Research on Interactivity of Architectural Design in the Information Age

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Abstract

With the rapid development of modern information technology, data media technology is increasingly permeated into many fields of social production and life. The architecture industry serves as an indispensable field of human development, on which information technology has a far-reaching influence. The emergence of graphic image processing technology, three-dimensional model technology, etc. adds the interaction between designers and participants to the architecture design concept. At the same time, the arrival of information age, the emergence and popularization of various high and new technologies have provided new design concepts and methods for the development of architecture industry. However, it is also necessary to understand that the influence of information technology on architectural design has certain limitations, and the participation and interactivity of various units also have problems of uncertainty. Therefore, in this paper, on the basis of analyzing the characteristics of digital information media in the information age, the integrated optimization research on energy consumption of architectural design is carried out, and the multi-objective optimization mode of fitness function under the genetic algorithm is used to finally obtain the main optimization process of energy consumption of architectural design. It is expected that in the development of the following-up architectural design, the real interaction between architects and participants can be achieved, thus to jointly promote the continuous development of architecture industry.

Keywords: Information age, Architectural design, Interactivity, Characteristics.

1. RESEARCH BACKGROUND

1.1 Literature review

With the arrival of information age, information technology, digital media and other modern technologies have penetrated into the architecture field, and have exerted far-reaching influence on concepts and methods of architectural design. Therefore, many scholars have conducted in-depth studies on the design of architecture and the interaction of multimedia in this new age of technological information. Liu Yueqin and Lin Xuanquan took the public space design of 11 venues in Pudong Park for Shanghai World Expo as an example, discussed many challenges faced by urban public space design from the rational perspective, and argued that the layout and planning of architectural space can be designed by interactive experience space atmosphere creation, humanized expression, operation management cooperation during the expo and other aspects (Liu and Lin, 2010). Zhuang Lili, Zeng Jiantook contemporary Chinese and foreign typical cinema as an example, carried out research and discussion on informatization design of cinema building from the aspect of cinema layout, humanized space design, stylized appearance design and intelligent management mode, providing references for future cinema building design (Zhuang and Zeng, 2013). Wei Zongcai, Xi Guangliang argued that it is particularly important to study the characteristics of urban functions in the information age, and globalization, flexibility, complexity, differentiation have become the main characteristics of urban functions in the information age (Wei and Xi, 2013). From the grand pattern of current information technology, Tang Xianghui explored the influence of Chinese tea culture on interior space design under the new information background and dug out the way of interior space design with cultural connotation in the information age (Tang, 2017). With Chinese classical garden as the object of study, Zhai Jun explored how modern gardens retain the essence of their own culture to be passed on under the background of globalization, thus trying to explore the inheritance and development of Chinese classical garden in the gap between times and traditions (Zhai, 2009).
1.2 Research purpose

The information age is also known as the age of computers or digital media, which is the age relying on the information, including knowledge, technology, new media, etc. for production. The arrival of the new age makes digital information becomes an important strategic resource, and this strategic resource is the basic element that constitutes the productivity (Zhao and Yu, 2014). The rapid development of information technology enables the spread of various carriers and the media through information technology get a wider range of rapid spread, and human's life also enters an era of unprecedented information prosperity. It can be said that we are in a world of information, and any technological implementation and grafting cannot be inseparable from information technology (Xu and Zhang, 2012). Through such quiet change, information digital technology is gradually becoming integrated and constantly changing the production and life style of everyone. Absolutely, traditional design concepts and methods in the architecture industry have been unable to better apply to more consumers, but the arrival of the information age has provided the platform and conditions for transformation of the architecture industry. However, with the emergence of information technology, digital media technology, three-dimensional technology and other technologies, the architectural space design technique in the new age has not fully developed this technological advantage (Jia and Mao, 2015). For this purpose, this paper mainly analyzes the characteristics of the age of digital information media in the information age, deeply analyzes the application of information digital media technology in architectural design, and obtains more comprehensive and professional knowledge of information technology through analysis. Thus, only with the professional knowledge of the information digital media technology can architect designers be able to take a better view, carry on real-time application of information technology, and get more perfect performance in the space design of architecture, so as to extend the breadth and depth of architectural design to achieve more comprehensive docking and interaction between information technology and architectural design, and provide certain theoretical basis for future architectural design.

