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Virtual Presentation and Customization of Products Based on Internet

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Abstract – Through reviewing and comparing the current virtual shopping malls web sites integrated VR into E-commerce, this paper analyzed both the advantages and disadvantages of two kinds of methods for product presentation: 2D image based and 3D model based presentation method. Using the virtual shopping mall (EasyMall) as a showcase, we presented the architecture of the system and the development technologies, especially those in the mixed presentation method. The presentation and customization methods in the two related modules, including the PhoneShow for mobile phone and EasyShow for textile products, were discussed. It indicated that the integration of E-commerce with VR could provide consumers with virtual experience and intelligent service for business activities. Furthermore, the product presentation methods can be made available for use in different cases.

Keywords: **Product presentation, Product customization, Virtual reality, E-commerce, Network**

1. Introduction

The wide-range applications of Internet, computer graphics, man-machine interface and the expressiveness of multimedia provide more and more opportunities for developing electronic commerce (E-commerce). E-commerce and online shopping are expected to become one of the fastest growing fields in Internet market [1]. However, most of the current E-commerce platforms only provide user with simple, 2D image-based and text-based interfaces or some flash animations to access the products. Such a kind of tedious environment neither provides users with the same shopping experience as they have in store, nor allows them to customize some personalized products which meet their tasty. Furthermore, it fails to make consumers enjoy fun and evoke an appetite for purchasing something. As a result, the functions of most commerce websites for production presentation and customization are impaired somewhat. Essentially, they just play a role of introducing products by indicating their apparent properties, such as the color, size, appearance, etc.

Virtual Reality (VR) is a new and attractive human-computer interactive interface technology, which is becoming one of the hottest research and development areas in computer industry today. It is being applied in wide domains and touching on many new fields. Also, VR offers a high potential for product presentation: instead of regarding flat, static pictures, configurable and animated 3D models embedded in entertaining environments provide a new way of product presentation. How to emerge VR technology in building the E-commerce platform, so as to exhibit products effectively and provides customers with powerful function tools of customizing products is one of the main goals in our research.

Regarding our current developing work related to this field, we implemented a virtual mall system (called EasyMall), which integrated the presentation and customization function. In EasyMall, we focused on analyzing the mixed usage of two kinds of methods for setting up the virtual purchase environment, 3D model based building method and image based building method. In addition, we have developed EasyShow system for textile products. PhoneShow [27] system is a virtual presentation of mobile phone developed by VR Lab, POSTECH, South Korea and our group.

This paper is organized as follows. In Section 2, work related to this research is first reviewed and compared. And both advantages and disadvantages of two kinds of product exhibition methods: 2D image based and 3D model based presentation methods are discussed. In Section 3, with our EasyMall as a showcase, the architecture of the system and the development technologies, especially the mixed presentation methods are analyzed. Furthermore, the presentment and customization methods of the integrated modules, including the PhoneShow module for mobile phone and EasyShow module for bed clothing and apparel, are described in detail. Finally, based on our practice and current website situation, we discuss how to improve the online service level and bring more bargains through the variable, convenient and realistic product presentation methods.

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2. Related Work

2.1. Applying E-commerce to product presentation

E-Commerce involves individuals as well as companies engaging in a variety of electronic business transactions by using computer and telecommunication network. Traditionally, the notion of E-Commerce focused on Electronic Data Interchange (EDI) as the primary means of conducting business electronically between companies which had pre-established contractual relationship. Recently, however, due to the WWW's surge in great popularity and acceptance of the Internet as a viable transport mechanism for business information, the definition of E-Commerce has been broadened to encompass business conducted over Internet and includes individuals and companies not previously known to each other [2].

The first researcher, Hoffman proposed a framework for examining the commercial development of the Web in 1995 [3]. After that, E-commerce had been developed rapidly. From the studies of the usability of current E-commerce sites, there is a general problem that buyers always fail to find what they are looking for, or abandon the purchase even through they have found the product [4]. Most reports suggest that promoters are disappointed with the current level of online sales [5]. Nevertheless, E-commerce is undoubtedly one of the best medias and tools for presenting product. However, the aim of online presentation is not only for exhibiting product, but most increasing the purchase rate by letting customer know products in more detail. Therefore, one of the challenges of E-commerce is the design on web sites which can effectively present products and are convenient and enjoyable for buyers to use.

2.2. VR and interactive virtual experience

VR was originally considered as a technological advance that involved human senses (e.g., vision, hearing, touch) through using input and output devices. As Heim pointed out, VR has "three I's" - immersion, interactivity, and information intensity [6]. Immersion is usually achieved through a head mounted display (HMD) or a CAVE environment [7]. A desktop virtual reality is usually equipped with stereoscopic glasses and maneuvering devices (e.g., data glove, joy stick or space mouse). Currently, VR devices are still not very popular because of their expensive prices. Most of them are used in universities and military departments. However, the immersive feeling also can be produced if an object is expressed with the similar Virtual Reality Modeling Language (VRML).

