



## The Application of 3D Digital Technology to Fashion Design

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### Abstract

With the development of China computer technology and social economy, the requirement to the quality, the fitness and individuation is higher and higher, and the present two-dimensional garment CAD technology has not fulfilled the requirement of CAD application in the garment industry, so the garment CAD urgently needs to be developed from the present panel design to the 3D design. Therefore, in recent years, many theoretical researches and practical applications of 3D body measurement, 3D garment assistant design and dummy garment design occur in domestic and foreign markets.

**Keywords:** 3D digital technology, 3D body measurement, 3D garment assistant design, Dummy garment

With the development of China computer technology and social economy, the requirement to the quality, the fitness and individuation is higher and higher, and the present two-dimensional garment CAD technology has not fulfilled the requirement of CAD application in the garment industry, so the garment CAD urgently needs to be developed from the present panel design to the 3D design. Therefore, in recent years, many theoretical researches and practical applications of 3D body measurement, 3D garment assistant design and dummy garment design occur in domestic and foreign markets.

According to the statistic of whole application to CAD by the Autodesk Company, at present, users who use 3D digital technology to design product have achieved 30% in the world, and 70% of user still use two-dimensional CAD to design product. In fact, 3D digital technology has been fully applied in the world, but in the domain of garment, the development and application of 3D digital technology are still lagged, because the garment is different to the solid-state product in mechanical industry or the electrical industry, and its character is soft and it will change with the different of environmental condition, so the simulation is very difficult, especially if the garment CAD wants to transform from two dimension to 3D, it needs solving many problems such as the representation of fabric texture and innervation, 3D reconstruction, living and flexible conk sculpt, and the translation from 3D garment design model to two-dimensional plane clothing. And these problems induce long development period and large technical difficulty of 3D garment design.

The difference between garment 3D digital technology and two-dimensional CAD is that the former is based on the body data model through 3D body measurement, and implements interactive 3D design to the model, then makes plane clothing, which mainly solves problems including the establishment and the local modification of body 3D size model, the archetypal design of 3D garment, the cover and shade treatment of 3D garment, the effect display of 3D garment especially the dynamic display and the reversible conversion between 3D garment and plane clothing.

The base of 3D garment digital technology is the 3D body measurement. At present, 3D body scanner system has realized commercialization in foreign countries and its technology has been mature, and using the grating principal of natural light, France, US and Japan can complete the measurement of 3D body data respectively in 40ms, 10s and 1.8s. The international usual 3D body measurement technology is interactive, which catches the image formed by the light shooting on the body through photosensitive equipment, and describes the 3D body characters through the computer image treatment. The 3D body scanner system possesses many advantages such as short measurement time and large data obtainment better than traditional measurement technology.

The interactive 3D whole body scanner system possesses many advantages such as rapid measurement speed, small error, and more measurement data. Through CCD vidicon and infrared imaging technology, combining with light filtering technology, it incepts and saves body image, utilizes the computer image processing technology to pick up the body real figuration in the body image, and then comprehensively operates several body real figurations to obtain needed 3D data which can reflect the 3D body structure character. The 3D body structure data auto measurement system is composed by control lamp-house, vidicon, computer and monitor, which characters include that the image incepted by the vidicon is transmitted to the computer and stored in the special space of the computer as the data form, and under the control of application, the computer analyzes and operates the input digital image signal and utilizes body figuration incepted from different views to compose needed 3D bogy structure data, and then the data in the computer are

transmitted to the monitor through the conversion of the image card, and the image transcribed by the video tape recorder is also transmitted to the monitor, the work situation of the whole system can be watched through the monitor, and the monitor displays the incepted 3D body images, and the computer controls the lamp-house, vidicon, video tape recorder and their transformation, and the isochronous control among different parts in the system is completed by the application of the computer, and the design of the application is based on the image edge treatment technology and the image segmentation technology.

The whole body scanner technology of the interactive 3D whole body scanner system catches the image formed by the light (including laser, white light and infrared ray) shooting on the body through photosensitive equipment to describe the 3D body characters. The international usual body scanners include SYMCAD, Turbo Flash/3D, TC2-3T6, TechMath-RAMSIS, Cyberware-WB4, Vitronic-Vitus and so on. The interactive 3D scanner system has many advantages such as short scanning time, high precision and more measurement parts better than traditional measurement technology and equipment. For example, the Germanic TechMath scanner can complete the scanning process in 20 seconds, which can catch 80000 data points of the body, and obtain 85 size values relative to the body, and its precision  $< \pm 0.2\text{mm}$ . American TC2 can scan 45 thousands points of the body to quickly obtain more than 80 data of the body, which can completely reflect the bodily form. English TuringC3D system also can catch the surface material and describes the color and texture of the object, which is very useful to study the labeled object. The output date through scanning can directly be used in the fashion design software to customize clothing according to the body. At present, the body scanner is abroad applied in many domains such as the anthropometry, the garment industry (MTM customization system and dummy fitting), the amusement industry (such as movie stunt), computer animation and medicine (such as prosthetics and modeling operation).

Through pivotal body geometric parameter data obtained, the 3D body measurement builds dummy 3D body and establishes static and dynamic body models, and forms a complete set of system which has the functions of dummy body display and dynamic simulation. Based on that, the 3D garment assistant design creates 3D effect of the garment material, realistically displays 3D color image of dressing effect and approximatively translates 3D design into the plane clothing on the screen.

The 3D garment assistant design is based on the body model obtained by the body measurement, implements interactive 3D design on the "true man" through the reappearing of "real man" (outlining the figuration and structure line on the human model by lines), and builds plane garment sample combining with corresponding software. It also can offer quick and convenient research project for the series design of the garment sample and the establishment of the original model. The method of 3D garment assistant design is implemented through following steps.

