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Design of Digital Guidance System based on Visual Communication of City Information

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ABSTRACT

After the reform and opening up, China's economy has entered a high-speed development road, and urban infrastructure construction has rapidly expanded. With the development of cities, the increase in population and the richness of city functions, the environment is becoming increasingly complex. Still, the design of the city guide needs to be revised. The actual role of the existing design is minimal, so it does not meet the current wizard needs. An excellent guide system can provide excellent guidance service to people and become a window for people to observe the city, thereby increasing people's good impression of the town. Based on the above points, the backward plane symbols' backwards design ideas were discarded in this paper, and more advanced information technologies and B/S architecture were used to design a set of city vision transmission digital guidance systems. A better information interaction model was intended from the new angle of visual transmission of urban information.

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1. Introduction

With the progress of society, the development of science and technology and the improvement of living standards, people are paying more and more attention to the quality of their living environment. The image and culture of a city are mainly reflected in its public spaces, so public infrastructure should be well constructed and better ways should be used to show it [1]. Now, the world has entered a digital era. The technology in the digital era can make people understand the information intuitively, and the city will move towards the digital road. Therefore, digital technology will become the best carrier of the city's guiding function. Although cities in our country have already built guidance systems, they still need to be improved. Compared with the mature wizard systems in foreign countries, our systems are still in the initial stage, and system forms remain in the plane symbol stage. No unified planning has been formed among cities [2]. Therefore, they can only show people the public space of the city in a stereoscopic way and effectively show the city's features to people. They serve as the original function of the city wizard system. Facing increasingly complicated urban structures, prosperous urban constructions and

rapidly changing urban environments, the cities now have a population scale, construction scale and traffic scale that have never been before [3]. The old guidance system has been unable to meet people's needs, so it is necessary to speed up research on new wizard systems. However, the unbalanced development scales of our cities and the imperfect digital construction industry have brought many difficulties in designing digital guidance systems based on city information visual communication. In such a significant context, we must overcome difficulties to complete the system design [4].

2. State of the Art

2.1. Research Status

There are many city guide systems, but they are still in the old graphic symbols design stage. In terms of the scientific and holistic design, they still have a lot of shortcomings, so they can't meet the current wizard functional requirements. A few wizard systems are based on digital technology but only focus on technical indicators without regard to people's interactive needs. In addition, their interface designs are pretty outdated, and the system interaction is not user-friendly with the simple data information display, so they can't give play to digital advantages. Compared with the original planar symbol designs, they have not achieved a qualitative breakthrough, and their guiding abilities have been significantly reduced. Hence, they need to be further studied and improved.

2.2. Research Significance

As a window to observe the city's image, the designers must consider the guidance system seriously. Excellent guidance systems can better show the city's cultural features and structures. Still, they can also promote the city residents' confidence and sense of belonging and improve the people's enthusiasm for the construction of public facilities, thus forming a virtuous cycle. Moreover, excellent guidance system designs can meet the needs of people in a fast-changing city. Therefore, it is of great practical significance to study and design the digital guidance system based on visual communication of urban information [5]. After studying the existing guidance systems, the deficiencies were identified and improved, so better guidance systems were designed to provide better guidance services.

3. Methodology

3.1. Design Principles

A digital guidance system design based on urban visual communication must follow human visual habits. These habits are usually divided into three categories: graphic visual habits, color vision habits, and visual word habits.

The graphic visual habit means people usually interpret graphic meanings according to their previous understanding. People are accustomed to combining the graphs they have seen before to judge the meaning of new shapes. For example, in the beginning, people regarded the symbol "X" as the symbol of mistakes. Still, after it was added to the guidance system, it now means prohibition and other negative meanings. This symbol is easy to understand, so it has a very wide range of practical values. According to this visual rule, icon design requires a large amount of conventional marking to reduce the difficulty of using the system [6]. Colour visual habit means that when people see a certain colour, they will have different emotions, and after some time, the relationship between this colour and emotion will be solidified. After studying this phenomenon, psychologists have found that different colors can bring different emotions. For example, when red is seen, people associate it with prohibition, so it can be used as the main color for dangerous and prohibited hints in the wizard system. Yellow is very attractive to people's attention, so it is used for marking the background colour, but it does not have a prohibited meaning. The mix of blue and white is also very attractive, and blue is calming, so they are often used as guides for urban roads. Green is the color of nature, and it can relieve fatigue, so there are green signs on the highway to relieve driver fatigue and remind them of traffic safety [7]. The above presentations are the application of different colors in the guidance system. However, it is important to note that any color scheme must avoid visual stimuli to avoid visual fatigue and negative effects on the transmission of information. With different shapes and colors, the text can convey the exact meaning that the

