

Constructing Thailand's National Anthropometrics Database using 3D Body Scanning Technology

Supiya CHAROENSIRIWATH, Piyawut SRICHAIKUL
National Electronics and Computer Technology Center, Thailand
supiya.charoensiriwath@nectec.or.th , piyawut.srichaikul@nectec.or.th

The SizeThailand project has now successfully completed Thailand's first national sizing survey using the 3D body scanning technology to obtain the body size and shape of 13,442 subjects. The body data collected was thoroughly analysed using a novel swarm intelligence technique to produce the national size charts which will help various industries in Thailand in designing and producing better fitting products for the Thai population. Running a sizing survey requires an enormous effort as it is a collaboration of the Government, major textiles organizations and retailers, academic institutions and other parties from interested sectors. Moreover, the success of the survey lies in the integrity and completeness of the data collected. This paper therefore presents the summary of the planning, the running and the results of the survey.

Background

SizeUK and SizeUSA pioneered the use of 3D whole body scanners for conducting national sizing surveys, and inspired similar surveys in France, Korea, Mexico, Brazil and Australia [1]. These national surveys were jointly funded by the government and the major national clothing & textiles companies; interested in measurement data for better fitting garments.

Prior to SizeThailand, four sizing surveys using only manual measurements had been conducted in Thailand. However, a comprehensive hand measuring procedure took around one hour per subject and therefore, with many thousands of subjects taking part, the data collection took a long time to complete. Furthermore, by using hand measurers, there could be problems relating to incorrect positioning and compression of the tape measure and hence, causing some measurement and transcription errors in the data.

To solve these problems, the National Electronics and Computer Technology Center (NECTEC) had reviewed and compared the procedures of the previous surveys with those of SizeUK. It was found that, by employing 3D body scanners, the survey could be conducted rapidly and accurately. More importantly, the captured 3D body data can now provide clear 3D visualization of body shape which, prior to this, had not been possible.

Planning and Preparation

SizeThailand was jointly funded by the government, 3 clothing retailers and an automotive company. In order to maximize the impact of the national sizing survey, a steering committee was formed to help in identifying the required body measurements and determining the statistical sample of subjects to be recruited. The committee comprised representatives from *the Government* (i.e. Thai Industrial Standards Institute, National Statistical Office, the Federation of Thai industries and the National Science and Technology Development Agency), *textiles organizations* (i.e. Thai Tailors Association, Thailand Textile Institute and Thai Garment Development Foundation), *clothing retailers* (i.e. Thanulux, Thai Wacoal and Tesco Lotus), *academic institutions* (i.e. department of Textile Science at Kasetsart University, nutrition division at Ramathibodi hospital, IT and Industry Pattern Development

Center) and an automotive company (Toyota Motors Asia Pacific Engineering & Manufacturing).

As it was not possible to measure everyone in the country, a statistically significant sample of subjects needed to be recruited. With the advice given by the national statistical office, the recruitment criteria for SizeThailand were *gender* (male and female), *age* (5 age groups: 16-25, 26-35, 36-45, 46-59, 60+) and *region* (5 geographical regions containing 13 data collection locations). The minimum number of subjects required in each cell to give an accuracy of ± 1 cm (stature) at the 95% confidence level is 189 [3]. Therefore, the minimum number of subjects required to represent the Thai population is 9,450. Therefore, throughout the data collection period, information on the subjects such as age, region of residence, socio-economic data, as well as size and body mass index data had to be continuously monitored in real-time so that those eligible would be chosen to take part. A real-time data monitoring and management system was developed specifically for this task, see fig. 1 and full details of the system can be found in [2].

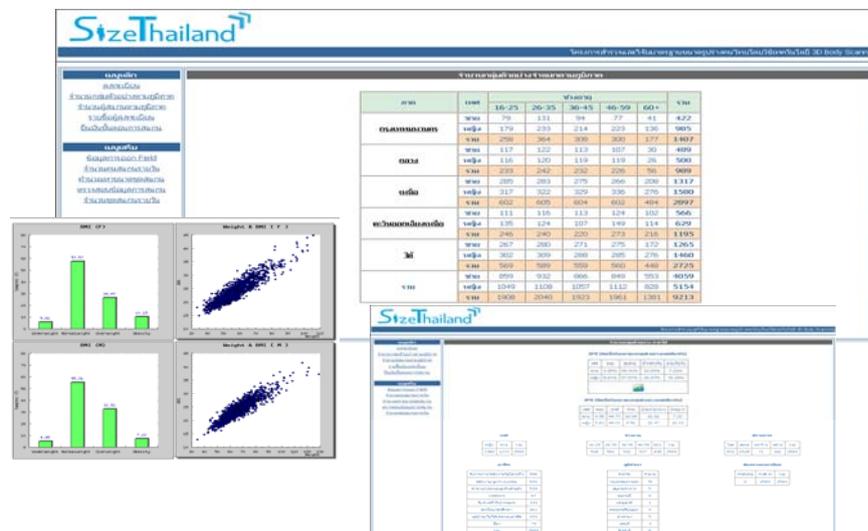


Figure 1: real-time statistical summary of the collected data

The 3D body surface scanner employed by SizeThailand, see figure 2 below, is based on a photogrammetry technique which works by projecting a series of white light stripes onto the subject and capturing the distortions of the light stripes by 12 CCD cameras. In less than 10 seconds per scan, the scanner is able to capture and recorded a highly accurate 3D body image, from which hundreds of body measurements can be extracted. Fig. 3 shows the 3D body data of a subject where the yellow lines display the measurements automatically obtained from the scanner.



