

Artificial intelligence in the construction sector

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Abstract. The application of artificial intelligence in the construction industry is divided into two main areas: 1. Using new technologies such as big data, cloud computing and the Internet of Things to optimise building design and management and provide users with a better living environment and service experience. 2. Using artificial intelligence technology to carry out intelligent building operation and maintenance, reduce the number of construction site operators and improve the efficiency of the construction site. Based on the analysis of the application scenarios in these two aspects, the application of artificial intelligence in the field of construction has a broad prospect. Especially with the continuous development and improvement of the Internet of Things and big data technology, artificial intelligence can better enhance the quality of intelligent buildings.

Keywords: artificial intelligence, construction, cost reduction.

1. Introduction

At present, for the Chinese market, the technology of artificial intelligence, if applied to the traditional industry, will become a breakthrough in the change of the traditional industry, making the application field expanding and the work efficiency being significantly improved. Artificial intelligence will certainly bring further innovation in the development after entering the traditional industry, by promoting the progress and technological transformation of the industry, with the continuous expansion of the scale of the construction industry, as China's national economy The construction industry, which is an important pillar industry in China's national economy, has also begun to integrate and develop with artificial intelligence. Artificial intelligence is currently a frontier technology for human beings, and the construction field is an important area of human civilisation, and the exploration of using artificial intelligence technology in the construction field is also very important, and this paper will elaborate on the development of artificial intelligence technology and the application scenarios of artificial intelligence in the construction field [1].

2. Data collection and analysis

The application of big data in the construction field mainly focuses on data collection and analysis in the construction industry, through a large number of building construction information data and data information for analysis and collation, so as to come up with a variety of specific, useful and real information. This not only helps managers to better control the situation on the construction site, but also provides more accurate and reasonable design solutions for construction. Data collection and

analysis mainly consists of two aspects, the first is the collection and collation of engineering information; the second is data value mining. Both processes are based on the premise that reliable, efficient and accurate links need to be established between the many parties involved in the construction industry so that the entire construction process can be effectively monitored. Only when this is achieved can the goal of intelligent O&M management be better realised.

2.1. Collection and collation of engineering information

The collection and collation of engineering information is the process of collecting, analysing and processing engineering information. In this process, there are two main sources of information, the first is the record and description of the project, and the second is the analysis, screening and judgment of the collected information. In this process, managers need to establish links between all parties involved in the project and to ensure that all parties involved can communicate effectively with each other. The most important aspects are construction design, construction materials and the construction environment. The collection and collation of information about these projects can help managers to understand the general situation of the project more intuitively and provide a more efficient and convenient service for the construction process [2]. However, it is important to note that the information collected should be filtered and organised, and made clear and specific.

2.2. Data value mining

In the process of data value mining, there are two most critical aspects that need special attention, one is to establish a sufficiently complete engineering database, and the other is to use the corresponding algorithms to mine all the information data. Both of these aspects are very important and complex tasks and can be considered a bottleneck in the development of the construction industry. In addition, the following points should be noted in the specific implementation process: (1) When analysing data for a construction project, a detailed and accurate survey of the construction site is required, and the data should be analysed for different operating environments. (2) There is a large amount of information and data in the construction industry, as well as construction-related documents and information. This information helps managers to make better decisions and manage operations. (3) There is a need to establish good and efficient communication channels between the different parties involved. Only in this way can the value of the data be better exploited [3].

3. Automatic monitoring and management

As traditional construction systems need to be manually controlled on site, they lead to high labour intensity and safety hazards for construction personnel, while intelligent operation and maintenance based on new technologies such as big data, cloud computing and the Internet of Things will effectively solve the above problems. For example, RFID technology can automatically identify the construction equipment, construction personnel, materials and other construction material information entering the site; through artificial intelligence technology to achieve real-time monitoring of construction personnel and construction materials, so that people in the office can understand the site situation and make decisions at any time; the use of intelligent robots for intelligent inspection, can accurately identify the defects and hidden dangers existing in each floor, etc. The application of artificial intelligence in the field of construction is promising, but there are still some problems, for example, people do not understand artificial intelligence technology deeply enough and thoroughly, and the quality of talent requirements are also high; in addition, artificial intelligence in the field of construction is mainly applied in the operation and maintenance, and in other areas such as design is still relatively weak. However, as new technologies such as big data and cloud computing continue to develop and mature, the application of artificial intelligence in the construction industry will usher in a new wave. Now there are also many companies that have already started to use AI technology for the development of intelligent building operation and maintenance systems. With the promotion of the concept of smart city and smart life as well as the enhancement of users' requirements for smart life, the future application of artificial intelligence in the construction field will also usher in a new development opportunity [4].

