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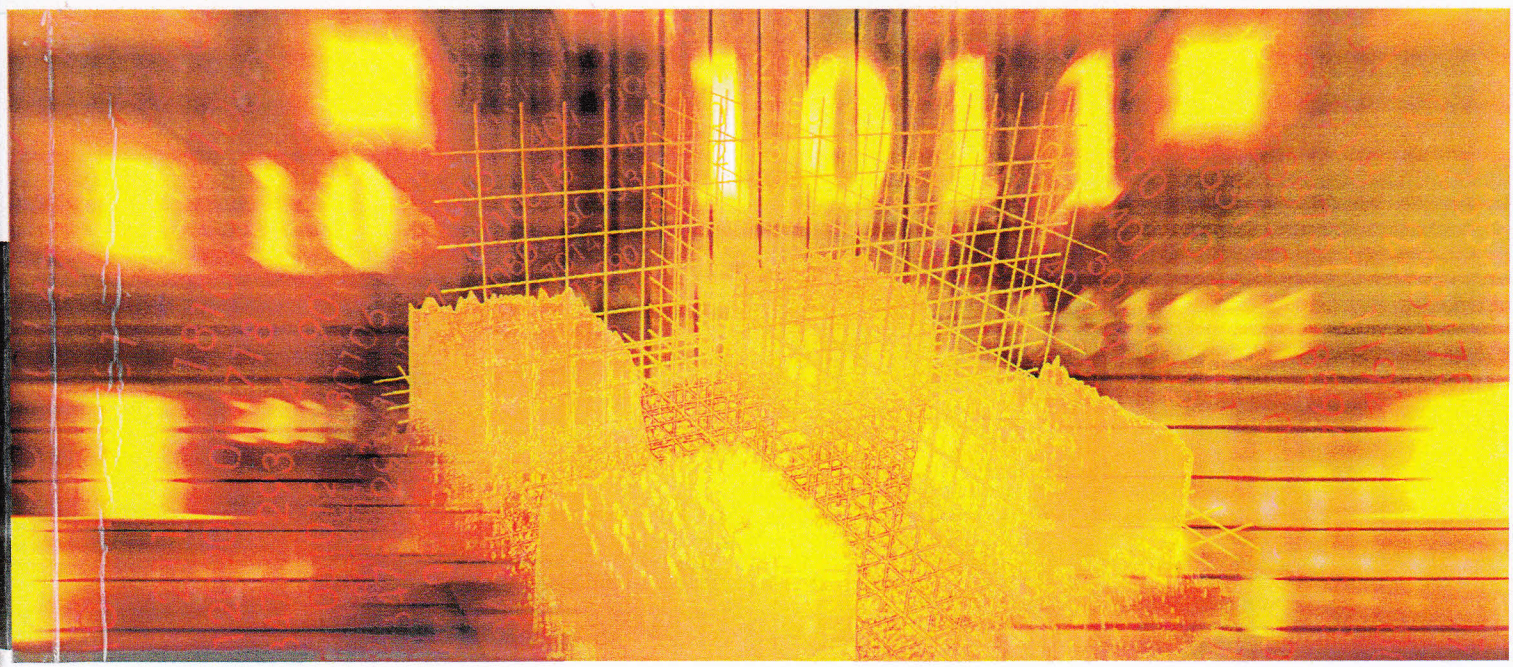

MYREN

NEW METHOD BASED ON IMAGE ANALYSIS TECHNIQUE FOR BREASTFEEDING POSTURE DATA COLLECTION

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ABSTRACT

Anthropometry data is a branch of ergonomic that must be embedded into product design to ensure comfort and efficiency. In order to maintain mobility for collecting anthropometry data, manual measurement method is always applied. This paper presents an automatic method that is flexible, cheap and fast to do data acquisition using image recognition system. The data collected were meant to be used in redesigning a compact (in size) support pillow for breastfeeding that is suitable for travelling. Subjects were 100 Malaysian working mothers from Klang valley. Data from the system were compared to manually measured data. T-test showed that there were no significant differences between the two system at $p<0.001$. It was also shown that the data were easily measured within a couple of days. It was concluded that image analysis system is a promising method that could replace 2D anthropometry data collection.