2. CHARACTERISTICS OF DIGITAL INFORMATION MEDIA IN THE INFORMATION AGE

In terms of the digital technology of modern architecture, the information media can establish the spatial structure connection of each other based on the graphic image integration and other processing technologies, and then assemble into an information integrated three-dimensional space system with interaction (Zhu and Ai, 2012). Therefore, for informatization design of architecture, the modern information technology media has the characteristics of interactivity, integration, artistry and interestingness, etc.

2.1 Interactivity

The interactivity of information technology media is usually realized by virtue of activities of participants. That is, the interaction and transmission of information between the participants and the products to be exhibited can be realized through modern communication and other technologies, thus to make the spread and reception cycle of the information of the products to be exhibited form a two-way process (Hao and Sun, 2017). What's more, with increasingly developed information technology today, the interactivity of information media can not only provide convenient and operable means for users and controllers, but also broaden the application fields of information technology. At the same time, this interactivity can also greatly enhance the user's mastery of information, thus to extend the time-limit of information, which is in sharp contrast to the traditional information. So, the interactivity of modern information technology is one of the important characteristics of modern digital technology, which is closely related to people's life and is also widely used in modern architectural design.

2.2 Integration

Digital information technology can process all kinds of graphic images and sound videos, etc., and then them integrate into a new form of expression, so that people can clearly master the information needed (Cheng and Yang, 2008). In addition, digital information technology can also combine the various organs of human beings to obtain information from the outside world, so as to clarify the external information, thus being in a more realistic and clear environment. In modern design and application of architecture, it is an external manifestation of transfer of information technology from traditional industries. The combination under this kind of transfer makes the architectural design no longer the traditional architecture, but the product of combined design of various high and new technologies. It helps traditional architectural design breaks the spatial limit and realizes the three-dimensional representation in three-dimensional space. Therefore, the integration characteristic of the information digital media is a way, while the interactivity is the essence.
2.3 Interestingness

Modern information technology can make the products to be exhibited more interesting, so that all products can realize the support and realization of information technology (Zhang, 2017). The emergence of digital information technology provides a broader entertainment space for product visitors, and on the basis of attracting the attention and curiosity of the audience, makes them more concentrated on the acquisition of product information. With the emergence of three-dimensional technology, virtual reality and other technologies, much more interestingness is added. In the information age, participants can choose various data based on their actual needs by virtue of the digital information technology.

2.4 Artistry

Digital information technology is also an effective integration of art and technology to some extent. So, in addition to its own technological properties, it is also artistic. We can say that modern information technology occupies "half of country" in the field of artistic creation. Therefore, digital information technology has led the modern aesthetic art to move towards informatization, which not only enriches the form of information expression, but also enhances the expression form of art. For example, as a high integration of technology and cultural art, the exhibition architecture is more mediumized. On the one hand, the exhibition architecture serves as a communication medium of information, which is directly aimed at the vast majority of human beings and meets the needs of information exchange between people. On the other hand, the introduction of large number of modern information digital media has further enhanced the media characteristic of diversification of exhibition architecture. As shown in Table 1, it presents the relationship between modern information media and exhibition architecture.

<table>
<thead>
<tr>
<th>Integration</th>
<th>Information digital media</th>
<th>Exhibition architecture</th>
</tr>
</thead>
<tbody>
<tr>
<td>Integration media</td>
<td>Digital graphic image, text network, etc.</td>
<td>Graphic image, integration with digital media, voice, animation, network, etc. added in the architectural design</td>
</tr>
<tr>
<td>User</td>
<td>New media users</td>
<td>Exhibition architecture visitors</td>
</tr>
<tr>
<td>Interaction object</td>
<td>People and information, between people, etc.</td>
<td>People and information, between people, people and space and other architecture environment</td>
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3. ENERGY CONSUMPTION INTEGRATED OPTIMIZATION MODEL FOR ARCHITECTURAL DESIGN IN THE INFORMATION AGE