other two habits can achieve, so the text has an undeniable advantage in information transmission, and this advantage stems from the text's literal meaning. However, in actual use, external factors impact the recognition process, which requires the specialized design for fonts and contents of texts. Considering the effect of speed on human vision, text needs to be as simple as possible, and text fonts and sizes need targeted designs [8]. In the digital guidance system, text information is displayed on the screen so they can meet the special requirements of the special period flexibly and timely in special sections and special times [9].

This paper will design a new digital guidance system based on urban visual communication and build a perfect, easy-to-use guidance system based on people's visual habits.

3.2. Logical Architecture Design

The overall architecture of the program mainly adopts the MVC three-layer architecture: the presentation layer, the business logic layer and the data access layer. MVC is a software design pattern that advocates the separate implementation of software interfaces, data processing, business logic processing, and so on [10]. Therefore, in the development or later maintenance process, if designers need to modify or expand related functions, there will be no changes or errors due to the complex association of software codes. The V layer represents the view layer and provides the user's display interface. The C layer represents the control layer, responsible for accepting and analyzing user request information. According to the identification of the operation mark, it can transfer the user information to the corresponding entity operations in the M layer for the process (including POJO, action, service, and Dao). The M layer represents the model layer, which is the core layer of the business logic processing. In this layer, different functions are encapsulated in other packages, and there are specific methods for implementing these functions in those packages. In MVC, data access often occurs on the Dao layer, and the system implements the database operation by mobilizing the Dao layer [11]. The logical architecture diagram of the digital guidance system based on the visual transmission of city information is shown in Figure 1.

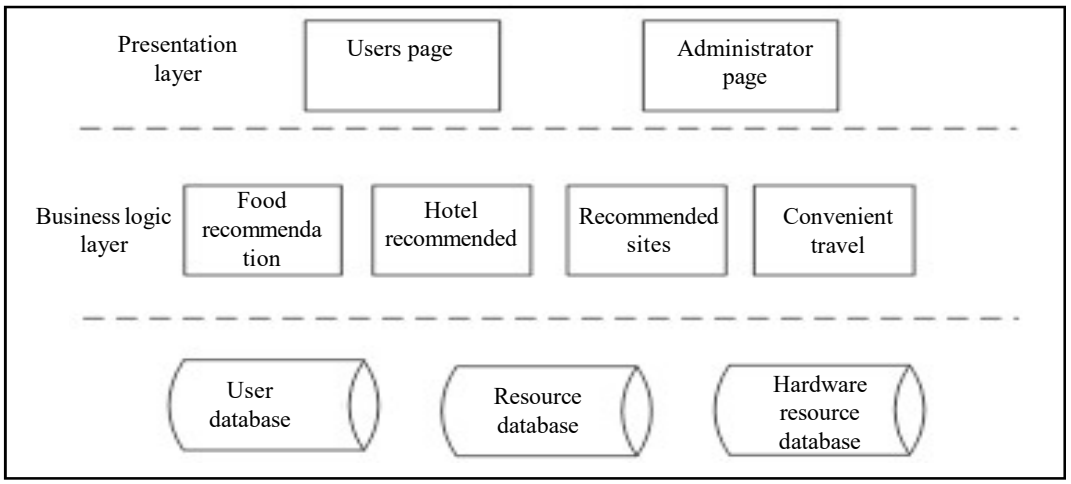

Figure 1. System logic architecture diagram

3.3. Physical Architecture Design

In the design process, the digital city information system-oriented visual communication system hardware and software include the system's foreground architecture, background architecture, server architecture application deployment, and so on, embodied in the following aspects. The architecture: the front of the UI presentation layer uses web page response design based on the BootStrap framework, so whether users use a PC or mobile terminal, they can easily log into the digital guidance system and use the corresponding functions; the structure of the background server is used for receiving the HTTP client request, and based on Nginx, it has web container handling request responses; the overall design of service is based on the ThinkPHP framework and the MySQL database; permission design is based on RBAC standard design; application deployment: Web server, Nginx+Keepalived server, data storage layer, and

MySQL database. The schematic of the system network topology is shown in Figure 2.

