An Image-based Virtual Presentation and Aided Design System for Textile Products

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Abstract

Virtual presentation and design techniques have found a lot of applications in textile industry in recent years. How to achieve realistic effects in exhibition and provide a set of convenient design methods is still a great challenge. In this paper, we design and implement an image-based presentation and design system (named Easyshow). Very realistic effects are achieved by using novel texture mapping and color blending algorithms. We also provide powerful management functions and various design tools. In addition, as it is an image-based system, it can be migrated to internet and mobile devices easily.

1. INTRODUCTION

Virtual reality (VR) is a new and attractive human-computer interactive technology, which has become one of the focuses of research and development in computer fields today. Famous VR experts Sherman and Judkins described the characteristics of VR as five-I: intensive, interactive, immersive, illustrative and intuitive [4]. Therefore, VR is greatly suitable for using in the application of virtual presentation and aided design [6]. A general definition of product virtual presentation is: a special computer system is designed to simulate or replace the experiences in dealing, according to the property of product, the trait of trade, and the favor of customers. The usual forms are online shopping, online auction, virtual mall, online try-on and so on [11].

Generally speaking, there are two kinds of product virtual presentation ways: 2D image based presentation and 3D model based presentation [3].

A 3D model can offer varying degrees of viewing, enables consumers to interact with their products rather than just look at them, but still encounters many unconquerable problems [5]:

- With the current limited transmission bandwidth, building virtual environments for Internet always means to reduce geometry and the number of elements shown;
- The sense of immersion is reduced because of using traditional 2D devices;
- The software needed for 3D is usually non-standard, crash-prone, and requires an extra download.

Today, the application of 2D image based method in E-commerce is still common. The reasons are also obvious:

- Averagely, the purchasing speed under 2D environment is 140% faster than that under 3D environment, because of saved searching time;
- Customers are more accustomed to control a 2D object with the interacitve techniques that are currently in common use;
- Cost is an important factor as it is relatively cheaper to convert a product's figure to pictures than to models.

The unique texture and color are the identifications of each cloth. We want to preserve the primal information after computer processing as much as possible. Images of the original product are obviously better than the models to this duty. Every cloth has very complicated expressive details, such as millions of microstructures in woof, floss, and wrinkle. It's still very difficult in research to realize 3D synthesized cloth [7]. We get the conclusion that 2D image based method is the optimal choice for the visual presentation of textile products. Not only for the guarantee of more abundant and convenient input sources, more accurately in preserving the trueness of texture and color, but also for the best use of the existing image-based graphics processing algorithms. It will achieve a more efficient running state than 3D method with the reduced computer complexity and reserving space.

2. RELATED WORK

2.1. Related Systems

Here we simply introduce some related virtual presentation and aided design systems developed by domestic or foreign companies or research institutes.

Vision Easy Map [10] is a very successful texture-mapping program developed by predominant NedGraphics company. Vision Easy Map Creator, Vision Easy Map Viewer, and the Vision Easy Map SDK make up a software suite that allows you to realistically visualize different color, fabric, and other surfaces on photographs of your product. Today, the technology has been migrated to the web as the e-merchandising component of B2B and B2C web sites.

Kaledo Style [9], a professional fashion designer oriented software released by famous Lectra company. It prefers to the inspiration and ideas come up with the designing of figures and colors. Its processing inputs are some system built-in cartoon figures or classic design templates instead of real photographs.

The Design and Practice for Strip Textile [12] is a prototype developed by China Textile Academy recently. It consists of more than one thousand design examples. Good harmony between color matches and innovative ideology for design procedure are the highlights of this system.

On-line garment exhibition system [13] developed by Hangzhou Saihu Network Technologies Co. Ltd. is a 3D online try-on system. It has powerful interactive functions, can make various figures, cloth, and styles replacements for garment models. It is especially fit for the exhibition of new patterns in dress companies.

2.2. Discuss

There are some deficiencies or shortages in the existing systems:

- The focuses of these systems include professional industry, fashion design, aesthetics and entertainment, but business dealing has not been covered yet!
- Lack of flexibilities in most time. The regions that can be replaced in the primitive image are mostly predefined. The samples in the database can't be imported or exported as will, be short of universality.
- The texture mapping or color blending algorithms have some defects [2]. Especially for Hangzhou Saihu's, we'll find obvious texture distortions when mapping crossband patterns. Highlight spot and shadow information will get lost in dark color cloth.

So we ascertain our system design principle and implement aim just against the analyses above.

- Realistic expressive effects. We make great efforts to preserve the image's appearance just like after natural replacement in real life. The new texture extension directions will be consistent with primitive ones. The algorithms adopted in our system are especially suitable for textile products such as garment, beddings, sofas, pillow, and table cloth.
- Provide diverse interactive ways for users and give them more opportunities to customize or alternate the visualization manners [1]. For example, you can select auto mode or manual mode on your own accord when determining the boundaries of replacement region.
- Powerful management capabilities. Since our system is business oriented, besides the simple presentation functions, we should make effective management for a great amount of base models and cloth textile images.

