Preliminary Study on Data-driven Building Intelligent Design Program

Weiling Yin
Linyi University
276000
6212154474jqzy@dlvtc.edu.cn

Abstract. This article analyzes the basic characteristics, specific applications, and application experience of data-driven. The author studies the basic concepts, design ideas, basic positioning, application advantages, and application disadvantages of the building intelligent design program. This article analyzes the application points of rational selection of maintenance methods, Internet of Things technology, cloud computing technology, BIM technology, perception technology, and distributed processing technology. The purpose of this article is to improve the rationality of the content of intelligent building design and create good conditions for the orderly progress of subsequent construction activities.

1. INTRODUCTION
In the context of accelerating social development, people's requirements for construction projects are also increasing. With the continuous improvement of the intelligent technology system, intelligent building design has also become an important development trend. In the process of intelligent design, data-driven is a processing method that is often applied. Based on this method, the optimization of building intelligent design program can not only improve the related content of the program, but also accelerate the speed of building intelligent design and improve the design quality of construction projects.

2. DATA-DRIVEN RELATED CONTENT DISCUSSION

2.1. Basic Features
Based on past application experience, data-driven has the following application characteristics. (1) Correlation is greater than causality. When using data-driven methods to conduct data analysts, its dependence on correlation is much greater than causality. Causality is a predictable type of relationship in application, but correlation cannot be predicted, which is also a basic feature of social practice science. (2) Data is greater than experience and intuition. Data is an objective fact, and experience and intuition are the thinking in the human brain. Data-driven methods require data to be greater than experience and intuition. In essence, they hope to replace the elements of experience and intuition in the human brain with objective and rational evidence and positivist methods. (3) Full processing rather than simple sampling. The mining of the correlation between data needs to rely on the full processing of the data. Specifically, it is necessary to traverse almost all the data and find the association, rather than draw conclusions by sampling the data alone.
2.2. Specific Application

The data-driven approach not only sprouted in the architectural design industry, but also has a lot of practice in the field of data-intensive urban planning. Roads, road networks, pedestrians, traffic, etc. in cities naturally have big data characteristics due to the high density of cities. For example, the Brown University research group uses big data analysis to determine the best construction location for engineering facilities. It can find construction sites that can satisfy the full utilization of resources through data such as the flow of campus people and the distribution of main functions of the campus, so as to achieve the results that are most beneficial to students and the school. At the same time, it also has good applications in the clothing industry. For example, Prada company began to use data technology in 2001 to study the perceptions of customers in the clothing market on design, which is achieved through the collection of customer behavior data. By embedding an RFID chip in the product tag, the Prada store realizes the "identification" of each product in the store. When customers pick up these RFID-embedded clothes in the store and go to the fitting room, the fitting room can record the fitting information. Subsequently, the system will sort out this information, understand people's preferences for clothing, and provide data reference for subsequent marketing strategy formulation.

2.3. Application Experience

As intelligent technologies continue to mature, people gradually accumulate big data, and at the same time realize that data can play a role in data-driven methods. The data-driven approach has achieved gratifying application results in the exploration of other industries, such as machine translation, speech recognition, auto-driving cars, and Go. As for the construction industry, with the accumulation of data and the development of building informatization, architects will eventually enter the era of big data like other industry professionals who are already fully informatized. The data-driven approach is not only a technology, but more importantly, a method and mode of thinking. Data-driven thinking has a significant impact on architectural design. Therefore, in practical applications, we need to optimize the design of intelligent buildings. At the same time, we also need to clarify the value of data-driven applications and make rational use of the application model to improve the reliability of the analysis results.

3. Analysis of Building Intelligent Design Program

3.1. Basic Concept

Building intelligence refers to the use of artificial intelligence to optimize the design of the target building to achieve the established design goal. The building intelligent design program refers to the comprehensive application of various technologies to simulate the architect's design ability to complete the corresponding design content. In the specific application process of the program, we need to use the functional design as the basic condition to expand the coverage design. Moreover, we need to organize the relationship of the building structure to get the required design content.

3.2. Design Ideas

When building intelligent design, the basic design ideas are as follows. Firstly, we need to do a good job of collecting basic data, and understand the location conditions, geographic environment, and climate conditions of the area where the building is located. We can use this as a basis to develop intelligent building design such as structural combination, HVAC system layout, underground pipeline arrangement, etc., to improve the design effect of the building. Secondly, we should rationally apply relevant design software, including computer technology, CAD software to scientifically organize the collected data. Meanwhile, we need to do a good job of collating related modules and checking the application of the program, and constantly improve the reliability of the designed content.
3.3. Basic Positioning
The design itself is a kind of basic behavior that transforms the surrounding application environment, and the basic condition of building intelligent design is to obtain value data from the existing building data to complete the optimization processing of the subsequent design content. The main source of such data is the practical experience of previous designers. Based on experience, feature data is extracted and related behaviors that imitate feature activities are established. It can be seen that intelligent programming has strong subjective initiative in practical applications, and its positioning is also a kind of tool for building content optimization. It is not much different from traditional design software, such as CAD software, sketch master and other software, which is also the content that needs to be paid attention to in design practice.