KEYWORDS

Antropometry data. Image analysis system, ergonomic measurement, breastfeeding support pillow

1. INTRODUCTION

Breastfeeding is not just about feeding an infant with breast milk, but it is also known representative to other things, among others; nurturing nature, knowledge and creation as well as the best comfort to the infant (Barlett, 2005). Historically, breastfeeding practices are influenced by the cultural practice of the mothers' background. However, in urban areas where education and awareness are more global, best practices are usually findings of researches from the Western. In Malaysia itself, Radzniwan et al. (2009) suggested that

although urban mothers' knowledge on breastfeeding was fairly adequate, there are still blur areas and misconceptions of breastfeeding that needs correction. There are many challenges faced by breastfeeding mothers especially the new ones. However, this study aims to focus on the hand and upper body postures while breastfeeding as well as during expressing breast milk that usually takes more than half an hours every time, twice or thrice times a day. Up till recent, there are no literatures regarding postures and musculoskeletal disorders can be found focusing on urban Malaysian career women. Back pain and musculoskeletal pain are common complaints of nursing mothers and this could degenerate osteoporosis during breastfeeding. Colson (2010) observed from her small case study, 9 out of 12 breastfeeding mothers feel pain and discomfort when breastfeeding while sitting upright. The struggle of latching while comforting a crying and hungry infant might cause a mother to develop an uncomfortable sitting or feeding postures. For a new mother especially, as long as the infant is quiet and happy, the mother will just succumb to whatever positions that she is in. As a result, she will develop back pain and other musculoskeletal disorder syndromes. Therefore, it is important that this issue is studied and tackled so that while breastfeeding is good for the infants, it does not threaten the mothers' wellbeing. Hence, a mother will not be demotivated and decide to quit breastfeeding after her first child.

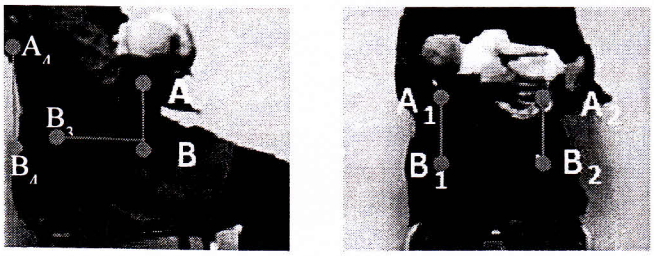
Consumers' expectation has gone beyond performance of the products. The latest technology had increased the option to broaden the ergonomic health and safety features in product design. However, it will also posed new risks and more complicated to manage it. Therefore, it is important for the product designer and manufacturer to utilize the available anthropometric data and ergonomic knowledge in making decision during designing of machines, equipment, products and systems (Matilla, 1996).

Lately, breastfeeding has regained popularity among Malaysian young mothers especially among the Malay community. UNICEF applauds Malaysia's Ministry of Health for its programs around breastfeeding which encourage mothers to breastfeed their babies exclusively for the first six months, and then continue to breastfeed while providing timely, nutritionally adequate, safe and responsively-fed complementary foods for two years or longer (Battlet, 2005). Many young and urban working mothers have now devoted the first and/or second years of their babies' age to expressing breast milk and direct breastfeeding. Many public places such as hospitals and shopping complexes have provided special nursing rooms for them. As a proof to the renewed trend, the emergence of many breastfeeding support group and breastfeeding products suppliers are also increasing. They supply breastfeeding support items such as electrical pumps and breastfeeding support pillow.

