數位建築時代的虛擬家具設計策略

The Strategy of Virtual Furniture Design in the Digital Architecture Era

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Abstract

This research attempts to explore the relationship between digital architecture and furniture design, and to propose a furniture design strategy in the digital architecture era. The digital and architecture are being invisibly integrated in a process that is not even apparent to most architects. It makes us aware of the many opportunities that exist between these two design approaches. Through an exploration of outstanding digital architecture the key feature of digital architecture are sculptural forms, free form, carriers of visual information, and interactive environment. They indicate a corresponding furniture design approach should be formulated. A virtual strategy titled *Virtual Furniture Design*, incorporating customization with interactive 3D is proposed. It provides customers an interactive 3D virtual platform. Personalized furniture can be achieved virtually.

Keywords: virtual furniture design, customization, Interactive 3D

摘 要

本研究旨在探討數位建築與家具設計的關係,並且提出對應的家具設計方法。當建築變成數位化與資訊表現的產生形式，並緊密地融入建築設計中。讓我們注意到這其中隱含著更多的設計可能性與機會。透過對成功數位建築的探討可以發現,其特色包含：(1) 雕塑的型態 (2) 自由曲線的型態 (3) 資訊的載體 與 (4) 互動式的環境， 因此在家具設計上必需要有相應的設計策略。藉由結合客制化與虛擬互動式媒體，本研究提出虛擬的家具設計策略,提供消費者個人化的家具設計平台。

關鍵字：虛擬家具設計、客制化、虛擬互動媒體

A. Background

It's the information revolution that is metamorphosing architecture and urban design. Digital technologies are transforming the nature and intent of architecture and creativity, blurring the relationships between matter and data, between the real and the virtual and between the organic and the inorganic and leading us into an unstable territory from which rich, innovative forms are emerging. At the end of 20th century, humanity's concept of space has suddenly experience a great change with the arrival of the internet. Cyberspace or networked space now exists alongside actual space. Computer

simulation technology has allowed building to be create in virtual space that were never intended to actually be constructed. This virtual space has not only influenced the direction of architectural design, but has overturned our existing spatial theories, interior design and furniture design.

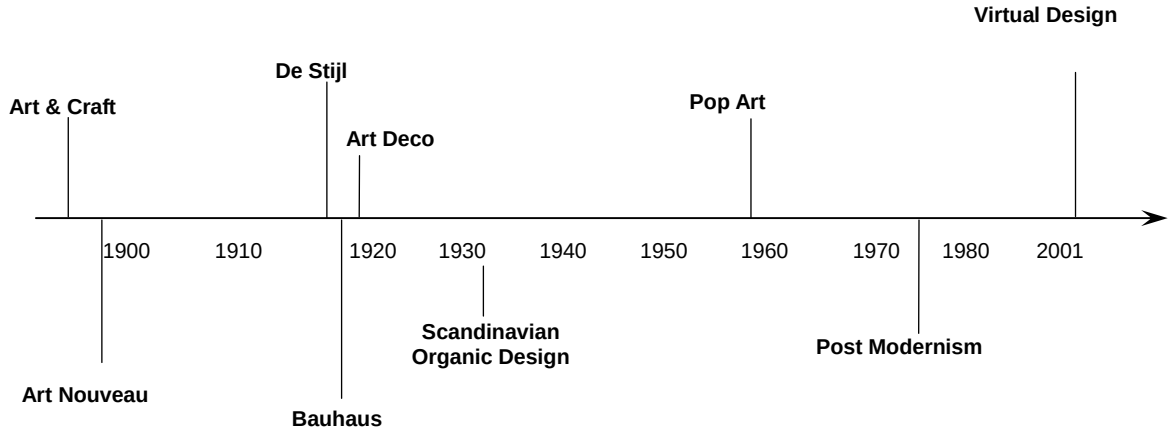

Figure1. The historical context of furniture

The success of particular furniture has always depended on the quality and range of the connections it makes, or the designer is able to make through it, while addressing a specific need. At the functional level, furniture makes physical and psychological connections with its form and material. At the same time, it may embody meanings and values which connect with the user at an intellectual, emotional, aesthetic, cultural and even spiritual level. Over the past 150 years, the evolution of the chair has paralleled development in architecture and technology and reflected the changing needs and concerns of society to such an extent that it can be seen to encapsulate the history of design (Charlotte & Fiell 2000). While the digital architecture is a revolutionary factor, none of which can be ignored, the furniture themselves express the coherence of emergence in the digital architecture era. Figure1 demonstrates the historical context of furniture design from Art & Craft Movement to Virtual Design.