3.1. *Wise construction*

Smart construction is an organic combination of artificial intelligence technology and construction engineering technology, and smart construction can solve the problems faced by the construction industry in the process of development. At present, intelligent construction mainly starts from three aspects, one is data integration, integrating and analysing construction engineering data resources to build an intelligent management system; the second is structure optimisation, integrating and innovating traditional construction techniques and advanced techniques to promote higher quality construction; the third is precise construction, using intelligent equipment to detect and control the construction process. Through the mining of information and data, the whole life cycle of the project can be simulated and emulated; through real-time monitoring, data processing and other technical means, problems in the construction process can be solved in time. Artificial intelligence can also help construction companies to reduce construction costs and construction time. According to relevant research, through the use of intelligent construction technology can make the construction unit project investment reduced by 15% to 20%; and when the intelligent construction system applied to the design of buildings can save about 3% to 4% of the project cost. In addition, intelligent equipment can be used to improve efficiency and reduce labour costs. However, there are still some problems with the application of artificial intelligence in the construction field, such as the lack of technical personnel and the inadequacy of the talent training system, which are the reasons that limit the promotion and application of artificial intelligence in the construction industry [5].

3.2. *Smart city*

A smart city is a concept that is constantly evolving and improving. It can achieve the interconnection of people, things and events information through a large number of IoT devices, analyse and process them through a comprehensive application system based on cloud computing and big data platforms, and ultimately provide services for users. As urban residents' requirements for living environment and quality of life improve, the application areas of smart cities will continue to expand. The construction industry will play an important role in smart cities. Intelligent buildings are an inevitable trend in smart cities, and many companies have already started to carry out intelligent building projects. For example, Guangzhou is building a "Smart Island", which includes 5G communication, wireless Internet of Things technology, intelligent robots, artificial intelligence and many other artificial intelligence technology applications, and will become the world's first smart island after completion. Guangzhou's "Smart Island" has already achieved a lot of results, the most important of which is the seamless integration with rail transportation, city roads and municipal pipeline systems, as well as various facilities such as smart street lights and smart meters [6].

This is only a small part of the smart city construction, as artificial intelligence technology continues to progress and develop, there will be more areas of the construction industry that can use artificial intelligence in the future. There are already a number of companies in China that have started to research the application of AI technology in the construction sector. For example, Alibaba uses cloud computing and big data platforms to provide a series of B/S-oriented solutions (such as Alibaba's "Internet of Things Platform"); Huawei has launched the "IoT Architecture Open Cloud" platform. For the artificial intelligence technologies that have been applied to the construction field, such as face recognition, voice recognition, behavioural analysis and other artificial intelligence technologies have a very important role in the construction of smart cities. As these technologies become better understood and mastered, they will play an even more important role in the construction industry in the future [7].

3.3. *Intelligent design*

The problems that exist in the current design process in the construction industry mainly include the following: (1) Long and inefficient building design. (2) The architectural design is complicated and the quality varies. (3) The traditional design process, the manual involvement of too many factors. (4) The application of intelligent auxiliary design software is still in its infancy. (5) The lack of professional talents and the low ability of the designer team.

Under the trend of continuous integration of artificial intelligence and the construction industry, we will usher in a new era of architectural design in the future, and artificial intelligence will provide more convenience for the design industry. At the same time, in addition to the above points, AI technology is also widely used in other industries. Artificial intelligence in the manufacturing field mainly solves the problems of "lack of data", "lack of models" and "lack of algorithms"; artificial intelligence in the medical field mainly solves the problems of "unreliability", "error-prone" and "low efficiency"; in the agricultural field, it mainly solves the problems of intelligent sowing, watering, fertilising and harvesting. Artificial intelligence is also present in the fields of education and entertainment. Speech processing technology, mainly represented by speech recognition and natural language processing technology, has been widely used in many aspects of people's daily lives.

4. Intelligent environmental control

In traditional building environmental control, designers often focus on the control of air conditioning, lighting and ventilation systems, while neglecting to understand the environment in which the building itself is located. In fact, building environmental control is an extremely complex system with many influencing factors, for example, the temperature, humidity and wind speed of the building's surroundings can directly or indirectly affect the indoor air quality. When there is a certain temperature difference between indoor and outdoor air, more condensation will be generated in the air; when the indoor and outdoor airflow is in opposite directions, vortexes will be formed in the air. Therefore, intelligent building environmental control is a complex and difficult task.

