

Quantitative Analysis of Proportion Beauty of Women's Breast-Waist Based on the Non-Contact 3D BodyScanner Technology

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Abstract: The non-contact technology is a measurement of using forms such as computer technology, image, light and wave and so on. It has the features of measurement with fast speed and high accuracy. The experimental application of non-contact 3D Body Scanner technology, measured 5 female students, ages between 18 and 22 that in Tianjin Polytechnic University. Based on the breast and waist data analysis, and with the results of subjective aesthetic evaluation, finally it reflects the most beautiful range of women's Breast-Waist proportion in a scatter plot.

Keywords: non-contact 3D BodyScanner; breast girth; waist girth; aesthetic evaluation

As a woman, the body's curve is the best part of showing the beauty of female body. From the upper, breast and waist show the most female curvaceous, but slim waist, breast fullness, or a perfect human female is it? I do not think so. Half of the 16th century, girdle became popular in Western countries, women around the waist is about 40cm, which is called "wasp waist", but it is a deformity in the aesthetics, and also does not meet the aesthetic standards of modern humans. In fact the human body aesthetic is not only the grasp of degree, but also the grasp of proportion between the degree and the degree. Only when the ratio of body girth feeling, the body can produce the overall beauty and the integrated beauty between breast and waist should be the focus of women to pursue. The study was designed to draw the basic morphological characteristics between breast and waist, and will provide a Reference of proportion between breast and waist that meet popular aesthetic standards.

Observation and measurement is the two method of evaluation in human body beauty. The former direct but have a certain subjectivity, ambiguity, lack of scientific and quantitative, combining the two methods so they can complement each other, from the aesthetic or logical side, the experimental results are more scientific and accurate technology.

1. Non-contact 3D Body Scanner Technology

Body measurement, the static measurement technique is the most widely used measurement technique, into contact with body measurement and non-contact 3D Body Scanner. Because accurate measurement is particularly important in this experiment, so choose the latter as a measurement tool, this can avoid the body measurement data arising from a small, poor accuracy, measurement time is long, low efficiency which in traditional meas-

urement.

2. Experiment

2.1. The test equipment and samples

This experiment is used Lectra, from French company, a non-contact 3D BodyScanner, to collect the data of human body, which consists of Vitus Smart, a 3D laser body scanner hardware, and Scan WorX, a digital body measurement software. Vitus Smart 3D laser body scanner hardware system using laser scanning, and the system consists of four pillars, each pillar including two CCD video camera and a not hurt eyes of lasers. 8 CCD video camera of Vertical collects data points which associated with the human body from four angles by movement, then cope with the data and display the scan results to three-dimensional images by Scan WorX. They are shown in Figure 1 and Figure 2.

The experiments were measured five female students of Tianjin Polytechnic University by Random selection, they are from 18~22 years old, the body height is in between $165\text{cm} \pm 2\text{cm}$, the body weight in $55\text{ kg} \pm 3\text{ kg}$, furthermore birthplace and growth is in north China area. Because of their height and weight is relatively large proportion in the present of female students, also accord with relatively large public health standards, and that is the ideal body height and weight ratio for public. The data of this kind of crowd also guarantee the accuracy and scientific of experiments, conclusions will be more persuasive.

2.2. Measurement equipment and requirements

Because of this experiment is mainly study the relationship between breast and waist, so in the experimental process, they were only need to meet the appropriate

requirements of the experiment, and collect the two main data.

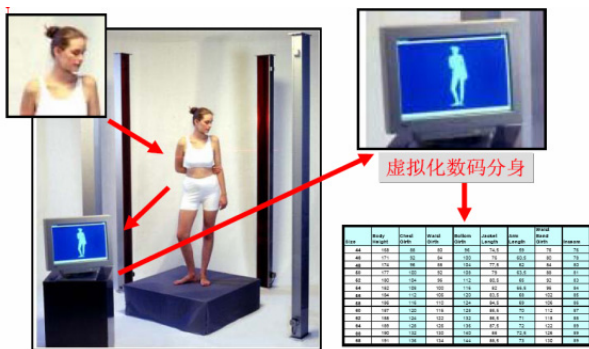


Figure1. Three-dimensional laser scanning hardware of Lectra

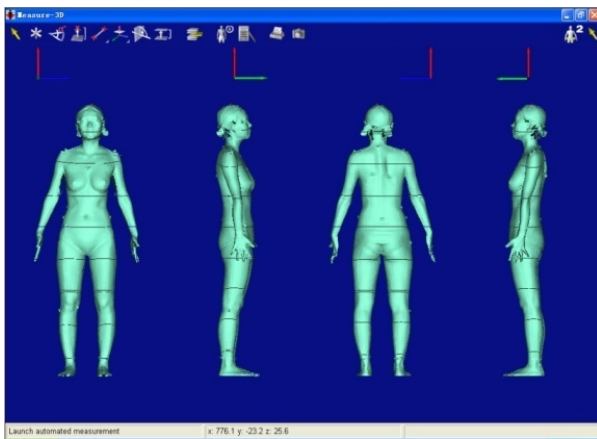


Figure2. Measurement Interface of Vitus Smart Software system

2.21 meter tall (measurements: Height measurement accuracy: 1mm)

2.22 bathroom scales (measurements: body weight measurement accuracy: 0.1kg Note: You must use the leverage scale)

2.23 non-contact 3D BodyScanner (measurements: breast girth and waist girth Accuracy: 2mm)

2.24 measurement cap: package head tightly, to ensure data accuracy.

