Application of AI in construction

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Abstract: At present, the application of BIM is in the ascendant, and 5G, the Internet of Things, and big data are also rising. AI is gradually influencing and innovating the construction field, and releasing the productivity of the industry from BIM, Internet of Things, big data and other aspects. The paper starts from the current situation of the construction industry, focusing on the integration of building construction, and tells how AI helps design in the early stage of architectural design to intelligent construction assistance in the later stage of the building. The use of AI can bring about the liberation of labor, improve the efficiency of the building from the beginning of the design to the final construction of the process and other advantages, and there are shortcomings such as excessive costs. In the future, AI applications may develop further when the time benefits can outweigh the cost benefits.

Keywords: AI, BIM, intelligent building design, building construction.

1. Introduction

In recent years, the application of artificial intelligence in various industries has become a hot topic, and it has made significant contributions to improving work efficiency, quality and reducing labor costs. At present, the concept of building intelligence has been accepted by the majority of users, and artificial intelligence has gradually shown advantages in intelligent building design, green energy saving, and operation and maintenance management. This paper discusses the application of AI in architecture, analyzes how it is applied from architectural composition to building construction, and analyzes the future application of AI. Building AI realizes the intelligence and digitization of human habitation, providing people with a convenient, efficient, and comfortable lifestyle.

2. Current construction industry background

The construction industry is interdisciplinary [1], and it is difficult for laymen to enter the industry, and the work efficiency of industry insiders is generally not high [2]. Even in recent years, with the advent of BIM and other 3D modeling software, not only have some of the staff in the industry been unable to accept the new way of building, but most users have commented that it is also too inefficient. This is not only a problem in the architectural design part of the building, but even in the construction part of the building as well. The advent of AI has therefore solved a significant part of the problem. Moreover, the world is currently facing the problem of aging, and the future workforce will be greatly impacted [1], especially in high-labor industries such as construction.

3. The application significance of AI in architecture

3.1. Overview of artificial intelligence

AI is an important branch of computer science, and it is also a particularly hot word in recent years. Its research purpose is to complete a variety of tasks like those performed by the human brain, including robotics, natural language processing, image recognition, etc., and the algorithms in architecture include deep learning, spatial syntax, adversarial networks, etc. [3]. As AI continues to develop and improve, the fields of application will also become more numerous. Although the construction field of AII started late, the impact of the AI on the construction industry should not be underestimated.
The significance of the application of AI in architecture

3.1.1. Improving efficiency. At present, most of the domestic buildings use ordinary drawings and CAD drawings, which are generally low-cost because of their errors in early coordination and later construction precautions, and their efficiency is also extremely high. Its low level, and losses caused by improper materials in later construction are also common [4]. Therefore, in combination with AI, a multi-style layout can be automatically generated according to keywords for the designer and Party A to discuss and study [5], and will not be redrawn because Party A is not satisfied with the rendering. In terms of construction, the use of A I + robot + IoT mode, a large number of site videos for data extraction, deep learning, and then on-site construction management can greatly improve efficiency.

3.1.2. Risk reduction. In terms of building construction, there are many hidden risks caused by improper operation and non-compliance with safety regulations, such as workers not wearing safety helmets as required, drawing review that is not careful, size errors, forgotten embedded parts, etc. [4]. The use of AI can reduce the occurrence of errors, by taking and analyzing the screen of the project at the end of each day, extracting the parameters, comparing them with the parameters of the original planned construction model, finding errors, and issuing warnings, and at the same time, taking the camera to determine whether the workers wear safety helmets at work, inputting the relevant parameters of the correct wearing of the safety helmet, and at the same time, the AI deep learning the correct appearance of wearing the hard hat in different postures, the taken screen is compared and analyzed for parameter comparison to determine whether the worker wears the helmet correctly [6].

4. Specific applications of AI in architecture

4.1. Acombination of I and BIM

4.1.1. Intelligent filling of component libraries and generation of 3D models. AI collects the components into a component library, and intelligently classifies them, extracts the characteristic parameters of a batch of components, and compares the parameters of the components to classify [5]. In the early stage, the designer used CAD to design the two-dimensional drawings, imported the CAD two-dimensional drawings into the BIM model, extracted the primitives of the toilet, bedroom, and kitchen one by one according to the AI recognition function, and then identified the primitives one by one [2]. For example, to identify the two-dimensional pattern of the toilet, according to the previous component library, automatically add a toilet component here, gradually complete the three-dimensional model of the entire toilet, and then to the three-dimensional model of the entire house, it realizes the automatic two-dimensional to three-dimensional transformation, and at the same time, the entire three-dimensional model will be tested to find whether there is any unreasonableness. Finally, the designer confirms the 3D model to form the final model.

4.1.2. AI assist in building layout planning. According to big data and deep learning, a variety of two-dimensional diagrams of house plans are imported into the system, and the two-dimensional diagrams of each appearance are given a general keyword positioning. AI deeply learns them through

algorithms [5], using the space syntactic algorithm, and just entering the relevant keywords to generate a variety of arrangement schemes, such as: comfortable, modern, etc. Comfort is the need to move the space to reach the maximum, and in the computer algorithm, this is to find the optimal result [5]. Customers can choose according to the following schemes, choose the most suitable and then modify and improve it, select the optimal two-dimensional drawing design [7], and import it into BIM. Finally, a 3D model is automatically generated.