Support pillow is used to elevate the baby's position during breastfeeding so that the mother is sitting comfortably and not bending forward in an awkward posture. Observations from many baby products online stores, all the support pillows in the market are either imported directly from overseas or Malaysian made but using shapes as in US patent 5,029,351, (Weber, 1991) and patent US7,832,036B2 (Littlehorn et. al 2010). They are bulky and unsuitable for travelling. Further, the pillow was not designed according to the preferred posture and anthropometry of Malaysian women. Hence, a project that aims to redesign the support pillow for breastfeeding has been conducted. It involves an important part of the design process, i.e. the collection of anthropometry data which is usually performed through manual procedures. Since the manual procedures take time and is not flexible, therefore, this paper proposes a new method based on image processing analysis to perform fast and flexible data collection.

2. METHODOLOGY

This study involved two methods to collect the anthropometry data, i.e. the manual method and the proposed method based on image processing analysis. In the manual method, subjects sit down on the chair with a four old dummy baby used for breastfeeding consultation session. The numbers of subjects involved in this study was 100 Malaysian women. All of them are working mothers from few offices around Kuala Lumpur. Five defined distance parameters were then manually measured using a ruler and recorded for each subject. The five distance parameters are distances used to redesign the support pillow, which are previously defined as shown in Figure 1. Data obtained by manual method were used to be benchmarked for comparison purpose.



Distance Parameter (X)
x1 = dist(A_1,B_1)
x2 =dist(A_2,B_2)
x3 =dist(A_1,A_2)
x4 =dist(B,B_3)
x5 =dist(A_4,B_4)

Figure 1: Five distance parameters used to redesign the support pillow

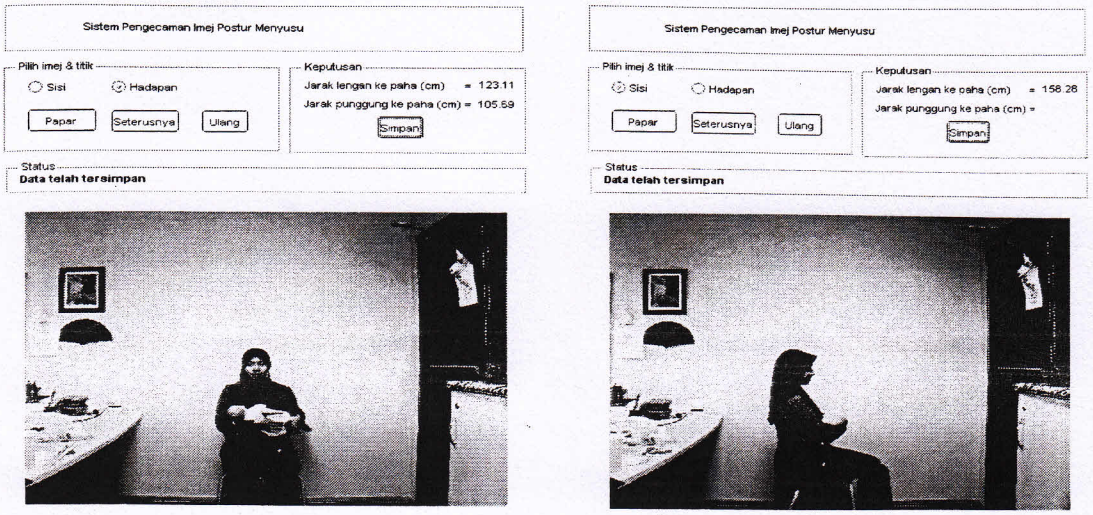
For the proposed method, the anthropometry data were collected using an image analysis system. Subjects sit down on the chair with a dummy baby and their images were recorded. Some conditions were set to be followed to ensure the images taken are valid and reliable to be measured by the image analysis system. Images must be snapped from two angles which are from front view and side view. The distance between the camera and the subjects must be consistent. The images obtained were then stored in the computer and processed using the image analysis system to determine the five distance parameters. These data were then validated by comparing them with the benchmark and analyze it with a statistical t-test. Detail of the image analysis system is explained in the next section.

