Development of Fashion Design System Based on Virtual Reality Technology

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Abstract. With the development of social productivity, computer technology has been widely used in various industries, improving the efficiency of enterprise production and management. In order to improve the efficiency of clothing design, based on the current clothing CAD technology, this research proposes a clothing design system using virtual reality technology. In order to realize the virtual reality function in the system, this system uses VRML language to design. Clothing design requires that the curve of the clothing fits the real human body, so this system provides the user with a parametric avatar model, which is convenient for the user to design based on the human body structure. The virtual clothing design system constructed in this study can provide a good design platform for clothing design, improve the efficiency of clothing design, reduce the cost of clothing design, and have good practical value in the field of clothing design.

Keywords: Virtual Reality Technology · Modelling · Clothing Design

1 Introduction

Nowadays, many product designs are realized through computer technology. Product designers can realize the design of objects and buildings through modeling on the computer. Designers design items by modeling on the computer, which can simulate the state of the product in different situations, and can simulate the final display effect of the product. Virtual reality technology has also gradually entered the field of computer design. Since the advent of virtual reality product design technology, many product development cycles using this technology have been shortened and excellent results have been achieved. But today's clothing design still uses traditional methods to design, mainly because in the process of clothing design, it is necessary to make the radian of the clothes fit the human body, which has higher requirements on the design system. In the process of clothing design, the designer needs to put the fabric on the bench for sewing to show the effect of the final product. If the effect is not good, the previously used fabric will be discarded, and this pattern of clothing design creates a lot of waste. The clothing industry is one of the most important sources of pollution in the world today. In order to reduce waste in the process of clothing design and improve the efficiency of clothing design, this study proposes to apply virtual reality technology to clothing design. The clothing design system based on virtual reality allows designers to realize their ideas

on the computer and simulate the effect of clothing in different scenes. Virtual reality technology has a very important use in clothing design.

2 Virtual Reality Language VRML

Virtual reality technology has developed rapidly since the 1990s, and now it has become the most promising technology in the computer field [15]. Virtual reality technology is a computer system that can create and experience virtual worlds. The virtual environment in virtual reality technology can bring visual, auditory and tactile experiences to users, allowing users to feel immersive. In a virtual environment, users can interact with the virtual environment [16].

Nowadays, most of the virtual reality dynamic models are constructed using VRML language. VRML language is a modeling language that can describe 3D objects and behaviors of 3D objects, and can further build virtual worlds. The VRML language can integrate various forms of media resources such as text, images, audio, and video, and can use languages such as Java and ECMAScript inline [1].

VRML is accessed based on a client/server model [8]. The server in the system provides VEML files and supporting resources. The client downloads the target access file on the Internet, and accesses the virtual world described in the file through the VRML browser on the local platform. This virtual world has interactive functions. Since the browser is provided by the local platform, the operation of VRML on the computer is not constrained by the platform, and one compilation can be executed in multiple places [7] (Fig. 1).

VRML uses the scene graph data structure to build 3D reality [2]. The scene graph data structure is a data format based on the Open Inventor3D toolkit. VRML's scene graph has a node hierarchy of real-world static features, such as materials, textures, textures, lights, viewpoints, geometric relationships, and nested structures. VRML files include file headers, comments, nodes and their fields, events, routes, and more. These contents describe the virtual time in detail. VRML is used in this system [12].

VRML has platform independence, high-speed network transmission, real-time and scalability. These characteristics of VRML make VRML have advantages in virtual reality technology.

The platform independence of VRML is reflected in that the access mode of VRML is based on C/S mode. The server provides VRML files, clients download the files they want to access through the network, and access the virtual world described in the files through the browser of the local platform. In this process, there are certain requirements for the browser of the local platform, and the browser must contain a VRML browser plug-in to allow customers to access the virtual world. The VRML file contains the logical structure information of the virtual world, and the browser can display the virtual world according to this information, and let the user experience the interactive function of the virtual world. Since the native platform provides the browser in the process, this achieves the platform independence of VRML [6].