3. ARCHITECTURE

Easyshow is a typical system developed under win32 environment, with database support in back end, and images processing and rendering works in front. In general, there are four components in the system. Database access sub-component is responsible for model base images and textile cloth images' loading and saving, and the users' private account information access; Image processing sub-component is the kernel part, the entire system's expressive effect and running efficiency are affected by it. The soul of it is two adapted texture mapping and color blending algorithms [8]; Aided design sub-component comprises Visual Stamp facility, Piece Paste utility, and region or texture borders' parameters adjusting tools. They are indispensable aided tools when you want to enhance the exhibition effects or improve the flexibility in comparisons. Security sub-component is a basic part of every modern commercial software， they're encryption, registration, authorization, rights control etc.. Four modules are organically unified by the systematic main interface, the corresponding series of dialog boxes and data exchange between the toolbars. The system use mainly mouse operations (cooperating with keyboard

incidentally). The overall system module constitution and its relationships may express with the following structure drawing (figure 1):

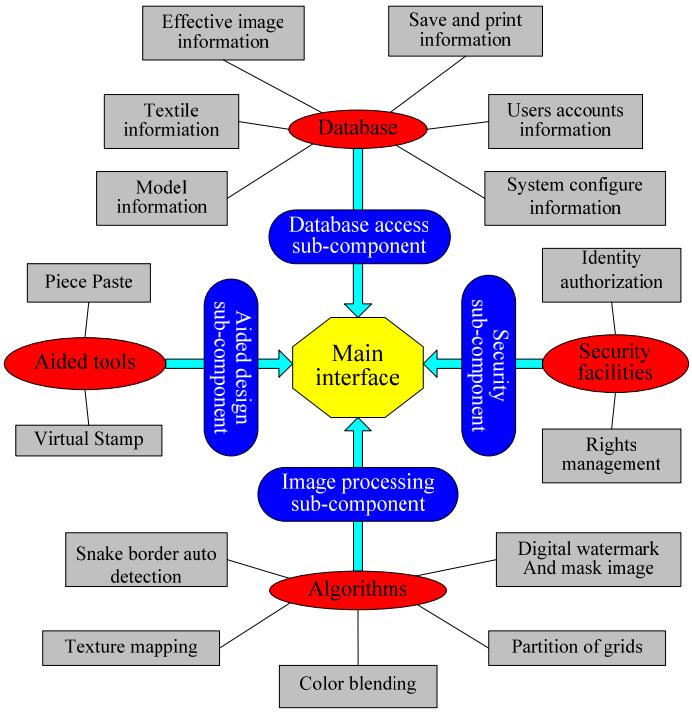


Figure 1: Easyshow system structure drawing.

4. IMPLEMENTATION

Applying the technologies the article proposed before, we have already successfully developed a new textile effect virtual demonstration system, mainly used for demonstrating different visual effects to customers when the window blinds' colors and texture are changed (system overall interface like figure 2). Under our cooperation with Shanghai Jiashuai Science and Technology Limited Company, this system has been successfully pushed to the market, and gained good response.

Figure 2: Overall interface of Easyshow

The development environment and program technologies applied in our system include windows XP OS, Visual C++6.0 IDE, OpenGL SDK and ADO database engine. The system is designed into two editions: self-running edition and network-running (LAN) edition, which provide it with broader using situation and stronger market competitive power. Considered to system backstage database scale is not big (the number of models and textiles is about 100 - 300, not exceeding 500 generally), we directly select Microsoft ACCESS2000 (the MDB document) as the data format. The network version choose MSSQL2000 server, guaranteeing the data consistence and safety when multi-users access at the same time.

A complete demonstration and transaction process can be expressed with the following steps:

Step1. Load models image come from database or outside file;

Step2. Preprocess, resizing, contrast adjustment, with Virtual Stamp possibly;

Step3. Specify replacement regions. If not saved before, draw new borders, manually or auto detected;

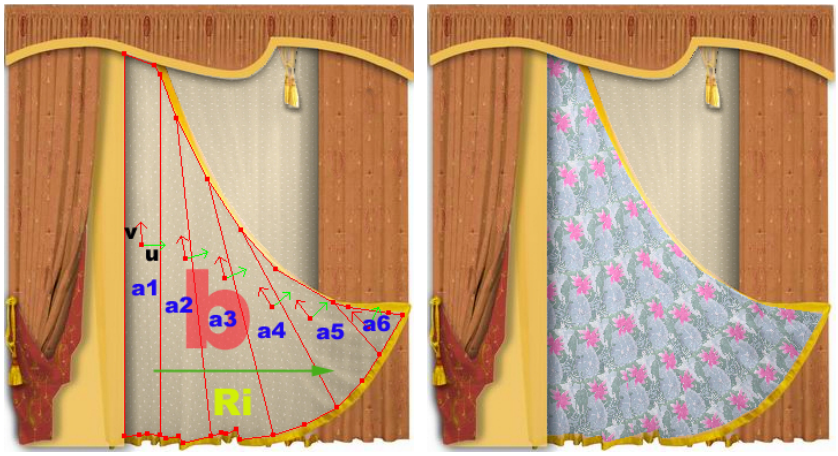
Step4. Parameterize texture directions in sub-areas. Texture coordinates are calculated, adjusted, and smoothed automatically;