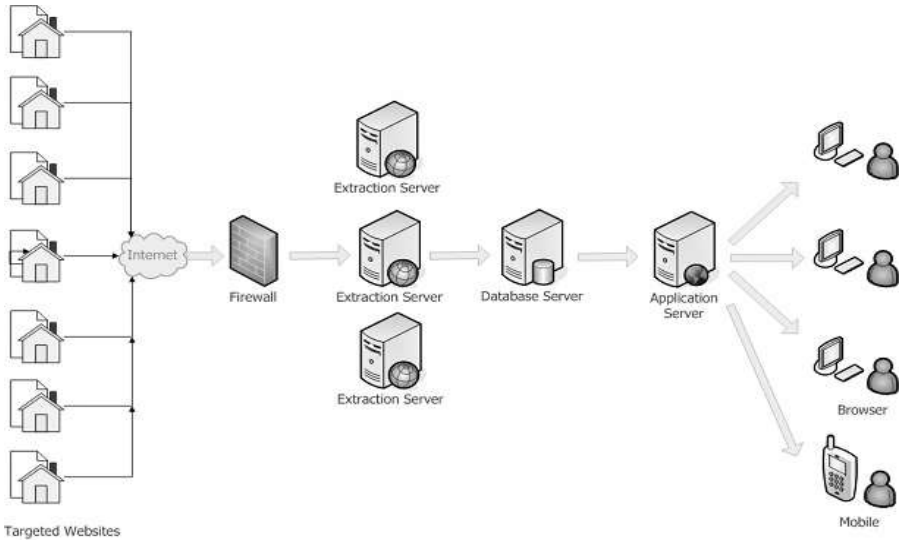

Figure 2. The user terminal function module use case diagram

3.4. Function Module Design

The design of a digital guidance system based on visual communication of city information adopts modular design to update the system's following functions. At the same time, the modular design concept also makes the program more consistent with the requirements of sustainable development. According to the function of a digital guidance system based on visual communication of city information, the design of this system can be divided into a client module and a server module. The client module can be divided into the following functions. The food recommendation module includes two sub-functions: dish recommendation and restaurant recommendation. They are displayed on the front page with pictures and texts, and this model mainly recommends local exceptional restaurants and dishes. The hotel recommendation module mainly recommends local cost-effective hotels. The attraction recommendation module mainly recommends local tourist attractions as references for visitors. The convenient travel module primarily provides accurate geographical location information for users. Based on the above analysis, the client's use case diagram is shown in Figure 3.

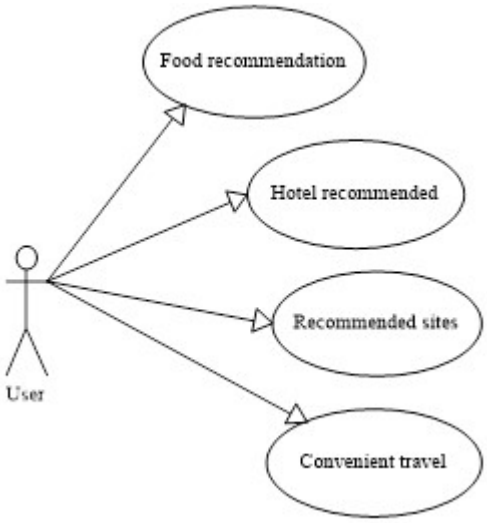

Figure 3. The user terminal function module use case diagram

Administrator information management mainly manages the administrator's account information and login passwords. User information management: administrators can use this function to manage the user's relevant information. Food information management: Administrators can use this function to manage the system-related food information, including food information views and modifications. Hotel information management: Administrators can use this function to manage the system's information and add, view, modify, and delete hotel information. Travel information management: Administrators can use this function to manage the system's travel information. Exit management: users can exit the current account login status and jump to the login page of the system background. According to the above analysis, the use case diagram of the server function is shown in Figure 4.