(1) Establish 3D manikin data base. (2) Establish 3D data base of the garment style and size, and the figure and size of various parts. (3) Establish garment cloth and color data base. (4) Establish 3D data base of the garment vignette and decorated parts. (5) Establish the data comparison between the body data and manikin data and select the program most closed to the manikin to store in the memorizer. (6) Translate the garment style in the 3D data base of the garment style and size, and the figure and size of various parts into the plane on the background composed by the pane figure which can confirm the longitude and the woof of the coordinate position and form a program with garment style plane chart and labeled data, and store them into the memorizer. (7) Translate the selective garment style into the same program of the selected cloth and color in the garment cloth and color data base and store in the program memorizer. (8) Store the data of pane figure composed by the confirmed longitude and woof and the program which matches with the manikin data into the program memorizer. (9) Dress the selected garment style on the manikin adding the sewing size, and form a program of a 3D antitype labeling size and store them into the program memorizer. (10) Store the program which can change relative data when modifying some certain data in the garment style deployment figure and labeled data, and selected garment style on the manikin data in the program memorizer. (11) Collect and input some one's body data including stature, three sizes, leg length, shoulder width, arm length, neck girth, neck length and leg girth. (12) According to someone's input body data, computer selects the closest manikin in the manikin data base. (13) Select a garment style in the data base of the garment style and size and the figure and size of various parts, and according to the selected garment style and the garment which matches with the manikin, CPU dresses it on the manikin, and create a 3D antitype figure which the selected model dresses the selected garment. (14) Select cloth and color in the garment cloth and color data base, and select the vignette and decorated parts in the garment vignette and decoration data base, and then create a 3D fitting effect figure which the selected model dresses the garment with selected cloth, color and vignette. (15) Create the deployment figure of the selected garment with sew size and labeling data. (16) Modify and confirm the size on the 3D fitting effect figure or the deployment figure, and correspondingly change relative data of 3D antitype figure and deployment figure and obtain confirmed 3D fitting effect figure and the deployment figure. (17) Connect the output port of the computer with printer or the auto cutting machine, and print the model of the cutting garment or directly cut the cutting slice of the garment.

To translate 3D garment model into plane cloth pieces, it comes down to the technology that deploys the complex space

to the conk surface, which is the requirement of flexible and plane characters of the garment material, and the difficulty of 3D garment assistant design. Foreign and domestic scholars have done many research works and obtained many methods of flexible conk surface deployment, and many methods have been applied in the practice.

The 3D design based on the plane CAD is gradually developing to the direction of intelligence, material analysis and dynamical simulation and the direction of 3D line frame sculpting, conk surface sculpting, entity sculpting and word meaning character, and the parameter design is developing to the direction of variable and super variable. The research and application of parts development technology also offer bases for the opening and the function free assembly of the CAD system.

The attention of the 3D body measurement system is to offer the 3D body structure data matching with “3D garment assistant design” and “dummy fitting”.

The garment dummy show is to create dummy body or model in the computer, exhibit series garment style or decorations matching with it and the customs can select the garment style, color and decoration to arrange in pairs or groups according to their favors. The present computer fitting system possesses complete fitting garment base including male western-style clothes, male fashionable dress, female fashionable dress, female suit, occupational suit, Chinese style dress and children dress, and the custom can add new style at will with the change of the fashion. The real and exquisite fitting textures include knitting, tatting and printing, and the system can scan the real texture in the computer to offer selection for the customer. The system only inputs customer’s image into the computer through digital camera, the auto fitting can be completed, which can conveniently assist customer to select the style quickly and directly. The selected style can be automatically switched using the cloth in the cloth data base, and changed its color at will, and the original sculpting of the garment would not been changed. Some products in foreign country can basically realize the functions of dressing of 3D garment, matching design and modification, the animation effect which can reflect comfort and sport character of the garment, 3D overhanging effect which can simulate different clothes and all directional rotation. The 3D garment CAD software developed by US, Japan and Switzerland is advanced, such as the CONCEPT 3D garment design system developed by US CDI Company, 3D system of French Lectra Company, AM-EE-SW 3D system of US Gerber Company, 3D system of Canada PAD Company, 3D system of Japan Toyobo Company and so on.

With the quick development of internet in recent years, the network garment design is gradually becoming the mainstream. The virtual fitting room is a sort of interactive platform which applies the garment electrical business. With the flourish development of electrical business technology, internet is gradually becoming a noticeable sales channel in the garment industry. To fit dress conveniently and really on the internet, the appearance of the net virtual fitting room is the necessary tendency. The virtual fitting room offers a real-time interactive platform for the customer, and it allows customer selects his favor in various garments and fits the selected dress on the dummy model. New virtual fitting system can realize the net-based 3D fitting on the network. The net-based 3D fitting system offers a sort of method which can create and display 3D garment model with third dimensional texture, and the customer can freely select the style of the dummy garment and define the size of the garment himself through a real-time interactive platform (i.e. the net-based 3D fitting system) inside the browser. At the same time, the customer can select the dummy model who matches with his body, and the fitting system can dress the dummy garment on the model and implement rotary display. This design is based on the garment simulation technology, and constructively exerts the garment operation technology to the dummy fitting room under the premise without damaging the convenience of the dummy fitting process.

The application of 3D digital technology in the garment industry has only tens years, but it can gradually applies its special advantages to the design and research of various products correlative with body, and really makes the product people-oriented. In the garment industry, it expedites the reactive speed of the enterprise to the market. At the same time, it is the necessary condition and important reference to develop the garment electrical business and it closely combines the garment production with high-technology, makes the garment production and design more individuation, enhance the fitness of the garment, and fully drives the rapid development of the garment industry.

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