	2.14	1.140187	38.63	2.06
			Image technique	42.92	2.44		38.87	2.06
		Breast	Manually	42.39	3.08	1.029221	43.91	4.02
			Image technique	42.55	3.17		44.31	4.03
		Waist	Manually	36.24	3.38	0.985207	34.81	4.08
			Image technique	36.4	3.33		34.81	4.06
		Hip	Manually	46.43	2.88	1.006944	48.37	4.65
			Image technique	46.52	2.90		48.6	4.62
		Arm	Manually	58.87	2.75	1.014545	55.19	2.39
			Image technique	59.11	2.79		55.36	2.36
		Shoulder-Hip	Manually	69.00	4.17	1.000000	54.41	3.14
			Image technique	64.20	4.17		54.22	3.29
		Waist-Ankle	Manually	98.83	5.35	0.990654	98.56	4.32
			Image technique	99.01	5.3		98.7	4.3
	Side (cm)	Breast	Manually	17.70	1.66	0.987952	20.78	2.12
			Image technique	17.93	1.64		21.1	2.15
		Waist	Manually	13.65	2.21	1.000000	14.04	2.8
			Image technique	13.85	2.21		14.33	2.76
		Hip	Manually	20.65	1.92	1.000000	22.89	3.56
			Image technique	20.88	1.92		23.11	3.54

CONCLUSIONS

The image technique using digital camera and processed with Adope Photoshop software, as well as Microsoft Excel were used, then the results of this technique compared with manual measurement showed no significant difference, indicating high degree of accuracy and precisions in measurement. From the accuracy and precisions analyses, it was found that, that technique under evaluation was capable of this performance.

In this technique, it is possible to obtain color information of the body texture, which is fitted to image of the human body from Adope Photoshop software and to use as guides to estimate structural data of the human body, recorded from a personal card.

This is all done without body contact, in a short period of time, safe, comfortable for the human and quite useful specially when the number of subjects is too much.

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