The high-speed network transmission of VRML is reflected in the fact that VRML can transmit data information quickly. Like HTML, VRML uses ASCII text format to describe and connect the world, which ensures that the VRML language can be used
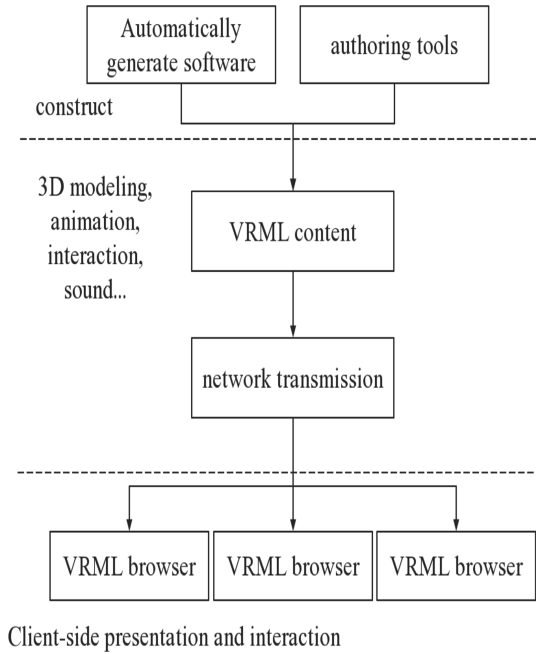
Fig. 1. How VRML works.

on various platforms. This also reduces the amount of data transmitted over the VRML network. The high-speed network transmission of VRML enables it to be implemented on low-bandwidth networks.

The VRML language can bring real-time shading to virtual reality. There are certain differences between virtual reality and 3D modeling animation. 3D modeling animations are pre-colored and provide no interactivity to the user. The VRML language can better represent the 3D shader engine. VRML provides 7 degrees of freedom, can move and rotate in three directions, and VRML provides virtual worlds with hyperlinks to jump to other 3D spaces.

3   The Overall Structure of the System

This system provides users with the functions of clothing design modeling, clothing display and clothing evaluation [14]. The system uses a three-tier architecture. The system system is divided into three parts, namely the interface layer, the application layer and the data layer. The overall architecture of the system is shown in Figs. 2 and 3.

There is a simple shared virtual scene in the network section. Virtual scenes can provide users with an interface based on virtual reality technology. Virtual scenes have the simplest models. Users can open the existing network models in the database to view the clothing design models [13]. Users can also design in the system by interacting with the system, and the design results can be passed on to other users. Sometimes several designers are required to design together in the process of clothing design, so
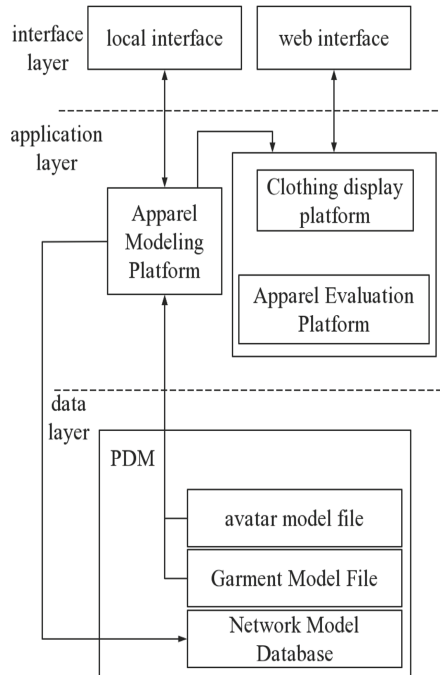
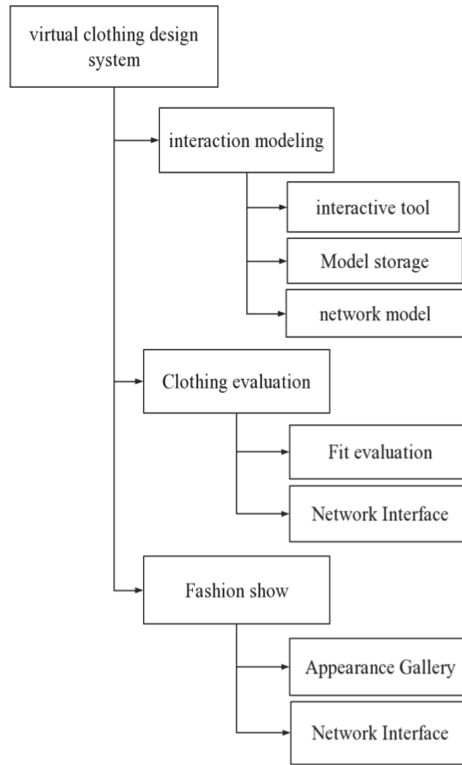**Fig. 2.** Architecture of virtual clothing design system.