Fig. 2: 3D Body Scanner



Fig. 3: 3D data obtained from the body scanner

Data Collection

At each data collection site, a data collection centre was set up as shown in fig. 4 below. For each volunteer, the data collection process, illustrated in fig 5, was broken down into 5 crucial stages: registration, hand measurement, 3D body scanning, questionnaire and gift collection.

Fig. 4: SizeThailand data collection centre



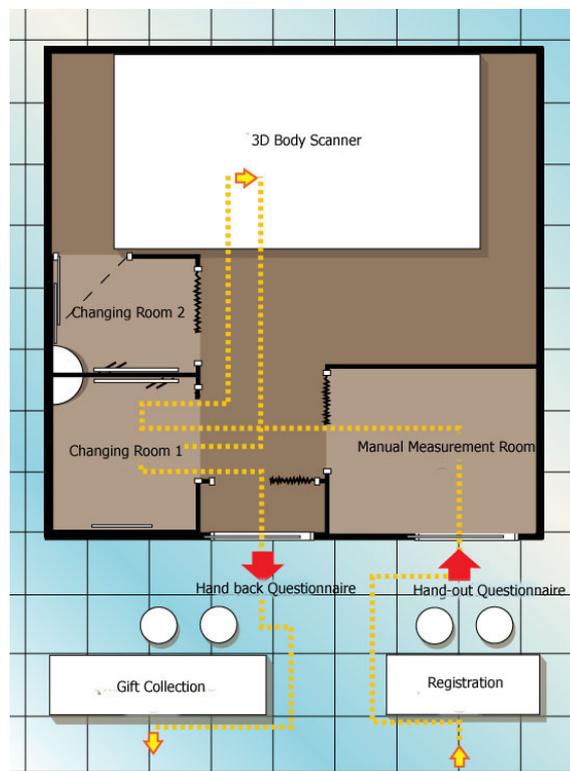


Fig. 5: 5-stage data collection

SizeThailand took 14 months to collect data in 5 regions of Thailand (Bangkok, Central, North, Northeast and South). One 3D body scanner was used in 14 different locations.

Results

A national anthropometrics database of the Thai population was constructed. In total, there were 13,442 subjects, aged 16 and over from 74 out of 76 provinces, taking part in the project. The information contained in the database includes over 140 body measurements, 3D body shape, together with demographic, health, eating and shopping lifestyle data.

Prior to SizeThailand, there was still no proper size designation standard (size charts) to determine the body sizes of the Thai people. Therefore, as one of the project deliverables, the body data was thoroughly analysed using a novel swarm intelligence technique to produce the national size charts as shown below in tables 1 and 2.

Size	Chest Girth		Waist Girth	
	inches	centimetres	inches	centimetres
32	31.0- 33.0	79.0-84.0	25.0- 27.0	64.0-69.0
34	33.0- 35.0	84.0-89.0	27.0- 29.0	69.0-74.0
36	35.0- 37.0	89.0-94.0	29.0- 31.0	74.0-79.0
38	37.0- 39.0	94.0-99.0	31.0- 33.0	79.0-84.0
40	39.0- 41.0	99.0-104.0	33.0- 35.5	84.0-90.0
42	41.0- 43.0	104.0-109.0	35.5- 38.0	90.0-96.0

44	43.0- 45.0	109.0-114.0	38.0- 40.0	96.0-102.0
46	45.0- 47.0	114.0-119.0	40.0- 42.5	102.0-108.0
48	47.0- 49.0	119.0-124.0	42.5- 45.0	108.0-114.0

Table 1: Male Size Chart

Size	Bust Girth		Waist Girth		Hip Girth	
	inches	centimetres	inches	centimetres	inches	centimetres
28	27.0- 29.0	69.0-74.0	22.5- 24.5	57.0-62.0	29.5- 31.5	75.0-80.0
30	29.0- 31.0	74.0-79.0	24.5- 26.5	62.0-67.0	31.5- 33.5	80.0-85.0
32	31.0- 33.0	79.0-84.0	26.5- 28.5	67.0-72.0	33.5- 35.5	85.0-90.0
34	33.0- 35.0	84.0-89.0	28.5- 30.5	72.0-77.0	35.5- 37.5	90.0-95.0
36	35.0- 37.0	89.0-94.0	30.5- 33.0	77.0-83.0	37.5- 40.0	95.0-101.0
38	37.0- 39.0	94.0-99.0	33.0- 35.0	83.0-89.0	40.0- 42.0	101.0-107.0
40	39.0- 41.0	99.0-104.0	35.0- 37.5	89.0-95.0	42.0- 44.5	107.0-113.0
42	41.0- 43.0	104.0-109.0	37.5- 40.0	95.0-102.0	44.5- 47.0	113.0-120.0
44	43.0- 45.0	109.0-114.0	40.0- 43.0	102.0-109.0	47.0- 50.0	120.0-127.0
46	45.0- 47.0	114.0-119.0	43.0- 46.0	109.0-116.0	50.0- 53.0	127.0-134.0

Table 2: Female Size Chart

References

- [1] Treleven, P. and Wells, J. "3D Body Scanning and Healthcare Applications" in *IEEE Computer Society*, Vol. 40, No. 7, pp. 28-34, July 2007.
- [2] Charoensiriwath, S. "A Real-time Data Monitoring and Management System for Thailand's First National Sizing Survey" in Proceedings of the Portland International Conference on Management of Engineering & Technology 2008 (PICTMET 2008), pp. 856-863, July 2008.
- [3] Wibultanun, B. "Statistically Significant Sample for SizeThailand". National Statistical Office. Confidential report for SizeThailand committee 26/12/2006.