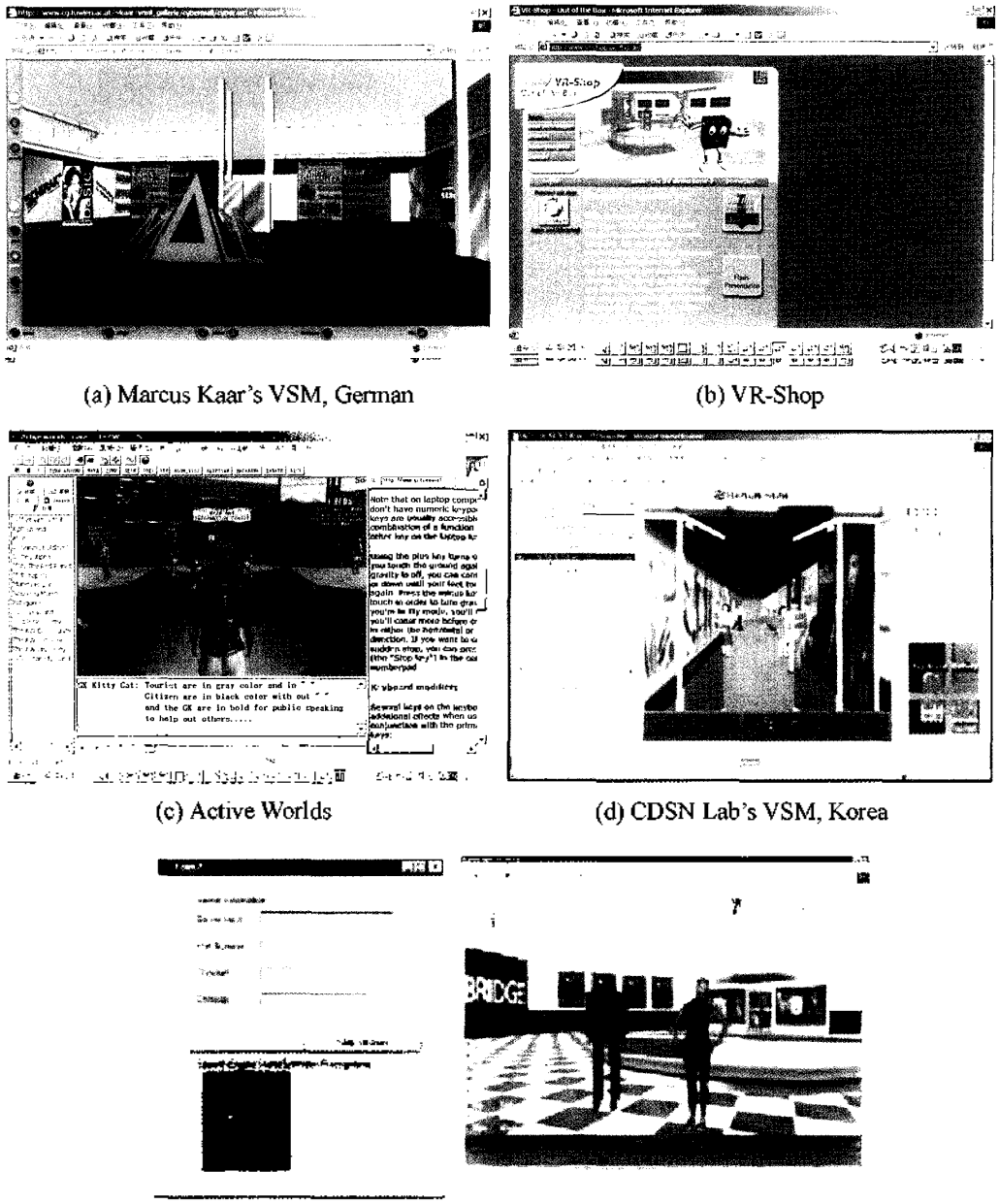
Interactivity makes it possible for people to feel the virtual experience just like direct experience to objects. Lundh defined such an experience as an event or process that can occur spontaneously or voluntarily within everyday situations but always involve the internal awareness of something taking place [8]. Biocca *et al.* [9] defined two conventional types of experience when consumers evaluate products: direct experience (for example, product trial) and indirect experience (for example, looking at product brochure). A direct product experience involves all senses, including 'visual, auditory, taste-smell, haptic (touch sense) and orienting' [10]. The virtual experience was defined as "psychological and emotional states that consumers undergo while interacting with products in a 3-D environment" [9]. Interactivity makes the virtual environment be capable of providing human with different feedbacks in response to different actions performed by them. In most cases, virtual experience derived from interactive media such as 3-D virtual environments is richer than indirect experience obtained from traditional advertising or others. With the vivid and media-richen interactivity, many 3-D virtual products and shopping malls are not only a representation of physical products and malls, but the simulations of the consumption experience.