2.25. dress requirements of testers

To ensure the accuracy of data, testers must wear uniform measurement cap, make sure all the hair inside the cap, with long hair should tie two shortest plaits and through the small hole measuring cap aside. Barefoot, wearing a thin light-colored bra without padding or without a bra, underwear waistband shall not exceed the hilar spot.

2.26 markers

Because the computer cannot completely identify the characteristic of natural body, therefore, must to stick markers in body in order to achieve fully automatic measurement of the computer. The experiment should stick mark points as follows:

Midpoint of breast: the midpoint in the left and right side joint which is in the third and the fourth Sternocostal.

The midpoint of the two nipples: the intersection of two nipple line in the middle line of body.

Waist point: the point of the fifth lumbar spinous tip.

2.27 Measurement position requirements

Standing position: Standing feet apart as wide as the shoulder, tiptoes align the horizontal of the measuring stage, feet inside align two vertical lines that parallel to each other, maintain a certain distance between hands and legs, trunk straight and head forward.

2.3 Measurement process

First, people enter the outer room of measurement room, take off shoes, hand their forms to measure their body height. Into the measurement room, change clothes, wear the hats, measure body weight, and stick markers, then enter the scan room. After scanning, back to the room and change their clothes. Leave the measuring room, Measurement process is over.

2.4 method of subjective evaluation

Because the experiment involving aesthetic aspects, so that the subjective evaluation is not negligible. In order to try to eliminate the deviation of the subjective evaluation caused by people's appearance, temperament, and dress, the experimental use of a 3D BodyScanner, simulate the 3D virtual human dynamic image from the front, side, back of the body. Let 10 college students from different grades (male and female each half of the ratio) make their aesthetic evaluation According to the samples' virtual image, the evaluation will more objective. From the picture, we can see the differences of various shapes between the breast and waist in the pictures evidently.

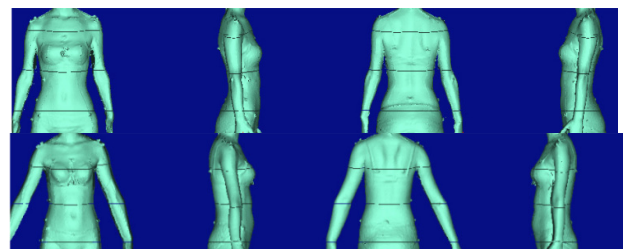


Figure 3. Comparison of two body Screenshots

Aesthetics is subjective feeling, it can be not directly measured by physical quantity, so the physical subjective feeling quantification, standards are shown in Table 1.

Table1. Subjective evaluation standard

Evaluation of subjective feeling	terrible	inferior	common	better	perfect
Estimated value of subjective feeling	2	4	6	8	10

2.5datas and statistical analysis

Since each observer scores in the experimental make the same influence, so take the average of 10 observers' score as the subjective evaluation scores in aesthetic aspects. The scores are in Table 2.

Table 2. subjective evaluation score table

Numbers	1	2	3	4	5
	7.5	8.5	7	6.5	6.5
	4	7	8	7.5	2
	6.5	7	6	7.5	6
	7	8.5	8.5	7	6.5
	5	8	7	6	4
	5	7	6	6	5.5
	8	6	8	6	6
	6.5	9	7	6	6
	4.5	6	6.5	6.2	4.2
	7	9	7.5	6	6.5
Subjective evaluation score	6.1	7.6	7.15	6.47	5.32

Through the statistics of each sample datas of breast girth and waist girth in table 3, obtain ratio of breast girth and waist girth, combined with the average score of subjective evaluation, and then summarize a comprehensive table.

Table 3. a comprehensive table

numbers	1	2	3	4	5
body height(cm)	165.2	163	164	165.1	164.6
body weight(kg)	51.3	54	53	53.2	55.3

breast girth(cm)	80.9	84.9	81.3	86	89.1
waist girth(cm)	63.1	64.1	61.6	66.3	70.2
ratio of breast and waist	1.28	1.32	1.31	1.29	1.26
Subjective evaluation score	6.1	7.6	7.15	6.47	5.32

According to the ratio of breast girth and waist girth from the table and the average score of subjective evaluation, then draw the Scatter in Figure 4.

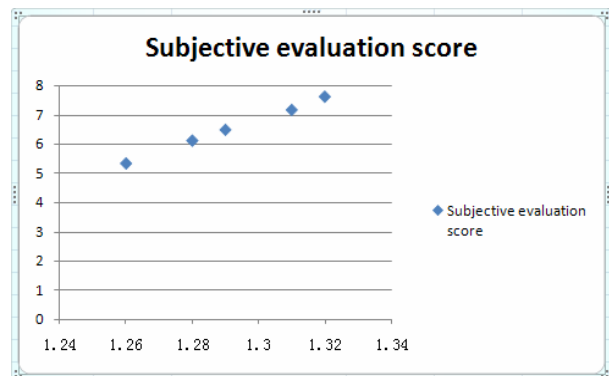


Figure4. Scatter

3. Conclusion

Through the experiments and analysis data can be obtained by:

- In the circumstances of randomly selected, through analyze the 5 testers' data, can mainly obtain that: when the ratio of breast girth and waist girth come up to 7.6, is meet the curve of breast and waist in popular aesthetic.
- Due to the limit in experimental data, the experiment data can be obtained only that: suppose the ratio of breast girth and waist girth is X, only when the X , $1.26 \leq X \leq 1.32$, the ratio of breast girth and waist girth and the degree of aesthetic are positive correlation.

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