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Design of Web Service-based tailored clothing mass customization system

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Abstract— In clothing mass customization, the size measurement paper-based documents and artificial categorization methods often lead to mistakes and more long period. To improve the efficiency of size measurement and categorization, this paper built a size categorization system for career clothing mass customization. It used a weighted and normalized minimum distance algorithm as well as the Web Service technology. By practical proved that the system has significantly reduced the time of categorization operations, avoided many mistakes. Through the Web Service interface, it can be established with different production management system connections..

Keywords- mass customization; size categorization; weighted and normalized; Web Service;

1. Introduction

As a corporate identity and culture of the manifestations, career clothing has been more and more attention. Wearing fit, excellent service is the customer's requirements for clothing manufacturers. "Tailored" has become the important trends in career and personal consumption of clothing. It also makes traditional clothing production gradually transformed into mass customization. [1]

Size categorization is an important prerequisite to achieve mass customization. Registration of large quantities of data, shape matching, adjusting, etc., in the traditional paper-based and manual mode, often have a long cycle, missing, repeat, and wrong filing phenomenon. [2] This has restricted the contract delivery and the quality of service, and been one of the bottlenecks.

In order to improve efficiency, reduce and avoid the occurrence of errors in the size categorization, and provide more information service, the tailored clothing mass customization system had been designed and built. It used intelligent computing, databases, and the scalable, adaptable Web Service technology[4]. The System will resolve the problems of data offline registration, fast size categorization, style review, production statistics, etc. It also provides size measuring management and service for the clothing production information management.

2. Algorithm of size categorization

China's current specifications standard of apparel is GB/T 1335-97. Male and female clothing specifications are divided into 4 body types - size Y, A, B, C , and have more than 200 basic shapes. These specifications have played a positive role in guidance on clothing production and sales [3]. For export

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enterprises, customers in other countries also have clothing size standards. Meanwhile, the enterprises also have their own clothing specifications standards.

Enterprises can not use excessive shapes. According to actual needs, they will form a resolution of the higher coverage size systems, which used only the basic measuring parts to determine the shapes [5].

To obtain a matching size NO, a man needs to search and compare from a large number of standard data To complete this cumbersome process, it must be on the form of body type judgment, and specification confirmation .

According to the manual process of matching size NO, the general clothing (jacket, pants, vest, skirt, etc.) body type, specifications stands can be converted to many two-dimensional value tables, like Table Ⅰ.

TABLE I. PANTS SIZE NO VALUE TABLE

NO	***Waist***	***Hip***	***T Crotch***	***V Crotch***	***Foot pants***	***Len***
44A	82	107	67.5	27.5	22.8	104
45A	84	109	69	28	23	104
46A	86	111	69.1	28	23.1	104
47A	88	112	70.2	28	23.1	104
48A	90	114	71.8	28.5	23.5	107
49A	92	116	72.6	28.5	23.5	107
50A	94	118	74	29	24	107
51A	96	120	75	29	24	107

In the table, the column is a measure of item (for example, in pants value table, the columns are NO, Waist, Hip, T-Crotch, V-Crotch, Foot Pants, Len). Each row is the standard values of a body style and specifications. There are m rows n columns. P_j is defined as the No. j size NO. H_i is defined as the No. i measurement item. Its standard value is C_i. The Standard size NO P_j can be expressed as:

$$P_j=f_b\ (\ H_1\ ,\ H_2\ ,\ \ldots\ ,\ H_i\ ,\ \ldots\ ,\ H_n\ )$$

The algorithm of measurement data categorization can be expressed as:

$$P_h=f_c\ (\ C_1\ ,\ C_2\ ,\ \ldots\ ,\ C_i\ ,\ \ldots\ ,\ C_n\ )$$

Where, f_c must contain f_b.

f_c calculation process is divided into the following three steps:

1) Determine the scope of a single measurement item categorization

For a single measurement value, the scope of its categorization is shown in Figure 1. Which, $H_n \leq H_{n+1}$. L and R represent the data points in the size standard left and right coverage of a range. Its value in the following formula ：

$$R_n = L_{n+1} = (H_{n+1} - H_n)/2$$

At both ends points of the queue for the size NO, the left and right values is same, L = R. For The overlapping data points have the same L and R values. Others have the different values. The points queue like figure 1.