2.3. Integrating E-commerce with VR

Studies on VR interface which is merged into e-commerce sites began appearing on Internet several years ago. Matsushita uses VR for product presentation in his Virtual Kitchen project [11], a retail application set up in Japan to help people choose appliances and furnishings for a rather small kitchen apartment space in Tokyo. Users bring their architectural plans to the Matsushita store, and a virtual copy of their home kitchen is programmed into the computer system. In 1994, Fraunhofer IAO and the British software company Division presented the Cooperative-Interactive Application Tool (CIA-Tool) which consists of a VR based system for immersive placement and surface adjustment of interior design objects in offices [12]. In 1997 at the IAA motorshow in Frankfurt, Germany, Mercedes-Benz introduced the "Virtual Car" Simulator to display its A-class model. This simulator allows users to hold a screen in their hands to make selections for colors. The Virtual Design Exhibition was presented in [13], which was founded by Fraunhofer IAO in collaboration with the Milanese Design and Architecture bureau Studio De Lucchi. The goal of the project was to offer a new way of presenting products of interior design furniture manufacturers. The Virtual Design Exhibition consists of an exhibition part and of a set of tools for interactive product configuration. However, according to statements presented in [14], immersive VR applications still lack an easy-to-use interface.

Currently, there are many existing 3D virtual shopping malls. Let's review several typical ones in the following section.

Virtual Shopping Mall (VSM), as a prototype system, allows users to choose their own figures from several simple avatars during their navigation [15], shown in Fig. 1(a). Just like VNet, it realizes a shared virtual environment based on VRML and Java. Before connecting



(a) Marcus Kaar's VSM, German

(b) VR-Shop

(c) Active Worlds

(d) CDSN Lab's VSM, Korea

(e) MCRLab's CVE, Canada

Fig. 1. Snapshots of Several Existing 3D Virtual Shopping Malls.

to the server, a user has to specify his name and select a custom or one of the built-in avatars. This function is very similar to the former one. After a user connects to the server, he is able to chat with other users, to move around and to watch the avatars of other users in the virtual space.

VR-Shop [16], a demo installation of a virtual shopping environment in a 3D online community, is based on Blaxxun VRML multi-user technology and capable of providing advanced visualizations in return for a rather lengthy plug-in download, shown in Fig. 1(b). VR-Shop enables companies to offer a complete and efficient service solution for their customers, and a faster, better way to communicate and access to the marketplace.

In Fig. 1(c), we can see a snapshot of Active Worlds, an excite net of interlinked, three-dimensional virtual environment. Unlike other similar systems, Active Worlds permits toolkits to build interactive virtual community. @mart in Active Worlds is an exemplary world which shows how the toolkit can be used to build a 3D virtual shopping mall. A user can get 2D information on objects by clicking them [17].

Based on the project of ATLAS, CDSN Lab, Information and Communications Univ., Korea, developed a 3D shared virtual shopping mall [18]. Its main goal is to design and implement a scalable network framework

for large distributed virtual environments. A screen capture is shown in Fig. 1(d).

The Agent-aided Collaborative Virtual Environment (CVE) over HLA/RTI was presented by MCRLab, Univ. of Ottawa [19]. Fig. 1(e) shows a snapshot of Client's View of the Running Application. Their CVE for E-commerce bridges the gap between the Industrial Training and E-commerce. It provides users with a very enjoyable experience while shopping online. In the virtual environment, a user, represented by avatars, can join a Virtual World, manipulate and interact with the objects like in the real world.

In addition, some other sites are also attempting to offer users 3D interfaces (e.g., Cybertown Shopping Mall at www.cybertown.com, Eluxury online shopping site at www.eluxury.com, FAO schwarz virtual playroom at www.fao.com), allowing them to explore a VR representation of the store.

2.4. Comparation of product presentation methods

Broadly speaking, there are only two kinds of product presentation: 2D image based presentation and 3D model based presentation. Then which one would be better for presenting product in E-commerce?

Integrating VR into E-commerce, the world of e-commerce is entering a new realm previously 'thought impossible' [20]. Since most products are 3D objects that are experienced with the senses, the use of dynamic and compelling 3D visualization in E-commerce is increasing as companies seek to give users an innovative experience of the product. A 3D model can offer varying degrees of viewing, but a standard 2D image can only appeal to the visual sense. 3D model based method enables consumers to 'interact' with products on Internet rather than just look at them.

However, a different view is that of Neilson [21], he states 2D is better than 3D, and virtual shopping malls are just a gimmick. In [22], Hurst also pointed out that the '3D product sites are implementing a feature just because they can. He expands on this to say that online shoppers do not need high-tech gadgetry and that it simply complicated matters. We have to confess, in some cases, using 3D model based method to present product is not what we expected:

- 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 deduced because of using 2D devices, the screen and mouse, but not head-gear 3D devices;
- Averagely, the purchasing time under 3D presentation environment is 140% of that under the traditional 2D presentation environment, because of increased searching time;
- It is difficult to control a 3D space with the interaction techniques that are currently in common use since they were designed for 2D manipulation (e.g. dragging, scrolling);
- The software needed for 3D is usually non-standard, crash-prone, and requires an extra download.

Today, the use of 2D image based method to represent products in E-commerce is still common. Thousands of E-commerce sites have used this method to represent their products. There are still many advantages of using 2D images to represent products. Among them, cost is an important factor as it is relatively cheap to convert a picture of a product.

Regarding the present situation, it seems that we can not distinguish which kind of presentation method is better. Both of these two kinds of presentation methods are important and valuable. In different cases, we need to resort different methods to present products.