B. Features of Digital Architecture

In 1990, Frank Gehery used computer to assist him to design free-forms, and then utilized CAD/CAM to quickly draw plans for the structures and actually build them. The digital design media and digital construction methods have liberated form and space in architecture, and have turned architecture into more of pure art form than previously (Liu 2001). The digital architecture has been changing the design procedure, methods, materials, and appearance of architecture, which are main factors to furniture design. There features are: generative and Sculpture form, free form, carries of visual information and interactive environment.

(1) Sculpture form

Time perhaps as an impediment to building has assumed a decidedly intimate role in an architecture that engages in a kinematics sculpting of space. Today, time and movement have been exploited in architecture with the aid of powerful animation soft wares, which have enable architecture to develop dynamic, mutable and evolving design techniques and new spatial paradigms (Graphic Image Studio 2001).The use of animation software has inscribed duration and motion into static form. These architects view spatial design as a highly plastic, flexible art in which the building form itself continuously evolves through motion and transformation. With complex time sequence and simulations, forms are no longer defined by the simple parameters of scale, volume and dimension.

(2) Free form

Today's technologies in coated fabric and computer-aided engineering allow designers and architects to set the limits higher, right to the edge of their imagination. A new form of free form architecture, known as Blob Architecture has arisen in the last years, along with more and more developments in shell and spatial structures and wide span enclosures. These structural forms are irregular and needs some form of structural system other than the classical structures.

(3) Carriers of visual information

In the mid 1990s, the New York Stock Exchange (NYSE) set out to integrate its vast storehouse of computer data into a single, user-friendly, computer accessible system. The NYSE designed by Asymptote (Waters 2003). Using an architectural approach, Asymptote designed a three dimensional, fully interactive, virtual environment that closely mirrors the physical and geographical layout of real trading floor. Asymptote's 3-D Trading Floor (3DTF) is the financial world's first large scale, virtual operational control center. It collects transactional and network activity data, and displays it on a high resolution video wall in the form of an animate, real time, 3D representation of the physical trading floor.

(4) Interactive environment

The Guggenheim Virtual Museum may be the largest three dimensional, interactive environment of its kind. The purpose of this museum in cyberspace is not merely to convert paintings and videos into digital objects, but also to serve as a home for a growing number of modern works that are digital in nature that can only be viewed on computers (Graphic Image Studio 2001). This idea that the digital realm is a place is what we make it possible for architects to ply their trade there. The most important defining element is the notion that the virtual architecture is a space. It's not a dynamic graphics representation of text and image. It possesses a kind of destabilized spatiality. Even concepts like walls, floors, inside, and outside may be accepted or ignore in this fluid terrain of infinite possibility.

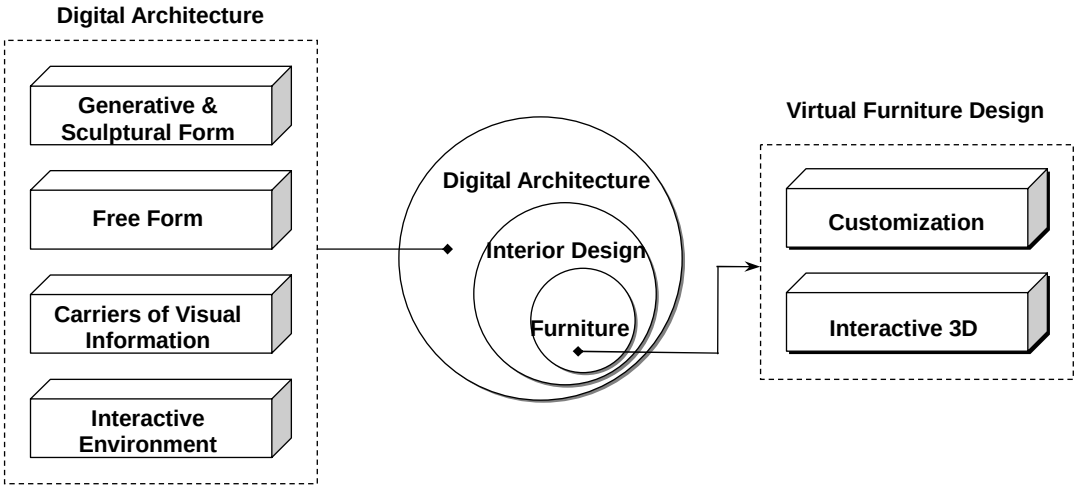

Figure2. The furniture design strategy in digital architecture era

C. The Furniture Design Strategy in Digital Architecture Era

Through the exploration above, it indicates that the digital architecture goes wild and be more intangible. The existing furniture design strategy can no longer satisfy the multiform representation of architecture in real and virtual world. This research proposes a method for capturing the essence of digital world- Virtual Furniture Design (VFD), including customization and interactive 3D. Figure 2 illustrates a corresponded strategy can be formulated for furniture design.