Step5. Select texture and replace. If you want to observe the effects with other texture, repeat this step, if dissatisfied, back to step 4;

Step6. Post-process, with piece paste possibly. If satisfied, save or print, and exit the system. If continue with other exhibition, back to step1.

Cloth textures and blind models can be managed by cloth management or model management sub-module respectively. Including the setting and modifying of relative attributes, importing outside image files, adding or removing specified items, printing or saving current effects.

The users only need to select their favorite model, following a series of steps like drawing borderlines and so on, then drag and drop fond texture onto the certain regions to examine the replacement effect in real time. It shows that wrinkles of cloth and lights of shade are well preserved after the mapping (which is showed in figure 3). Since we've specified and saved the real sizes for every texture cloth and blind model, the visualization effects are consistent with those under real environment. In order to achieve software general-purpose, we also allow the user to load non- window blind model images from outside temporarily. For instance, import a fashion model picture to carry on virtual try-on demonstration.



a. before replacement **b.** after replacement

Figure 3: Comparison of windows blinds placement effect

In order to cause the texture mapped onto to the window blind model at the same time it can extend naturally according to the base picture's fold and suspends, we used a semiautomatic mechanism. That's the division of sub-areas for every border and the specification of directions for every area (see figure 3.a).

The pseudocodes of our novel texture mapping algorithm is shown below：

Definitions：**B** is a set of all borders in the model image，**b** is the current border; **A** is a set of all sub-areas within **b**, **a** is the current sub-area， $\mathbf{a_1}$,$\mathbf{a_2}$ are two adjacent sub-areas; **u**,**v** are two texture directions of **a**; **N** is a set of all adjacent sub-areas for **a**, $\mathbf{R_i}$, $\mathbf{R_j}$ are two regions (parallel connected sub-areas) that through **a** in i or j direction respectively (i, j are two nearly perpendicular directions)

```
CalTextureCoordinates()
1    ForEach  b∈B  Do
2         ForEach  a∈A  Do
```

```
3          CalTexCoor() with u、v          //initialize the coordinates
4      PrepareRegions() among N            // find the regions include current area
5      ForEach  a∈R_i  Do
6          AjustTexICoor ()                // adjust coordinates in vertical direction.
7      ForEach  a∈R_j  Do
8          AjustTexJCoor ()                // adjust coordinates in horizontal direction.
9      ForEach  a_1,a_2∈A and a_1∩a_2≠0  Do
10         SmoothTexCoor() between a1,a2   // smoothen the neighboring coordinates
```

The system also offers two convenient and practical auxiliary tools to users. One is the Virtual Stamp. The goal is to pre-process the model image before texture replacement, such as dispelling the stains, or eliminating the grains in deep color gird patterns (see figure 3, the disappearance of dark-red elliptical spots in the left and right sides in contrast with the patterns on top). Another is Piece Paste. It enables the users to paste their interested piece from other image onto their own (in figure 4, we are prepared to put a vase onto a tea-table). Both tools are playing one kind of image editing roles under suitable situation. The experiment results are appropriate and effective.

Figure 4: Application examples of Piece Paste

In order to strengthen the system to be interesting, we also provided small functions such as "Full Screen Display", "Automatic Demonstration", "Special Show Effects", "Wallpaper Replacement" and so on.

5. CONCLUSION AND PROSPECT

In this paper, we designed and implemented a complete business oriented 2D image-based virtual presentation and aided design system for textile products. It is grounded on the analysis of attributes of textile products and characteristics of cloth dealing business. The system has applied texture mapping, color blending, automatic

boundary detection, image layers' separation and combination, transparent masked bitmaps [14], digital watermark technologies, as well as database and software security mechanisms. It has the advantages of realistic exhibition effect, widespread using situation, simple and flexible operation manners, and powerful opening and expansibility. And it has already obtained promotion and application in actual production life, proved to be a mature and productive system.

There are still many aspects that need to be corrected or improved in our system. Firstly, the method used to select the replacement regions may be more artificial, rather than current drawing continuous points; Secondly, further optimizing for current texture mapping and color blending algorithms, achieving more realistic effect; Thirdly, transplanting from LAN edition to WEB edition. Fourthly, developing a thin-version for mobile devices is a very challenge work. Finally, adding a few practical aided design tools, such as dynamic effect demonstration and visualization under moving light source and so on.

6. REFERENCES

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