3. Our Experiences and Showcases

In our project, we explored two methods mentioned above for product presentation. In image-based way, we improve the traditional method and allow users to change properties of products, thus make it possible for interactive presentation. In addition, based on the standard of VRML 2.0, ActiveX controller and some other E-commerce related techniques; we set up our virtual shopping mall (called EasyMall). EasyMall supports multi-user to interact and manipulate, leverages existing E-commerce solutions through an immersive 3D environment based on VRML and Java. One of our goals for developing the EasyMall is to make it easier for consumers to experience virtual shopping and, as such, to make our virtual store more natural and consistent with the shopper's previous physical experience through providing them with intelligent guide service. Another goal is to offer a customizable platform with which customers can change the attributes of products, such as the shape, style, color, size, etc, to satisfy individual requirements of customers.

3.1. Implementation of EasyMall

In EasyMall, two kinds of presentation methods mentioned above are introduced. As to the structure of the mall, we employ the 3D model based presentation method. 3D visualized environment could bring an entire new dimension to the way people learn and purchase products online. Thus, consumers can virtually 'interact' with products in EasyMall. In order to let a user test some simple manipulation functions of product, for instance, the folding and unfolding operation of mobile phone, 2D image based presentation method is difficult to meet the needs. So as to the presentation of mobile phone, we also apply 3D model based presentation method. However, regarding the main aim of matching effect, such as the fashion match, the clothing match, etc. in this case, it might be better to provide 2D images instead of a 3D model.

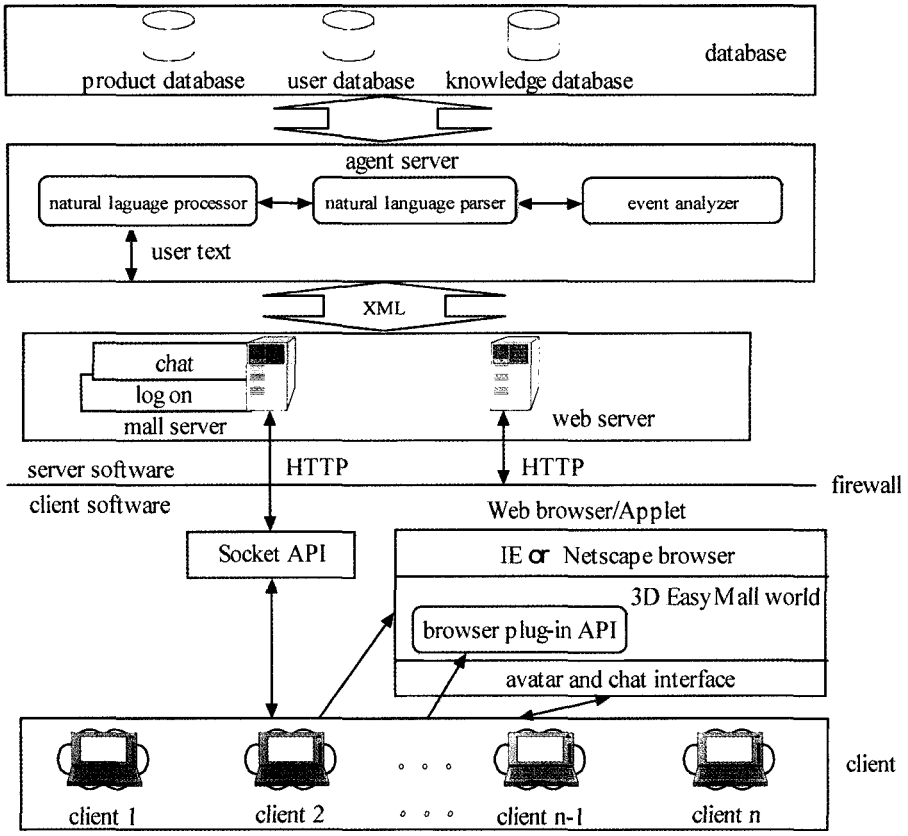


Fig. 2. The architecture of the EasyMall system.

The EasyMall consists of four modules, presentation and customization module for furniture [23], presentation and customization module for ceramic products [24], presentation and customization module for kitchen product, and presentation and customization module for electrical apparatus.

The technologies we explored and employed in our EasyMall are described briefly as the following four levels of implementation: i) Basic VRML modeling and behavior; ii) VRML communication to Java through Script Node; iii) VRML communication to Java applets through EAI; and iv) JSP to support input, saving, and processing of forms, new world files and file uploads. In addition, we apply VNET+ to ensure the data share of our Agent guiding system. The EasyMall system, which is based on multi-server, takes use of Blaxxun to realize the interaction between customer and virtual environment. This system includes a web server which stores customer information, user avatar server and agent data server. The EasyMall mainly puts use of VRML technology. The overall architecture of the system is shown in Fig. 2.

In Fig. 3, a shopping assistant is guiding the customers to enter EasyMall. There is a guiding marker

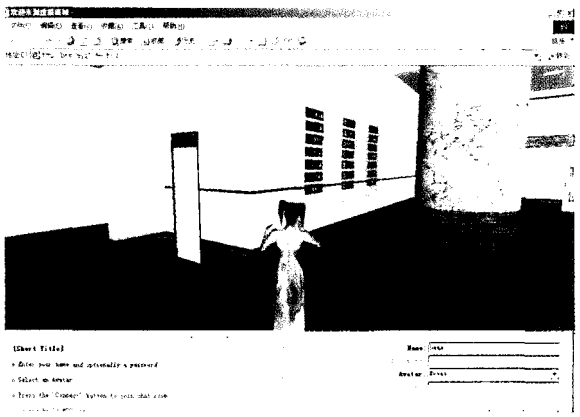


Fig. 3. Avatar guiding customer enter EasyMall.