3. IMAGE ANALYSIS SYSTEM

The image analysis system was developed to determine the distance parameters based on image processing analysis to redesign the support pillow. Figure 2 shows the interface of the developed system which is equipped with buttons to facilitate four aspects, i.e. selecting image, selecting points, calculating distances and storing distances. Generally, the software serves two modes of image view, i.e. front view and side view, which are shown in Figure 2(a) and (b) respectively. After selecting the view mode, user is requested to select an image in the selected view. The selected image is then displayed and user should select points on the particular locations following the defined points as shown in Figure 1. Once all points required were selected, the software directly calculates the distance and displays it in centimeter unit. The calculation of distance between two points A(x_A, y_A) and B(x_B, y_B) were calculated using the formula;

$$X = \sqrt{(x_A - x_B)^2 + (y_A - y_B)^2} \qquad \text{Eq. 1}$$

Since this calculation produces distance in pixel unit, the result must be converted to centimeter unit to obtain an appropriate size of pillow. The conversion from pixel to centimeter follows a normalization procedure using a reference object on the image taken. For these collected data, a length of 35cm of the reference object is equal to 60 pixels in the image taken. Therefore, distance between two pixels in the image is equal to 35/60 cm in the real situation. The software provides choices either user will select points on the next image or reselect points on the current image. Finally, the user is facilitated to save the result for further process.



(a) (b)

Figure 2: Interface of Breastfeeding Posture Image Analysis System

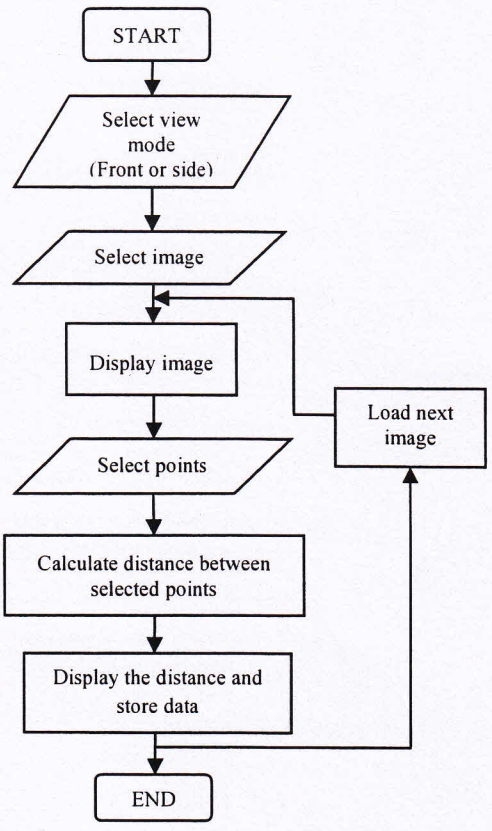


Figure 3: Flowchart of the software to compute the size of baby support pillow

Flowchart of the image analysis system is shown in Figure 3, depicts an overview of the overall system that outlines the basic structure. It consists of the following steps; selecting points and image, calculate distance, stored and display the distance.