From the available research results, there are many scholars who are currently studying how to design building environment systems through artificial intelligence technology. A number of products and systems in the field of intelligent buildings have already applied the above theoretical approaches and achieved good results. For example, LAAM (Leap-match Automatic Air Mechanism), an intelligent ventilation system developed by the University of Michigan's Institute of Engineering and Design (IET) in around 2000, uses a variety of intelligent technologies based on neural network technology, fuzzy logic and expert systems. The LAAM method uses a comprehensive analysis of the air conditioning and ventilation system to determine a rational control strategy and to achieve optimum energy savings.

Taking air conditioning control as an example, firstly, predictive control based on neural network technology is used to determine the frequency and number of starts and stops of refrigeration compressors at different points in time; secondly, the actual situation on site is analysed through fuzzy logic and a new fuzzy logic model is established using fuzzy control principles; finally, the new model is used as a judgement standard to determine the best operating state of the air conditioning system at that moment in time, so that The new model is then used to determine the best operating conditions for the air conditioning system at that moment in time, thus achieving energy savings and maximum indoor comfort.

Another intelligent environmental control system, DACS (Dynamic Control System), is an intelligent environmental control system jointly developed by the Department of Computer Science and Engineering (CMS) of the University of California, Berkeley and the Department of Computer Science (MIT) of the Massachusetts Institute of Technology (MIT), which consists of field detection technology, expert technology and computer networks. It has the advantages of being good, adaptable, functional and easy to implement. DACS ensures a comfortable indoor environment while maximising energy savings and minimising maintenance costs. The method can be used to design various types of applications such as multi-energy utilisation, air conditioning and cooling requirements, and the need for people to stay and move around.

At this stage of building environmental control in China, the traditional centralised approach to air conditioning management often requires unified management of the entire building: not only does it entail high property management costs, but it is also not conducive to energy saving and emission reduction. As artificial intelligence technology continues to be applied in the field of building environmental control, many scholars have put forward some new ideas. For example, the "IoT

"Intelligent Building Environment Monitoring System" jointly developed by Huazhong University of Science and Technology and Huawei Technologies Co., Ltd. uses sensor networks to collect data and cloud computing to achieve real-time dynamic monitoring and intelligent processing of a variety of parameters in buildings. The "IoT intelligent building environmental monitoring system" installs various instruments such as air quality sensors, temperature and humidity sensors, carbon dioxide sensors, etc. in buildings, transmits the acquired information to the cloud for big data processing and analysis through IoT technology, and uses cloud computing technology to provide a unified cloud service platform to realize the interconnection and sharing of data and information.

The system can dynamically monitor and control a wide range of parameters in the building, including air quality parameters such as humidity and CO₂ content, and human comfort parameters such as CO₂ concentration; it can also compare indoor environmental parameters with the outdoor environment in real time and make intelligent adjustments to indoor air quality through preset data. The system can be widely used in office buildings, commercial buildings and residential buildings. There is also an Internet of Things-based Smart Building Environments Control System, which transmits collected data to the cloud for analysis and processing to achieve energy saving and emission reduction as well as security control. The Smart Building Environments Control System will transmit the collected data to the cloud for analysis and processing to achieve energy saving, emission reduction and security control.

5. Intelligent security technology and applications

Intelligent security technology refers to the detection of the external environment of the building to determine whether a danger has occurred, so that the building security equipment protection, supervision of personnel activities, facilities and systems security protection, emergency evacuation and other security prevention. In terms of security, according to the features of the building function, set up access control systems, monitoring systems, etc.; using a variety of intelligent identification technology for personnel behaviour and vehicle dynamic monitoring; using intelligent processing, such as security codes as a communication method to achieve intercom functions. Intelligent security technology is a comprehensive technical means. In practice, it is usually composed of sensors and software systems. The sensors are used to collect relevant data such as temperature, humidity, vibration, wind speed, etc. The software system is responsible for analysing this information and making decisions and controls.

6. Summary

This paper has mainly explored the integration and application of artificial intelligence and architecture field. Artificial intelligence technology has gradually begun to be applied and promoted in the fields of planning and design, architectural design and project management, but there is still much room for improvement in the specific architectural design content. Architects further master the design method of using AI platforms as design aids to promote the renewal and transformation of the industry. Architectural practitioners should pay attention to the technology of artificial intelligence and combine it with the field of architecture to realize the transformation and development of the construction industry.

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