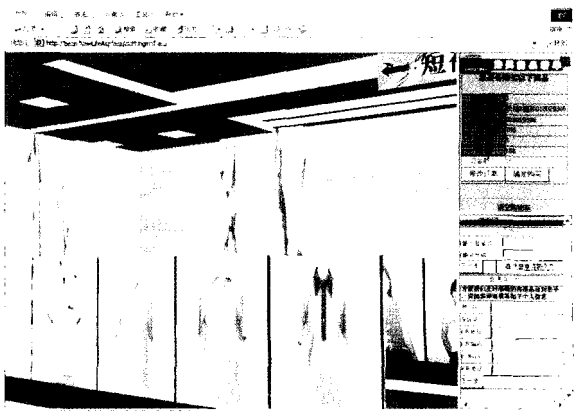
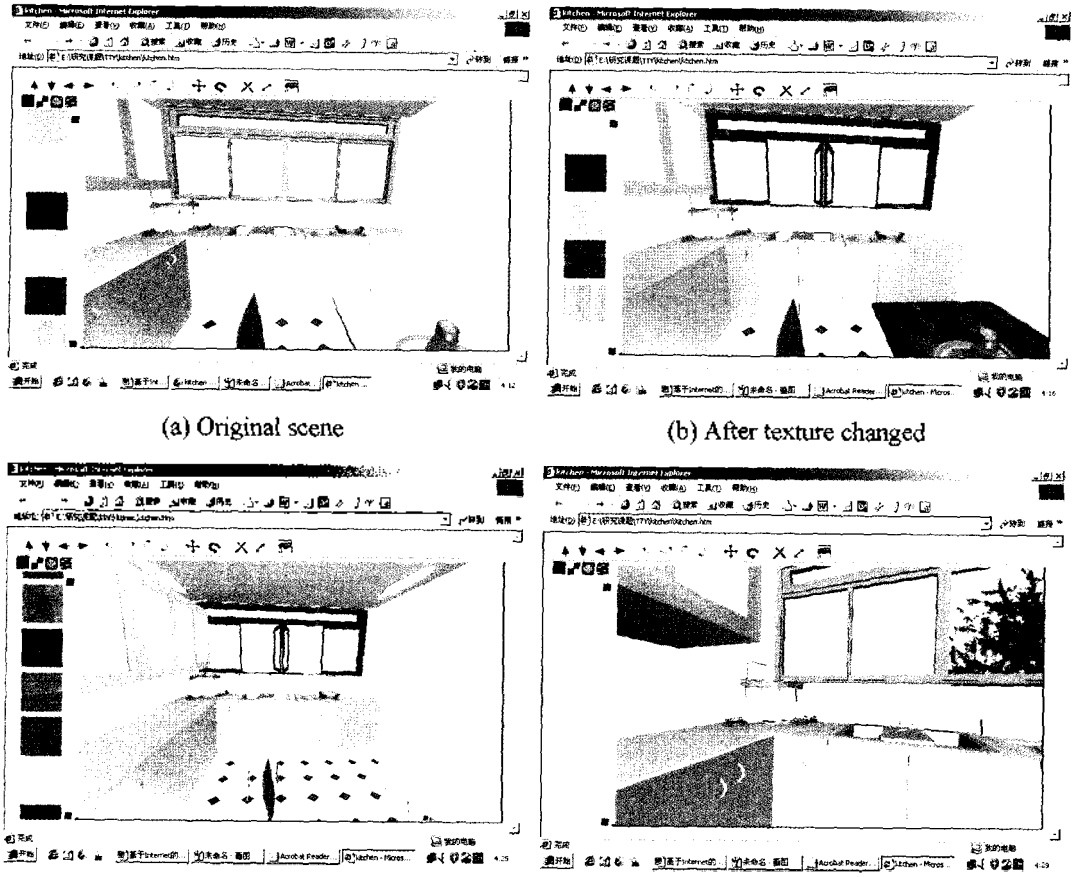


Fig. 4. A group of recommended T-shirts.



(a) Original scene

(b) After texture changed

(c) Interact with scene (ex. table is deleted)

(d) Navigate in the room

Fig. 5. Experimental result of our system.

beside the elevator, and customers can arrive at the corresponding floor on which the category of products is located through pushing the button. Fig. 4 shows that the customer got a group of T-shirts recommended by the shopping assistant in the apparel presentation hall. The presentation is based on the image of the shirts. The recommended items are based on the consumer's personal information, the purchase action as well as the interactive communication between the consumer and sellers. Then customers can inspect them through rotating, zooming and manipulating them one through one by popping up another window. Therefore, they may perform the whole purchase process, such as choose the detailed attribute of products, place orders, decide the paying method, etc. Nevertheless, a consumer may, instead of navigating through the virtual shopping mall, perform an intelligent search based on an item (the parameters such as price, color texture, etc.) to save his purchase time.