this collaborative design function can improve the efficiency of user design and meet user needs. The final design result can be saved to the database. In the display module, the system will render the design model and display it. Users can communicate through the information exchange module [9].

Clothing and mannequins are in the local system. The local system can be combined with the existing CAD system, and the two-dimensional design model can be converted into a three-dimensional model on the local system, and then exported to VRML file format to connect with the network. The functional structure of the network part is shown in Fig. 4.

4   Key Technologies of the System

4.1   Clothing Modeling

In order to make the system more close to the needs of clothing designers, the clothing design modeling function in the system needs to be designed and developed accordingly [3]. In this system, an improved surface patch method is used to build a three-dimensional clothing model. In the process of 3D modeling, it is very important to import and reconstruct several model information. In the 3D virtual system, before the 3D model is displayed, the surface must be meshed, that is, multiple connected triangular surfaces are created to approximate the original surface [10]. This method can save the memory

Fig. 3. Functional structure of virtual clothing design system.
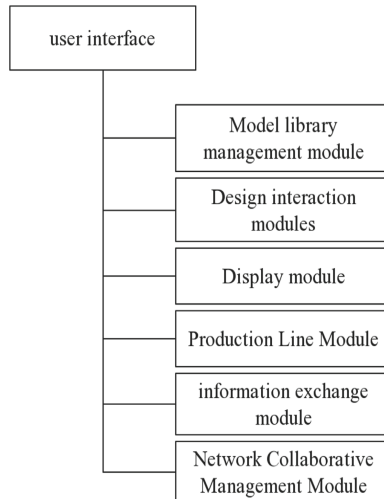
Fig. 4. Functional structure of the network interface part.
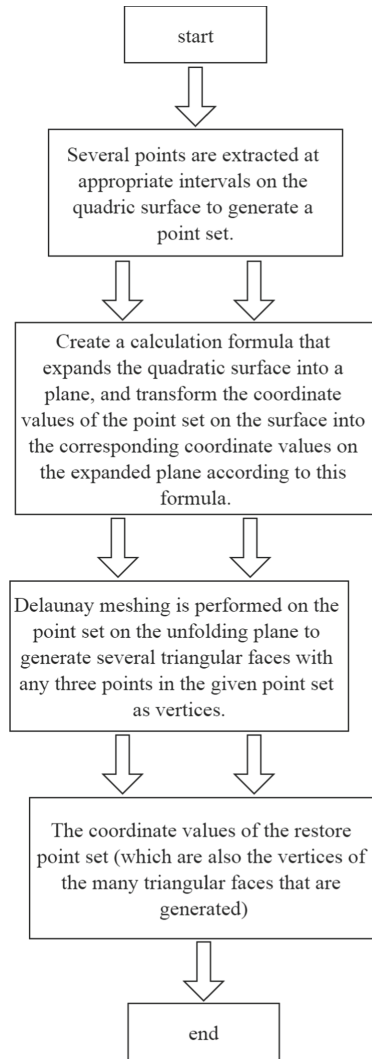
Fig. 5. Surface meshing process.

occupied by the display. Improve the speed of the display, etc. In the process of visu-
alizing the geometric model, the most important link is to mesh the basic patches that
make up the three-dimensional Fig. 5 [4]. For example, using meshing, you can divide
a cuboid into 6 planes, and a cylinder into two planes and two half-cylinders.