1. Customization

Davis (1987) and Pine (1993) conceptualized mass customization as a business strategy that involved customers in the development process of a product or service in order to address individual needs. The goal was to provide business customers and consumers with a differentiated, low-cost product with input from the customer and efficient production and delivery using information and manufacturing technology. The mass customization paradigm is one of the methods for creating customer-centric product. Mass Customization is the ability to quickly and efficiently build customized product. It uses all the techniques presented so far for the build of standard products and extends that to custom products. These products can be customized for individual customers or niche markets, such as version optimized for certain market segments, industries, regions, or countries. Mass customization may need effective web sites through configurators and convert order entry data into parametric CAD models, CNC

programs, electronic manual instruction, supplier pull signals, and shipping instructions. The most advanced configurators can display solid models and advanced graphics to show the customer what the contemplated product will actually look like. For very new products, this visualization capability can help early customers understand and comprehend new concepts and approaches. This can help get early feedback from customers. Web-based configurators offer the tantalizing prospect of customers not only placing their own orders but also “designing” their own products, all through automatic systems that are carefully constructed to allow ease of use and permit only valid product configurations. Different categories of key value attributes can be distinguished and each type has implications for product design, process design, and inventory. There are five dominant types of customizable attributes as follow (Rautenstrauch 2002).

(1) Fit: Customizing the fit of a product often involves, adjusting a product’s dimensions to the customer’s specification or preference. Clothing, fitted furniture and eyeglass lenses illustrate dimensional fit.

(2) Function: Function customization allows the addition of features or their removal from a product. This is enabled or hindered by a product designer.

(3) Aesthetic: Color is a common customizable aesthetic attribute and call for process flexibility. Other aesthetic attributes such as drape in textiles and clothing, and styling attributes in consumer products may have many hidden operational costs, such as additional subjective human quality control processes.

(4) Quality grade: Quality grade customization gives customers discretion over the quality of the components, e.g. the speed of processor in their computer, or the choice of chrome plated versus stainless steel components in their kitchen. This has implications for product architecture to allow part interchange.

(5) Packaging: Examples of customizing packaging include using customer specified boxes and accompanying manuals, inserting additional promotional material and freebies, supporting a two-for-one sales campaign.

Once a customer has configured the desired product, and has had an order provisionally accepted, the order must be translated into a bill of materials and a set of shop orders. The order fulfillment prediction based on the current schedule and using statistical demand prediction techniques must provide an expected delivery date for the customer. Once the customer has been presented with a price and a devilry date, he or she must either confirm the order, or cancel the process.

2. Interactive 3D

Interactive 3D media brings products to life and gives users the opportunity to visualize the image and interact with it. Users are able to rotate a product 360 degrees to view it from all angles, zoom in to see all details, explore all of the features and functions in order to make an educated and involving purchasing decision. Interactive 3D will be the ideal platform of the communication interface between consumer and designer. Whenever we use the Interactive 3D on the webs or CD titles, it must be because it is better than the 2D alternatives. Interactive 3D media on the web has become an integral part of company strategies and development decisions. The problem of providing customers with personalized products is very complex. Firstly, the customer himself has to be modeled by means of a machine-readable representation of his preferences, attitudes and latent needs. Secondly, the products have to be described by their relevant product attributes. Finally, intelligent matching algorithms are needed to combine the customer on the one hand and the products on the other hand, that is, there has to be a matching based on the information provided in the customer and product models in order to get a customized product. Figure 3 illustrates the process for selecting a personalized product.

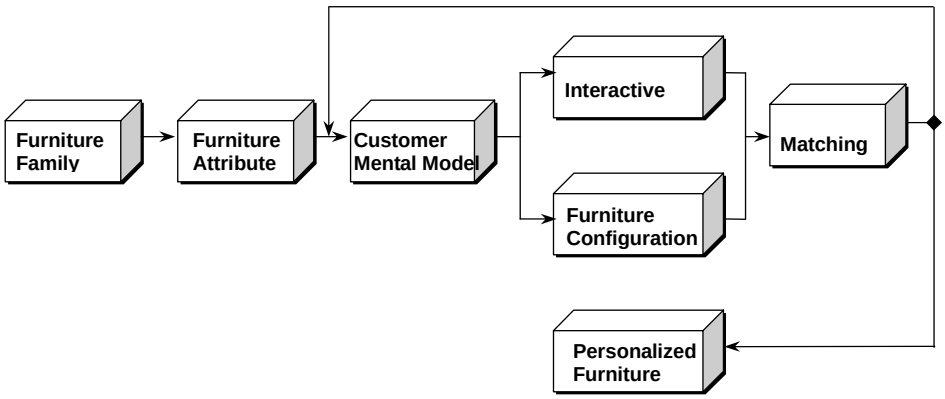

Figure3. The interactive 3D insists customers to select personalized furniture

D. Application of Virtual Furniture Strategy

The method of how to design modern Chinese style hardwood furniture and the application of 3D interactive media to mass customization will be illustrated. Within this, the single chair is the basic element which will be extended to a whole sofa set.