3.2. Image-based virtual presentation of textile products

EasyShow is an image based presentation and customization system for bed clothing and apparel. It employs the 2D image based presentation method to exhibit the bed clothing and apparel.

As to customization, the product matching is mainly considered, including the color matching, texture matching, style matching, etc. For example, when a consumer is choosing a shirt, he may want to choose a piece of tie which is used to match his shirt at the same time. Another case, after a consumer selects the style of his bedspread, he may want to check the showing effect of different textures, or different materials, to make sure if it matches his bed.

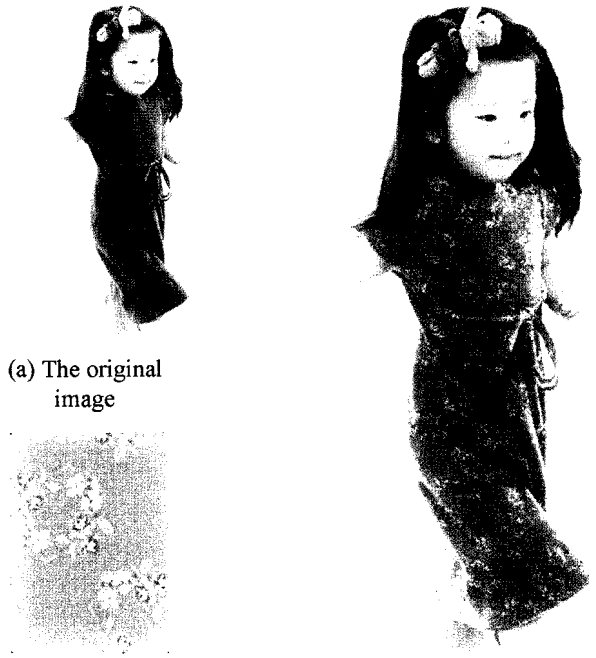
In order to produce the 3D effect, at first, we need to preprocess the ordinary picture of cloth, including adjusting color, light, etc. Secondly, we render interactive interface, guiding tools to help a user select the region that the texture should be attached, where the Snake technique [25] is applied. Thirdly, the system offers variable degrees of depth by texture deformation (e.g. regular disturbing, regular shade), joint and smooth transition as well as pleat vision through the fusion of color and light. In addition, different light model for different kinds of materials, such as cotton, silk, leather, are considered.

Fig. 6, Fig. 7 and Fig. 8 show the EasyShow's customization snapshot for bed clothing and garments. And the detailed techniques, were discussed in [26].

(a) The original image

(b) The texture image (c) The result image

Fig. 6. The simulating of garment (1).



(a) The original image

(b) The texture image (c) The result image

Fig. 7. The simulating of garment (2).

Fig. 8. Screenshot for customizing bed clothing with EasyShow.

3.3. Integrating virtual human into product presentation

Cooperating with VR Lab, POSTECH, South Korea, the second author of this paper was engaged in the development of an OpenGL-based customization and presentation system for mobile phone (called PhoneShow), integrating virtual human into product presentation.

Customization is a means for a better communication among users, computers and products. The screenshot of customized mobile phone is shown in Fig. 9. We briefly divide a mobile phone into eight components. Among them, upper body and lower body are the two fundamental parts [27]. Users can customize the properties of each component separately, such as its position, texture color and model style, etc., through the hierarchical tree of components showing on upper-left of the customizing window in Fig. 9. In addition, some simple behaviors of operating phone, including paying a close seeing (far seeing) through zooming in (zooming out), Power on (Power off) through mouse event, opening (folding) the upper body of the mobile phone, can be implemented by interactive devices [28]. As to the presentation, in this system a user can control an avatar and let him do some motions, so as to inspect the customized phone through playing animation at a third person viewpoint. Meanwhile, the system allows a user to operate phone at the first person viewpoint. In PhoneShow module, the animation is performed with the skeleton-based human model (shown in Fig. 10). Moreover, a serial of motion pictures for scenario design of getting through mobile phone are shown in Fig. 11.

Fig. 12 shows the screenshot of a user receiving the

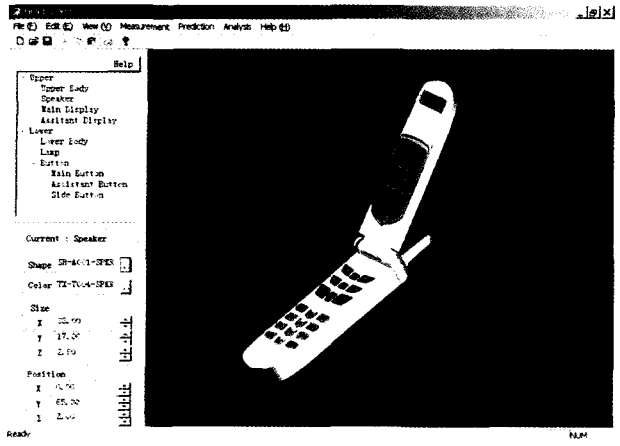


Fig. 9. Screenshot of customizing mobile phone.