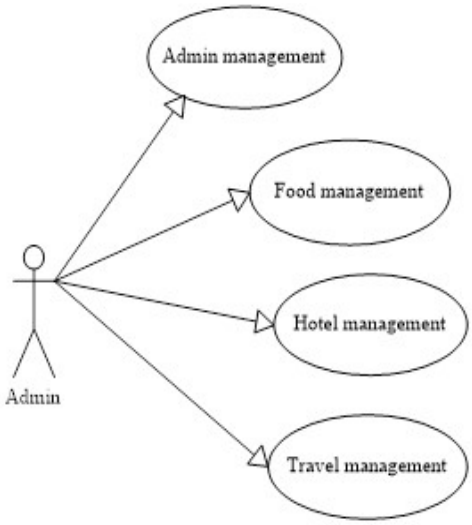

Figure 4. The server-side functional use case diagram

4. Result Analysis and Discussion

4.1. Test Overview

Software testing is an integral part of the project construction and a comprehensive and perfect test of the previously developed codes. Testing the already-developed systems can reveal existing problems or hidden problems. After a timely fix to the issues, regression testing can be carried out. In repeating tests, the codes can constantly become robust and stable [12].

The software system was tested through the corresponding test methods. During the testing, some related errors were obtained and repaired to ensure the system's stable operation for a long time. At the same time, we hope to correct some subtle flaws we haven't noticed in the software development process to achieve the fundamental purpose of software testing [13].

4.2. Test Methods

Program testing means testing the already designed programs, including the hardware environment, the network environment, the external device, the software environment, etc. The purpose of the test is to detect vulnerabilities and errors before the program is officially released to the web to improve the quality of the application on time, the content of the program that is not consistent with the user's needs and omissions, and to put forward more reasonable solutions to improve the quality of the use of the program [14]. Program testing is divided into white-box testing and black-box testing. White box testing means that the program is considered a transparent box, and it tests according to the program content's design structure and interface to ensure that the program's design is in line with the expected requirements. Black box testing takes the program as a black box and then designs some corresponding test cases to test the functional modules of the program to ensure that the

Function	Test the user login process				
Purpose	Verify the concurrency of the system when the performance is reached 200 times				
Methods	Virtual maximum limit of 250 concurrent, minimum 50 concurrent test scripts				
Concurrency	Average response time (seconds)	Transaction maximum response time (seconds)	Average transactions per second	Transaction success rate	Clicks per second
50	0.5	1.1	102.154	100%	50.00
100	0.8	1.3	117.941	100%	125.941
150	1.7	2.9	231.667	100%	154.742
200	2.5	4.5	292.173	100%	245.851
250	10.2	21.7	180.411	100%	271.212
Number of concurrent users	CPU utilization	Utilization rate of MEM	Disk I/O situation	DB parameter (M)	The other parameters
50	7%	4.53	451.319	3500 /400	7%
100	11%	8.16	579.951	3500 /400	11%
150	13%	12.32	671.532	3500 /400	13%
200	21%	19.21	785.435	3500 /400	21%
250	40%	31.13	800.233	3500 /400	40%

Table 1. A test table that is concurrent with some users of the system

program design meets the expected requirements [15]. The digital guidance system designed in this paper is mainly based on the urban visual communication system, which uses the black box testing method. The system's performance was tested through LoadRunner software. By simulating the system with different levels of user access, the overall response time of the test system was used to determine whether the system meets the actual load requirements.

A 10-minute test was carried out using 50, 100, and 200 concurrent numbers to systematically test the program's main functions. The average pass time of users and the pass time of 90% were recorded. Table 1 shows part of the test situation of operational performances.

Based on the above test results, the following conclusions were obtained. Based on the same data concurrency, the registration submission processing ability is stronger than the login module home page display. In the case of 100 concurrent numbers, the system can support the normal use of about 150 thousand users within 8 hours.

After testing, all operations can meet the user response time requirements. When browsing a tutorial course, the loading speed does not affect the user's experience using the function.

4.3. Analysis of Program Test Results

The program function test case covers functional tests at several levels, the most prominent of which are the functions of the digital guidance system based on urban visual information transmission. The functional test results are shown in Table 2.