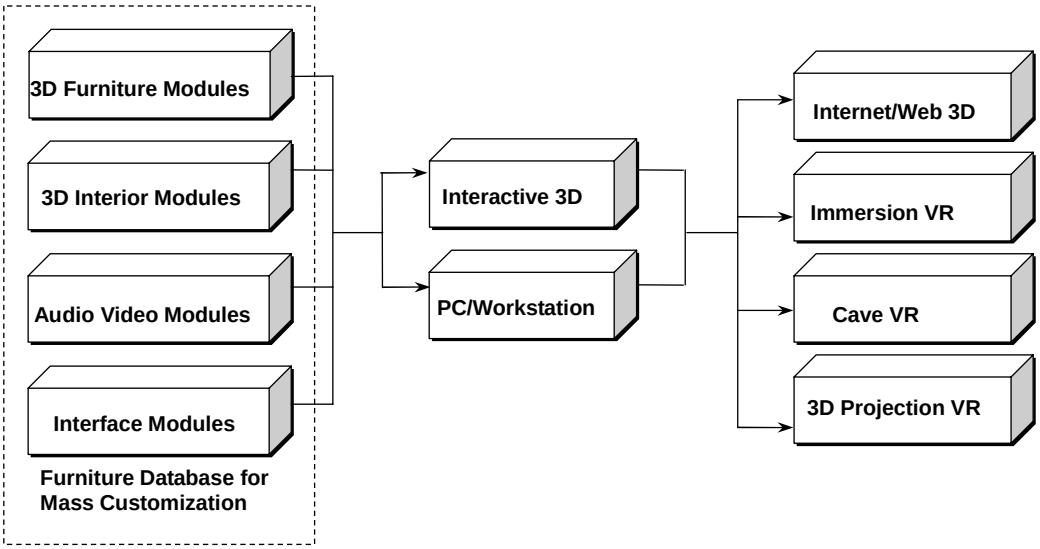

Figure3. The digital elements of the Virtual Furniture Strategy

For mass customization on the web, the product development process must consider the compatibility of all the modules of the single chair. This experimental design shows how the chair can be decomposed into three parts; back, seat and arm rest.

The first step is to develop different styles of back and to create these models in 3D software. The seat acts as a common platform for all modules. Figure5 shows three styles of back on the same platform.

Figure5. Developing various chair back for product database

The second step is to develop different styles of seat and to create these models in 3D software. As the seat is the modular platform, its height above the ground should be constant. Figure6 shows 3 kinds of seat.

Figure6. Developing various chair seat for product database

Developing the arm of the chair and create these 3D models in 3D software is the third step. Figure7 shows 3 kinds of model we have developed. Except these 3 steps we can also add others types of customizable attributes, such as different kinds of timber, painting, materials, etc.

Figure7. Developing various arm rest for product database

Within this experimental design there are at 27 (3*3*3) alternative configurations for users to customize their own product. These components will export into 3D interactive software for integration. Meanwhile, the 3D interactive interface and the interior environment can be created as well. Furthermore, we can customize one sofa set from those configurations.

As furniture is part of architecture, it is important to see what the furniture looks like in the interior where it will be used. The 3D interface offers typical styles of

interior design whereby customer can chose one interior design similar to their own for their customized hardwood furniture. In another word, customer can customize their own hardwood furniture according to their style of interior. Figure 8, 9 illustrates various chairs can be achieved with different virtual elements with selected interiors.

Figure8. Variation of selected Zen chairs with its interior

Figure9. Variation of living room chairs with its interior

E. Conclusions

The digital architecture has been playing an important role not only in architecture design but also in visual communication design and virtual furniture design. Through the exploration and the implement of virtual furniture design, we can conclude that:

1. The generative form and free form give architecture and furniture more dimensions on creation new form of representation.
2. The digital architecture is a new representation on visual information design and interactive environment which lead the furniture design to a new approach with Interactive 3D.
3. The Virtual Furniture Design (VFD) offers the best solution to individual customer with satisfaction on purchasing furniture in the digital architecture era.

The digital architecture gives the world more imagination and possibilities. The implement of virtual furniture design bridges the gap with interactive platform for designers and customers in the digital era

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