The main basis of the surface patch method is the original point set, which divides
the model into multiple parts with surfaces and splices them together. The surface patch
method will number the known shape points in order, such as V0, V1, V2, and so on. Then
connect the three-dimensional value points to form a plurality of simple triangles, and
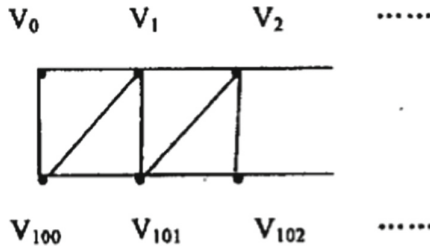fit the three-dimensional surface. In the model, the finer the triangular mesh is divided,

Fig. 6. Surface patch method.

the smoother the obtained 3D surface. The surface patch method is very suitable for the needs of clothing design (Fig. 6).

This system improves the surface patch method. The surface patch method used in this system obtains the original point set through an algorithm, and then uses the surface patch method to obtain the model. This method can solve the problem of high server pressure brought by the surface patch method [11].

4.2 Modeling with VRML

This system uses the Indexed Face Set node in VRML, and generates VRML model based on the point set [17].

An Indexed Face Set node represents a 3D shape formed by a series of planar polygons constructed from a set of vertices. Using the Indexed Face Set node, a three-dimensional model can be generated as long as the specific value of the point set in the coord domain and the index value of the polygon plane formed by each point in the domain are assigned. This system takes the 3D model data line constructed in the local platform as the basis of the network model. The network model can be implemented by importing the point set into the relevant domain of the Indexed Face Set node. Algorithms allow Java Applet and VRML virtual world to access each other in the same HTML file. An example of the algorithm is as follows:

```
<HTML>
<BODY>
<embed src ="bd.wrl">
<applet code="eai.class"height=250 width=250>
</applet>
</BODY>
</HTML>
```

Using this algorithm can make VRML file bd.wrl and Applet eai.class to achieve mutual access. Users can browse the 3D model on the Applet more conveniently.

5   System Test

In order to quantitatively test and analyze the practical value of the system, after the initial construction of the system, 50 fashion designers were invited to conduct experiments

Table 1. Fifty users' report on usage experience.

	satisfy	ordinary	unsatisfy
This system fully show your ideas	80%	13%	7%
The usage experience of this system	73%	21%	6%
The utility of this system	66%	27%	6%
Clothing display effect of this system	61%	12%	27%
This system compares to the one you normally use	76%	6%	18%

through the network. These 50 fashion designers usually use a CAD system or cut fabrics to design on the mannequin. Designers compared their usual design methods with the virtual clothing design system constructed in this study, and submitted a report on their experience. In this test, 50 valid usage reports submitted by fashion designers were collected, and the experimental result Table 1 was made according to the trial report as follows [5].

As can be seen from the Table 1, the development direction of this system is correct. The clothing design system based on virtual reality technology allows designers to give full play to their creativity. The system also needs to be continuously improved, and the interactive design and clothing display of the system should be improved.

6   Conclusion

According to the needs of clothing design, this research constructs a clothing design system based on virtual reality technology. Users can build three-dimensional clothing models in the system, observe the clothing models from multiple angles, and collaborate with other users to design. This research uses VRML language to design and develop the modeling function in the system, and uses the surface patch method to help users to model clothing. The system has good practical value for the development of clothing design.

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