3.4. Application Advantage
In the specific application of the program, it has the following application advantages. Firstly, it can not only better meet the design needs of architects, and provide reliable retrieval functions in the application phase of the program, but it also has a richer original database content. This also improves retrieval speed. Secondly, it can provide designers with a periodical reference. It can use quantitative calculation methods in program applications to process the architectural design content in stages to obtain some guiding data. The design results obtained will also be used as reference content in the specific application process, and have strong practical value. Thirdly, it has stronger convenience, and the designed service program is a network-based application. The user does not need to download and then install it when searching or using it. This also simplifies the installation steps during the period and meets the design requirements of the market.

3.5. Application Disadvantages
There are still some application disadvantages in the application phase of the program, and the specific content includes the following points. (1) Judging from the current program application situation, the rationality of the design content has a direct connection with the previous data collection. If the completeness of the basic data is low, the integrity of the design content will also be reduced in practical applications, which will affect the level of the design content. (2) More than 50% of the content of the design program in the application process stays in the functional design of the content. But for deeper design content, such as abstract content, structural detail expression, etc., there is still a situation to be improved. This is also a problem that needs to be paid attention to in the follow-up development of program design. (3) The intuitiveness of the interactive form needs to be improved. At present, many interactive interfaces of intelligent programming mostly stay at the web page interactive level. It is affected by factors such as list options, retrieval progress bar, design requirements, etc., and the interaction effect is relatively poor, and it cannot give users an intuitive experience. This is also the content that needs to be focused on in the follow-up development.

4. KEY POINTS OF APPLICATION OF DATA-DRIVEN BUILDING INTELLIGENT DESIGN PROGRAM

4.1. Reasonable Choice of Maintenance Method

| Maintenance Method          | Basic Features                        | Scope of Application                      |
|-----------------------------|---------------------------------------|-------------------------------------------|
| Maintenance Afterwards      | Start Maintenance After the Problem Occurs | Over 70% of Service Companies Use         |
| Regular Maintenance         | Schedule Maintenance as Planned        | Over 70% of Service Companies Use         |
| Preventive Maintenance      | Advance Maintenance Based on Analysis | Over 70% of Service Companies Use         |
It can be understood from Table 1 that in practical applications, the maintenance methods frequently used include post-maintenance, regular maintenance and preventive maintenance. The specific type of maintenance method to be selected also needs to be selected in accordance with the actual situation. Now it is analyzed in detail. The specific analysis content is as follows.

4.1.1 Maintenance Afterwards

Among the three common maintenance methods, post-maintenance is classified as a passive maintenance method. In the application process of this method, after the system operation failure occurs, the system itself cannot be operated or damaged. At this time, the company began to assign maintenance personnel to carry out maintenance and downtime inspections of the entire system. The main purpose of this type of maintenance method in application is to reasonably solve the system operation failure, so that the system can be restored to a normal working state. However, this maintenance mode requires higher response time for maintenance. If a problem can be responded to in a timely manner, coupled with reasonable handling measures, the negative impact will be relatively small. Otherwise, it will bring users a poor service experience, and even financial losses in terms of property.

4.1.2 Regular Maintenance

Among the three common maintenance methods, regular maintenance is classified as a routine maintenance method. In the application process of this method, after the system has been running for a period of time, the company appoints maintenance personnel to carry out maintenance according to the prepared maintenance plan, and performs shutdown or non-stop maintenance of the entire system. The main purpose of this type of maintenance method in application is to optimize the operating state of the system so that the system can continue to maintain a normal working state. However, this maintenance mode requires a higher level of detail for the time interval of the maintenance plan and maintenance content. If the established maintenance tasks are completed in accordance with the requirements within a reasonable range, the stable working state of the system will also be maintained and the probability of operation failures will be reduced. On the contrary, it will create conditions for the expansion of the scope of the fault's influence and bring about a greater negative impact. Therefore, more than 70% of enterprises choose regular maintenance and post-maintenance for system maintenance to improve the corresponding timeliness after failure [1].

4.1.3 Predictive Maintenance

Among the three common maintenance methods, predictive maintenance is classified as a proactive maintenance method. In the application process of this method, after the system has been running for a period of time, according to the collected monitoring data, the enterprise appoints maintenance personnel to carry out maintenance, and shut down or non-stop maintenance of the entire system. The main purpose of this type of maintenance method in application is to dynamically supervise the operating state of the system. It can carry out related maintenance processing in time when abnormal data jumps, so that the system can continue to maintain a normal working state. However, this maintenance mode has higher requirements for the synchronization of the system monitoring status. If the monitoring data can be synchronized, abnormal conditions can be discovered in time and preventive maintenance can be done. In this way, the stable working state of the system can be maintained, the probability of operation failure can be reduced by 75%, and the maintenance cost can be reduced by more than 30% [2].