Under the background of modern information technology, the energy consumption calculation method of architectural design can be divided into two categories: simplified calculation method and dynamic energy consumption calculation method (Fei and Ma, 2015). The simplified calculation method can simplify the theoretical method, such as the widely used bin method (BIN). The dynamic calculation method is a kind of dynamic model of the building heat transfer process, which should be on the basis of the detailed modeling information to achieve accurate calculation, and is not suitable for use in the early stages of architectural design. For this purpose, BIN is chosen as the calculation model of building energy consumption in this paper. The calculation model can calculate the energy consumption at different temperatures and then through multiplying by the corresponding time number of each temperature segment, the average annual energy consumption of the buildings to be designed can be obtained. BIN method can calculate the temperature frequency meteorological parameters, such as temperature, humidity and moisture content, etc. in a certain time period. Therefore, if the temperature frequency band value is set as $\Delta T$, and $T$ represents the temperature of the midpoint in a certain time period, then $(T - \Delta T/2) < T \leq (T + \Delta T/2)$, and the representative value of the moisture content in the time period can be obtained hereby. BIN method can calculate the temperature frequency parameters in different time periods according to the calculation purpose of different energy consumption. In this paper, the temperature frequency parameters are obtained on the basis of the typical climate annual temperature data, and with 2° for statistical interval, the set energy consumption heating period is calculated to be 11.9-2.31, of which the maximum temperature and the minimum temperature are respectively 40°C and -15°C.
If there is a linear relationship between architectural structure load, air infiltration load and outdoor temperature, then insolation load is:

$$SCL = \sum_{i=1}^{n} (MSHGF_i \times AG_i \times SC_i \times CLFT_i \times FPS_i) \times \frac{1}{A_j}$$ (1)

So, SCL and outdoor temperature $T$ have the following linear relationship:

$$SCL = M \times (T - T_{ph}) + SCL_i$$ (2)

Where, $M = (SCL_f - SCL_i) / (T_{pc} - T_{ph})$

Through the above methods, conduction load and internal load can be respectively obtained as follows:

$$TCL(THL) = \frac{\sum_{i=1}^{n} (A_i \times K_i)(T - T_i)}{A_j}$$

$$CLI = \frac{AU \times CL_{max} \times HF}{A_j}$$ (3)

4. MULTI-OBJECTIVE OPTIMIZATION OF FITNESS FUNCTION UNDER GENETIC ALGORITHM

The genetic algorithm is a process of simulating the selection of survival of the fittest of natural environment, while the fitness function simulates the survival environment of each individual, so as to decide the survival of the fittest for each species. Therefore, the fitness function provides a reliable basis for obtaining the optimal solution.

If the objective function is respectively the problem of maximization and minimization, and $c$ is the conservative estimated value of the objective function boundary, then:

$$Fit(f(x)) = \frac{1}{1 + c - f(x)} \quad c \geq 0, c - f(x) \geq 0$$

$$Fit(f(x)) = \frac{1}{1 + c + f(x)} \quad c \geq 0, c - f(x) \geq 0$$ (4)

Multi-objective problem is the focus of research in many fields, which needs to satisfy multiple objectives under certain constraints, so as to choose the optimal solution. Generally, assuming that there is an optimization variable $X = (x_1, x_2, ..., x_n)$ that meets the constraints of $g_i(x) \geq 0 (i = 1, 2, ..., k)$ and $h_i(x) \geq 0 (i = 1, 2, ..., l)$, and assuming that there are $r$ optimization objectives, and they conflict with each other, then the optimization objective can be expressed as:

$$f(X) = (f_1(X), f_2(X), ..., f_r(X))$$ (5)

The inheritance optimization design objectives for building energy conservation are analyzed above, and building energy consumption, natural lighting and natural ventilation are conducted of the minimized fitness function. Then the overall optimization prediction model can be expressed as:

$$\max F(x) = \begin{cases} 
\min F_{building\ energy}(X) \\
-\max F_{natural\ lighting}(X) \\
-\max F_{natural\ ventilation}(X)
\end{cases}$$ (6)

Finally, the main optimization process is obtained as shown in Figure 1.
Figure 1. Optimization Flow Chart of Building Energy Consumption Algorithm

5. CONCLUSION

In short, with the constant development of technology, the new social information background will certainly produce big influence on various industries. For the architecture industry in this background, the grafting of information technology makes the vast majority of people able to communicate with architectural designers through more channels and express their feelings and opinions. The introduction of information technology in the architecture industry produces revolutionary influence. Therefore, under the background of new era, the design of architecture industry also needs to keep up with the trend of the times, and meet the demands of vast majority of people for the concept of architectural design, so that their demands for life and production will be more convenient. Information technology has also further strengthened the public participation of demanders, and a circular supply chain has been formed between building designers and demanders, so as to together promote the architecture industry, and make it achieve constant development under the new social information background.

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