By tracking debugging and regression testing of design defects of the program's main functions, 76 Bugs were eventually resolved. The testing methods used by software programs should be applied to program management according to standards, and the development requirements of programs should be pointed out according to different test results. The management level shall be stated by general requirements. The functions of the whole program can be realized so that the regular operation of the program can be stably and safely promoted.

Function module	The total number of cases	The total number of defect	Resolved	Unsolved
Admin management	210	18	18	0
User management	185	19	19	0
Course management	98	14	14	0
Convenient travel	102	29	29	0

Table 2. Functional test results table

5. Conclusions

With the progress of society, the development of science and technology and the improvement of living standards, people are paying more and more attention to the quality of their living environment. The image and culture of a city are mainly reflected in its public spaces, so public infrastructure should be well constructed and better ways should be used to show it. A set of digital guidance systems that are easy to use in people's daily habits and can express their guiding intentions accurately is needed when a city has developed to a certain level. It is a city-supporting facility that can really and effectively facilitate our daily lives and is also necessary for future urban development. At present, the guidance system of a digital city in China is not perfect, as it is at the preliminary stage of development with many shortcomings and defects, so in the future, there will be room for its development; this is an opportunity and also a challenge. With the development of society, the expansion of the city and the improvement of digital guidance systems, more advanced information technologies and B/S architecture can be used to design a set of digital guidance systems based on urban visual communication. It can use its vast display spaces to play, bring tangible convenience to city life, and bear more city information.

References

[1] Osder, S. (2015). DC-9-80 Digital Flight Guidance System Monitoring Techniques. *Journal of Guidance Control & Dynamics, 4*(1), 41-49.

[2] Uesugi, K. H., Dattilo, A. M., Black, M. M., et al. (2016). Design of a Digital-Based, Multicomponent Nutrition Guidance System for Prevention of Early Childhood Obesity. *Journal of Obesity, 2016*(1), 1-12.

[3] Haeussler-Sinangin, Y., Dahlhoff, D., Schultz, T., et al. (2017). Clinical performance in continuous curvilinear capsulorhexis creation supported by a digital image guidance system. *Journal of Cataract & Refractive Surgery, 43*(3), 348-352.

[4] Brook, A., Carney, R., Krasovec, J., et al. (2015). All digital guidance and control systems. *Journal of Spacecraft & Rockets, 7*(5), 613-615.

[5] Portalés, C., Gimeno, J., Vera, L., et al. (2015). Towards a Guidance System to Aid in the Dosimetry Calculation of Intraoperative Electron Radiation Therapy. *Journal of Imaging, 1*(1), 180-192.

[6] Higgins, R. (2015). Influence of the intelligent evacuation guidance system on crowd evacuation in case of building fire. *Journal of Safety & Environment, 69*(1), 13-18.

[7] Xnav Technologies L. (2016). Image guidance system for detecting and tracking an image

pose. *Shanxi Architecture, 21*(19), 2-6.

[8] Ter-Ovanesyan, E. (2016). Catheter guidance system. *Value Engineering, 38*(4), 473-505.

[9] Inc, H. M. (2017). Surgical guidance system with low interference metal support structure. *Journal of Henan Science & Technology, 22*(3), 362-399.

[10] Ahmad, W. (2017). Vision Guidance System for the Robotic Roadway Message Painter. *Journal of Henan Science & Technology, 22*(3), 362-399.

[11] Anstett, D. (2016). Warning and guidance system to assist the parking of a vehicle. *Energy & Buildings, 132*, 91-106.

[12] Madegowda, R. (2016). Method for providing real time guidance to a user and a system thereof. *Building Structure, 19*(02), 492-336.

[13] Nielen, T. M. J., Smith, G. G., Jong, S. D., et al. (2016). Digital Guidance for Susceptible Readers: Effects on Fifth Graders' Reading Motivation and Incidental Vocabulary Learning. *Journal of Educational Computing Research, 136*(3), 523-538.

[14] Sun, G. (2016). Application of Digital Guidance Technology in Sports Leisure Equipment Design. *Atlantis Press, 20*(1), 64-69.

[15] Nelson, G., Wu, M., Hinkel, C., et al. (2016). Improved targeting accuracy of lung tumor biopsies with scanning-beam digital x-ray tomosynthesis image guidance. *Medical Physics, 43*(12), 6282.