4.2 Internet of Things Technology

4.2.1 Data Collection

As a new type of processing technology, the Internet of Things technology has many application advantages in practical applications, and it is also an important technical component of intelligent design programs. In the application of technology, its primary task is to do a good job in data collection.
In the specific data collection, the system will use the provided IP/TCP protocol and compatible interface to collect different types of running status data and running status data. In the meantime, the system can also use sensors to collect environmental operating parameters, including external humidity, climatic conditions, and temperature differences. In this way, not only can the collection task of the established data be completed in a short period of time, the speed is increased by 1.5-2.0 times compared with the previous, and it also lays the foundation for the subsequent finishing work [3].

4.2.2 Identify Positioning
During the operation of the building intelligent design program, there are still some data information that cannot be directly identified and positioned. When processing such data, the system will use RFID technology in the Internet of Things technology to identify it, and in terms of positioning, it will rely on GPS technology for processing to complete the identification and accurate positioning of the client's location. Its main function is to provide reliable data support for equipment operation and maintenance management. In this way, the data management system can be established faster during the implementation of maintenance work, so that it can be in an updated application state. This is also the basic condition for the smooth operation of the system [4].

4.3 Cloud Computing Technology
Intelligent design programs need to perform very cumbersome calculations during operation, and it is difficult to meet the requirements by relying on traditional calculation methods. Therefore, cloud computing technology will also be applied in the establishment of the program. In the application process of this technology, it integrates a variety of network computing methods, parallel computing methods, distributed computing and other algorithms. Simultaneously, the system has also established a cloud to store computing data. This also provides convenient conditions for the smooth access to the calculation results. In addition, in the development of cloud computing work, Saas software, Pass platform, and lass platform are also needed to continuously optimize service content. This can also further improve the service response speed and improve the corresponding service quality [5].

4.4 BIM Technology
In the intelligent design of buildings, BIM technology is also a type of technology that is widely used. In the specific process of use, its role is to establish a corresponding three-dimensional model based on the final feedback result of the program to enhance the visualization of the content itself. In the specific visualization process, the content includes the following two parts. Firstly, visualization of architectural content. It can use the corresponding parameters of the programming feedback to process the details of the building model. The system can help designers find design vulnerabilities faster and optimize design schemes after comparison [6]. Secondly, the visualization of emergency plans. This content is mainly used for system maintenance, using the virtualization function of BIM technology to simulate the application process of the measures to verify the rationality of the proposed measures.

4.5 Perception Technology
In the process of intelligent programming, we need to associate it with the sensing technology, and use sensors, electronic tags, coordinate recognition, coordinate positioning and other methods to collect and transmit the content that needs to be measured and collected. Moreover, the application of perception technology also needs to process the massive amount of information generated. It can use the capture function of perception technology to digitize such information. This is also the basic condition for the continuous improvement of intelligent programs. Furthermore, perception technology will also be used in conjunction with other technologies such as distributed processing technology and cloud computing in applications, so as to provide a reliable application basis for the continuous optimization of the system itself [7].
4.6. Distributed Processing Technology

Except to the technical application points mentioned above, distributed processing technology is also a commonly used processing technology. This technology can associate computers with different operating functions together during use. In this way, when the collected data is sorted, the processing tasks can be completed in sequence as required. For example, Hadoop software, which is widely used in programs, can comprehensively process massive amounts of data. Moreover, the program can also complete data optimization and sorting during processing. After the data is divided and processed, it will rely on the map function to complete the processing of the data mapping block, and assign the modules to different computer groups, so as to achieve the purpose of classification calculation. The established ecological chain system can also meet the continuous requirements of the system to process data, thereby improving the stability of the system's operation process [8].

5. Conclusion

In summary, judging from the current development of the construction market, intelligent buildings have become an inevitable development trend. In the design process of the building, an intelligent design program needs to be used. Sorting out the relevant content of the program during the application period has a positive effect on improving the rationality of the content of the intelligent building design.

References

[1] Wen Shuang, Li Nannan. Talking about the application of BIM technology in the design of intelligent building lighting system——Taking University Town as an example [J]. Western Leather, 2021, 43(03): 131-132.
[2] Ye Xiaodong. Design and research of intelligent building fire automatic alarm and fire protection linkage system [J]. Architecture and Budget, 2021(01): 47-49.
[3] Liang Yuqing, Ji Jiumao, Yang Jialei, Zhang Dongsheng, Wang Ke, Wang Lingyu. BIM evacuation design automation method based on artificial intelligence [J/OL]. Journal of Graphics: 1-9 [2021-02-21].
[4] Li Che. Application analysis of BIM technology in green intelligent building design[J]. Ju She, 2020(35): 79-80+98.
[5] Shi Chuan. Analysis of key points and development direction of intelligent design and engineering of medical buildings[J]. China Equipment Engineering, 2020(23):136-137.
[6] Chen Nansheng. Analysis of electrical design and energy-saving measures based on modern intelligent buildings[J]. Real Estate World, 2020(22): 6-8.
[7] Zheng Wei. Research on energy-saving and water-saving technologies and applications of water supply and drainage in smart buildings [J]. Smart buildings and smart cities, 2020(11): 50-52.
[8] Wang Hebin, Liu Shan, Ni Feifei. Design and implementation of intelligent data analysis application scenarios for building energy consumption monitoring platform[J]. Building Science, 2020, 36(S2): 373-377.