Fig. 12. Showing with third viewpoint.

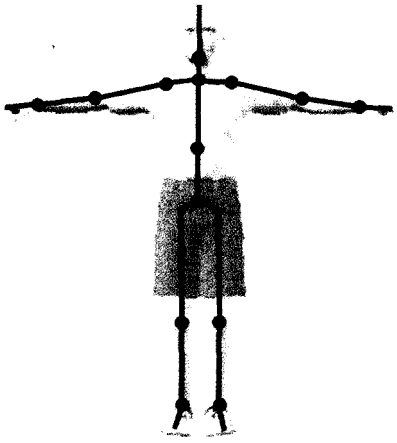


Fig. 10. Skeleton-based virtual human model.

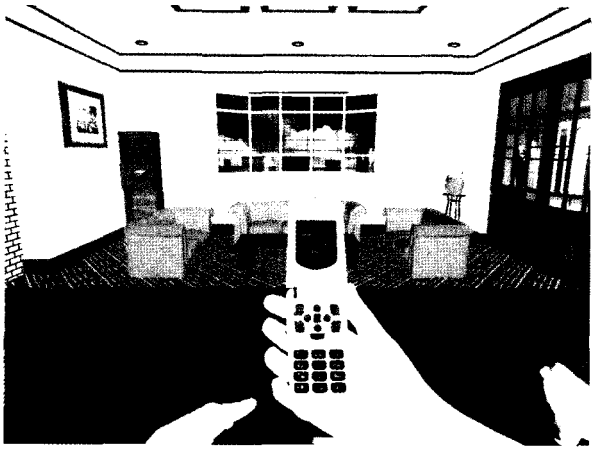


Fig. 13. Showing with first viewpoint.

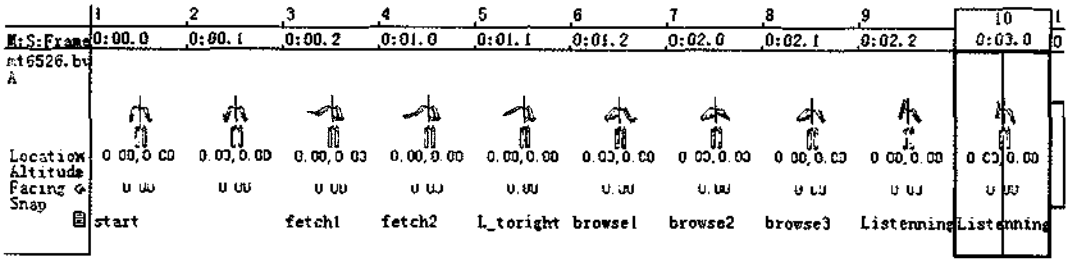


Fig. 11. Scenario design of getting through mobile phone.

mobile phone from Cally, an assistant Avatar for exhibition. Here, a user can control Cally for showing several behaviors of operating phone through blending some fixed motions smoothly, then feel and image what it would be like during his own operation at the third viewpoint. In Fig. 13, a user rotates, manipulates the mobile phone with his own hand after getting it. The feeling of operating product with the first viewpoint is very important for selecting products due to it makes the product to be embedded in a lively environment. Both the mobile phone and the human figure here are 3D models.

4. Conclusion

The rapid development of information technology and the prompt spreading of Internet resulted in the increase of customers' personalized demands for products. Thus, the traditional product presentation methods no longer meet the current market needs. In this paper, we reviewed the research work related to online product presentation and customization, especially the development of virtual shopping mall. It indicates that integrating E-commerce with VR provide a customer with virtual experience and business activities. Obviously, there are still some

disadvantages of using 3D model based product presentation method even though 2D image based presentation method are limited in some cases.

According to [22], there is more than 40% of buying attempt which failed in the shopping web site embedded with 3D visualization technology. There are many research organizations who are engaged in the related work to overcome existing defects. For instance, the company of VR Interactive is setting out with goal of making the power of VR web presentation more readily accessible to web developers and e-tailors.

In our EasyMall, we employed the mixed presentation methods. With the Easy-Show for presenting and customizing textile products, the 2D image based method was mainly applied, and with the PhoneShow for presenting and customizing mobile phone, the 3D model based method was mainly used. A possible future work is to integrate the functions of the EasyShow and PhoneShow into EasyMall.

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References

[1] Arndt Kraft, Stefan Pitsch, Michael Vetter. Agent-Driven Online Business in Virtual Communities. *33rd Hawaii International Conference on System Sciences*, Vol. 8, January 04 - 07, 2000.

[2] Pankaj Kamthan. E-Commerce on the WWW: A Matter of Trust. http://tech.irt.org/articles/js158/#ec_www.

[3] Hoffman, D.L., Novak, T.P., and Chatterjee, P. Commercial Scenarios for the Web: Opportunities and Challenges. *Journal of Computer Mediated Communication*, Special Issue on Electronic Commerce, **1**(3), 1995. http://www.ascusc.org/jcmc/vol1/issue3/hoffman.html, 2003.

[4] Chittaro, L. and Ranon, R. Virtual reality stores for 1-to-1 commerce. *Proceedings of the CHI2000 Workshop on Designing Interactive Systems for 1-to-1 E-Commerce*, The Hague, The Netherlands, 2000. http://www.zurich.ibm.com/~mrs/chi2000/, 2003.