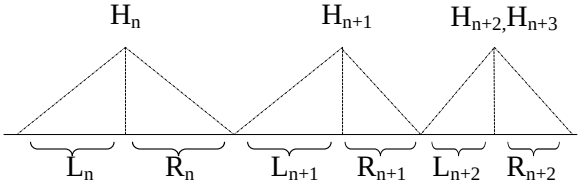

Figure 1.Categorizing range of size value

Therefore, any single measurement item number data structure by the three elements, said H_n、L_n、R_n. By sorting the collection H of a single item stand values, each available value (L, R) on the points will be calculated.

2) Normalize the value of single measurement item

The correlation between the measurement items are difficult to be calculated. In this paper, the normalized ratio of single measurement value and stand value was adopt as the distance value, In this paper, the normalized ratio of single measurement value and stand value was adopt as the distance value. If C_i is the value of single measurements and H_j is one stand value in H, the straight distance X_i is:

$$X_i = \begin{cases} (H_i - C_i)/L_i, & \text{当} C_i < H_i \\ (C_i - H_i)/R_i, & \text{当} C_i \geqslant H_i \end{cases} \tag{1}$$

3) The closest distance categorization

After all the measurements data were normalized, these values can form the distance matrix X to all measurement items and stand values. In the categorization, the weight of each single measurement item is different. After giving the weight value, a weight matrix W is to form.

$$X = \begin{bmatrix} X_{11} & \cdots & X_{1i} & \cdots & X_{1n} \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ X_{j1} & \cdots & X_{ji} & \cdots & X_{jn} \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ X_{m1} & \cdots & X_{mi} & \cdots & X_{mn} \end{bmatrix}, \quad W = \begin{bmatrix} W_1 \\ \cdots \\ W_i \\ \cdots \\ W_n \end{bmatrix}$$

The distance between measured value and the size standard values is:

$$G = X \bullet W = \begin{bmatrix} G_1 \\ \cdots \\ G_j \\ \cdots \\ G_m \end{bmatrix} \tag{2}$$

After substituting the formula 1, the distance between measured value and the NO. j, which named G_j, can calculated from the following expression:

$$G_j = \sqrt{(X_{j1}{}^2 W_1 + \ldots + X_{jn}{}^2 W_n)}$$

$$= \sqrt{\sum_{i=0}^{n} (Abs(C_i - H_{ji}) / iif(C_i < H_{ji}, L_{ji}, R_{ji}))^2 \times W_i}$$

Finally, by finding the minimum value of collection G corresponding to the NO., to get the customer size NO.

Wherever Times is specified, Times Roman or Times New Roman may be used. If neither is available on your word processor, please use the font closest in appearance to Times. Avoid using bit-mapped fonts if possible. True-Type 1 or Open Type fonts are preferred. Please embed symbol fonts, as well, for math, etc.

3. Design the system

In measurements customization work, an important prerequisite for fast categorization is to solve the data registration and synchronization problems. Meanwhile, at the job site, it should also provide clothing information services. Customer data can be registered at job site, and then synchronized with the production process management system database server.

For the job site constraints, customer data often can not be sent directly to the server. Therefore, the system used the desktop databases to build the offline client, and exchanges data with production process management systems by the way of Web Service. The system framework is shown in figure 2.

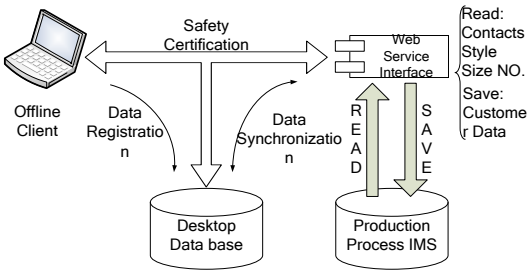

Figure 2. System framework

Offline client is tailor's operating software at job site. Its functional structure is shown in Figure 3.