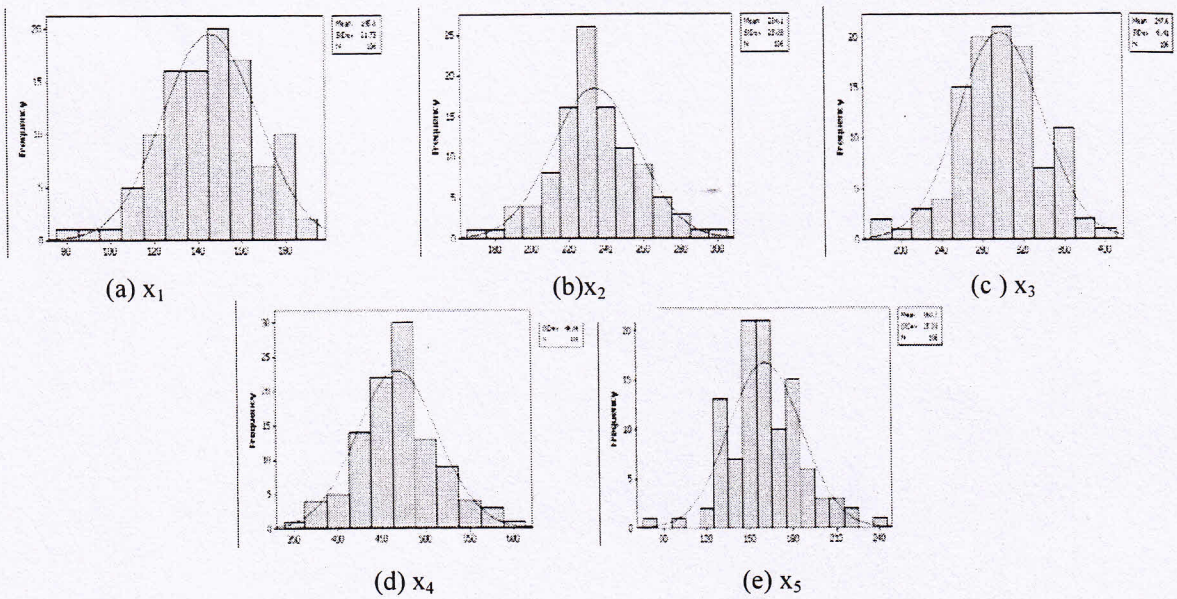
4. RESULT AND DISCUSSION

The results of the breastfeeding postural measurement obtained from image analysis system are shown in Table 1.

Table 1: Data For Breastfeeding Postural Measurement in Distance Parameters.

Distance Parameter (X)	*5th Percentile*	*50th Percentile*	*95th Percentile*	*Standard Deviation*
x1 = dist(A_1,B_1)	106	147	182	22
x2 =dist(A_2,B_2)	53	76	106	22
x3 =dist(A_1,A_2)	222	299	367	41
x4 =dist(B,B_3)	194	235	276	23
x5 =dist(A_4,B_4)	125	164	206	24

Data were analyzed for its normal distribution as shown in Figure 4 below, before further analysis was carried out. Distance parameter from 50th percentile was used as measurement for support pillow sketch as shown in Figure 5 below. The 50th percentile represents the average preferred posture and anthropometry measurement taken from 100 samples of Malaysian women. However, the dimensions suggested above can be varied to provide for a small or big person.



(a) x_1 (b)x_2 (c) x_3

(d) x_4 (e) x_5

Figure 4: Normal Distribution Plot for Distance Parameter

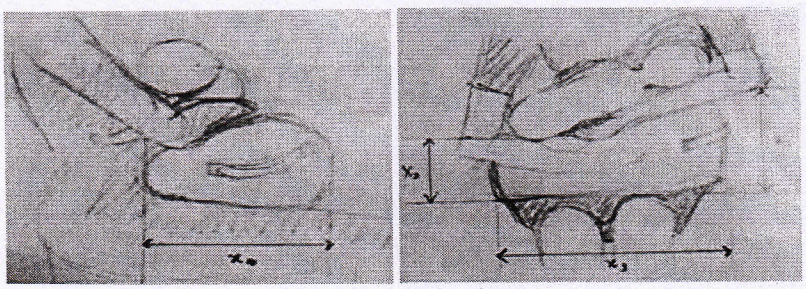


Figure 5: Support Pillow Sketch Based from Distance Parameter Measured

Data collected from the system were compared with manual measurement for example popliteal length. T-test analysis showed no significant different with ($p<0.001$) between the manual measurement and the data from image analysis system. The 100 data were collected within a few days only whereas the manual system requires at least 1 day just measuring a subject. The system does not only speed up the data collection process but also cheap since less human resources needed to do data collection.

5. CONCLUSION

The statistical analysis shows that there are no significant differences between the values from image analysis system and the manual measurement methods. In other words, the proposed method based on image analysis can be used for collecting breastfeeding posture angles in future postural angles measurement because as it could shorten the measuring process and avoid the hassle. The study showed that with the simple image analysis system, the hassle process of collecting data could be making simpler and faster.

6. ACKNOWLEDGEMENT

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