[5] Phelan, S.E. (1996), Internet marketing: Is the Emphasis Misplaced? Presented at the Annual Meeting of the Australian & New Zealand Academy of management, Australia, Wollongong, NSW. 1996.

[6] Heim, M. (1998), Virtual Realism. New York, Oxford, Oxford University Press.

[7] Cruz-Neira, C., Sandin, D.J., DeFanti, T.A., Kenyon, R.V., *et al.* (1992), The CAVE: Audio Visual Experience Automatic Virtual Environment. *Communications of the ACM*, **35**(6), 65-72.

[8] Lundh, L.G. (1979), Introspection, Consciousness, and Human Information Processing. *Scandinavian Journal of Psychology*, (20), 223-238.

[9] Hairong Li, Daugherty Terry and Biocca Frank (2001), Characteristics of Virtual Experience in Electronic Commerce: A Protocol Analysis, *Journal of Interactive Marketing*, **15**(3), 13-30

[10] The senses considered as perpetual systems. Boston Houghton Miffin, 1996.

[11] http://www.wired.com/wired/archive/2.07/kitchen.html

[12] Hinkenjann, A. and Riedel, O., CIA-Tool: A Tool for Cooperative-Interactive Planning in Virtual Environments. *Human Computer Interface (HCI) International*, Yokohama, July 1995. http://ls7-www.informatik.unidortmund.de/~hinkenja/-publications.html, 2003.

[13] Dauner, J., Landauer, J., Stimpfig, E. etc. 3D Product Presentation Online: The Virtual Design Exhibition. *VRML 98*, Monterey, CA, USA, ACM Press, 57-62.

[14] Mine, M., Brooks, F. and Sequin, C. (1997), Moving Objects in Space: Exploiting Proprioception in Virtual Environment Interaction: Proc.SIGGRAPH' 97, Los Angeles, pp. 19-26.

[15] Marcus Kaar. A Multi-user Environment for the World Wide Web - The Virtual Shopping Mall. PhD thesis, Vienna University of Technology - The Institute of Computer Graphics, October 1998.

[16] http://www.vr-shop.iao.fhg.de, 2003.

[17] Oliveira, J.C., Shen, X., and Georganas, N.D. (2003), Collaborative Virtual Environment for Industrial Training and e-Commerce, Proc. Workshop on Application of Virtual Reality Technologies for Future Telecommunication Systems, IEEE Globecom'2000 Conference, Nov.-Dec. 2000, San Francisco. http://www.discover.uottawa.ca/publications/

[18] http://www.activeworlds.com, 2003

[19] Han, S., Lim, M., Lee, D., etc. (2003), "Scalable Network Support for 3D Virtual Shopping Mall", VSMM2002, September, 2002. Korea. http://vega.icu.ac.kr/~cats/publications.html

[20] Walsh, E.A. and Bourges-Sevenier, M. (2001), Core Web 3D, Prentice Hall, USA.

[21] J. Alterbox Neilson: 2D is better than 3D. http://www.useit.com/alertbox/981115.html.

[22] Hurst, M. (2000), Why 3D shopping makes no sense-Measuring the online customer experience [online] cited at http://www.goodexperience.com, 2003.

[23] Fangsheng Wu, Zhigeng Pan, Tian Chen, etc. (2003), Distributed Prototype System of Furniture's 3D Displaying and Customization. Computer Applications. **23**(3), 78-81.

[24] Tian Chen, Guofu Yin and Zhigeng Pan, "Interactive Design and Presentation of Ceramic Sanitary Products", SPIE Proceeding of the Third International Conference on Virtual Reality and Its Application in Industry, Vol. 4756, pp. 259-264, April 2002, Hangzhou, P. R. China.

[25] Kass, M., Witkin, A., and D. Terzopoulos. Snake: Active Contour Models. The International Journal of Computer Vision, **1**(4), 321-331, 1988.

[26] Peng Wang, Mingmin Zhang, Zhigeng Pan. A New Texture Morphing Method for Visual Presentation of Textile Product. Second International Conf. on Image and Graphics, Aug.2002.

[27] Jayoung Yoon, Gerard J. Kim. An Intergrated VR Platform with 2D Images and 3D Models. Master's Thesis. Dept of CSE, POSTECH, 2002.
[28] Sangyoon Lee, Tian Chen, Jongseo Kim, Gerard J. Kim, Sungho Han and Zhigeng Pan (2004), Using Virtual Reality for Evaluating Affective Properties of Product Design, accepted to appear in *IEEE VR* 2004 *Conference*, USA.

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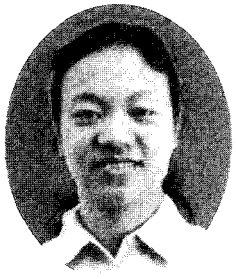
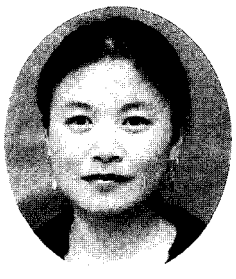


Mingmin Zhang



Tian Chen

Bin Xu