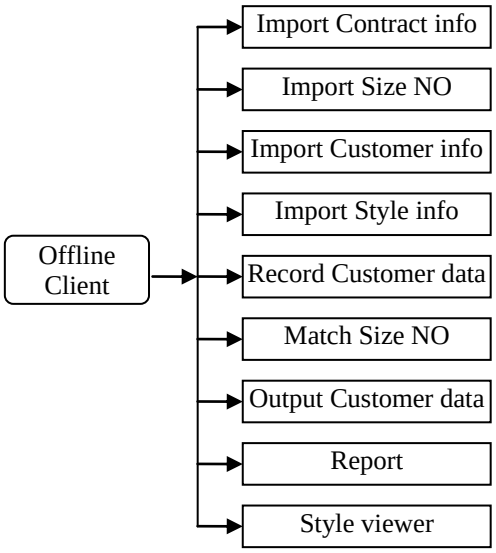

Figure 3. offline client's functional structure

Web Service provides a wealth of data exchange interfaces in the system, such as searching contract information, styles and shapes, saving customer data, etc. It provides off-line client relevant contracts, styles, shapes and other data, and sending customer data to the production management system. During data exchange, the safety certification is needed.

Applied Web Service for the system brings the possibility of expansion, so that it can be well integrated with different production management systems.

Part of the desktop database entity relationship design show in figure 4, which is designed by the Erwin, be created in Access.

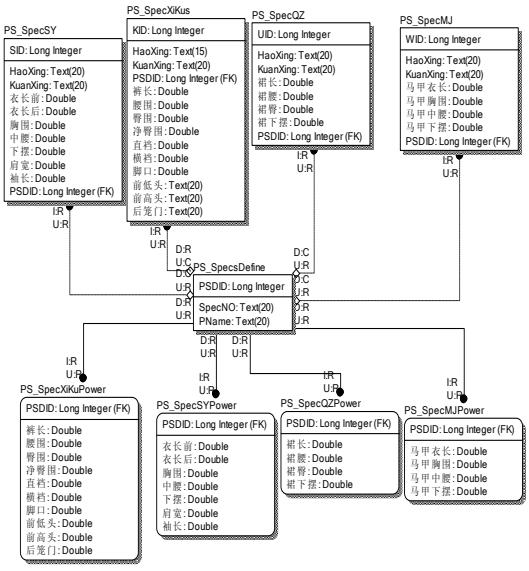

Figure 4. Part of the desktop database ER design

One of offline client's user interface is shown in figure 5.

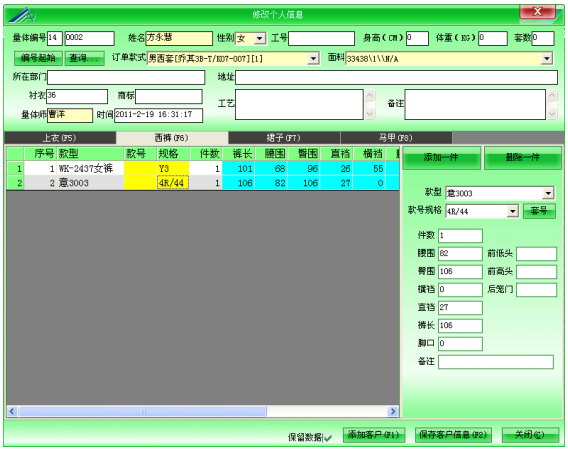

Figure 5. One UI of client

4. One Application Case

In one large clothing enterprise, tailors recorded customer data by paper-based document. And then they typed the data into computer, matched size NO manually, printed washing tag and cut size bill.

For a customer contract with 1200 customers, an employee often requires 5-7 working days at manual categorization mode.

After using this system, the categorization operation time only needs 1-2 hours, and has almost avoided the leakage and reintegration errors. Through the Web Service integration, the measurement jobs are done more smoothly with production management system. It provides the basic data in mass customization of garment production and management, such as procurement, cutting, sewing, and packaging process.

5. Conclusion

"Using modern technology to transform traditional industries" is the only way to improve development of garment industry. This system used computer technology to change traditional paper-based manual matching mode, and greatly reduced the operating time. It provides the foundation for garment mass customization business and high-quality services.

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