4.1.3. AI auxiliary electromechanical arrangement. Mechanical and electrical problems are the parts that encounter more problems in the later construction, and if most of these problems can be solved in the early design, it can greatly improve efficiency in the construction part. The traditional two-dimensional drawings and CAD cannot specifically and clearly express the problems between the mechanical and electrical pipelines. By using BIM for electromechanical simulation collision experiments, several parts of architecture, structure, electromechanics and decoration are combined to obtain specific collision locations and quantities, to modify unreasonable places and to reserve the relevant maintenance space. At the same time, pre-installation is carried out in the BIM model, the set of pipe sleeves is arranged according to national standards (verticality, size and shape), then the casing hole reservation is completed and the cross-sectional drawing is produced at the same time, so that even the most complex holes can be displayed in an orderly manner on the drawing [4]. At the same time, the current requirements of green environmental protection and low energy consumption are put forward. In terms of mechanical and electrical aspects, it is necessary to combine energy-saving and consumption-reducing technologies to meet the requirements of future green AI buildings. The BP neural network algorithm is a major component of artificial intelligence techniques, where the input, and output algorithms can be presented as linear problems, and by using momentum factors can effectively shorten the training time and is more effective in dealing with local convergence problems. To enhance the collection and collation of information on electrical The energy saving model is based on the collection and collation of information on the electrical and gas systems of buildings. The evaluation model can be used to visualise the overall energy saving effect. The evaluation method is more efficient and the weights are set more scientifically to ensure that the energy consumption of the building can be effectively controlled after completion. This ensures that energy consumption can be effectively controlled after the building is completed [8].

4.2. The use of AI in building construction

The use of artificial intelligence in housing construction and the help of intelligent systems to complete the intelligent construction of buildings and greatly improve the efficiency and quality of building construction. With AI+BIM+IOT for on-site construction management [4], various targets can be clearly found through sensors for corresponding intelligent technology, and terminal monitors can monitor the whole construction site. At the same time sensors and monitoring cameras can perform edge AI calculations based on the collected information and compare the final obtained data with the safety data. Exceeding the range of safety data will be alarmed for rectification and treatment, greatly reducing the possibility of accidents on construction sites, while the terminal can also issue corresponding information instructions, such as construction instructions [9]. Every day there will be cameras and drones for monitoring cameras, scanning the appearance and structure of the building, and analyzing and processing the construction data, so as to obtain the entire actual construction progress and further plan the construction progress. At the same time, each information instruction is collected, similar to the function of the black box, and each time the stored information is very important, if there is a problem in the future construction, you can re-find the corresponding reason for these stored information [6].

4.3. O&M management of AI in buildings

Operation and maintenance include on-site equipment, on-site operation and maintenance personnel, remote engineers. The engineer can set up AI intelligent algorithms in the cloud platform, according to

the data collected by the sensors to make judgments. For example, in a summer, employees enter the office to work, the sensors feel people coming in and issue air conditioning cooling instructions, but the temperature sensor gets data and does not find the temperature drops, the alarm to the terminal, the terminal issued instructions to determine which step is wrong, and eventually send the appropriate operation and maintenance personnel to repair [10].

5. Discussion on the future application of AI in architecture

The proposal and development of AI architecture not only depends on the development of digital technology and the Internet, but also depends on the transformation of people's architectural concepts. When people realize the advantages of AI buildings, they will develop in the direction of AI, and constantly adjust the business model to adapt to AI until an excellent business model appears. When the benefits of AI are maximized and the profits can be brought in more than with the previous traditional model, the era of AI architecture has really arrived. At present, many AI are judged and performed the next step according to the data extracted by the sensor, and in the design of AI auxiliary buildings, it relies on the approximate features extracted by big data for judgment and learning, and there are still many uncontrollable and observable factors, although this is the more advanced level that can be achieved at present. However, with the further development of AI technology in the future, the accuracy will be further improved, including how AI can extract visual parameters that the human eye is not aware of, extract the architectural design that people feel sunny in the form of pictures, and then analyze AI pictures to put them in the implied relevant sunlight parameters are extracted for analysis and learning, and further accurately express people's feelings digitally [11]. This is only a direction for the future development of AI in the future, and the application of AI will be more extensive, and people's lives will be faster and more efficient.

6. Conclusion

At present, China's construction industry is facing great changes, many real estate companies have been hit hard, at this time epoch-making technology is needed to change the current construction industry pattern. But at present, China's use of intelligent buildings is not sufficient, and many regions have even been using the traditional two-dimensional and CAD drawing combination design system. It's not that they don't understand AI, it's just that the current use of taking intelligent buildings is so costly that it won't lead to revolutionary progress without absolute benefits. Perhaps one day in the future the cost of AI intelligent buildings will come down, or the reduced time cost of increased efficiency will be able to compensate for the economic cost of investment, and our construction industry will be able to truly usher in intelligence. The development of artificial intelligence also has some inconveniences. Serious accidents can occur when commands are incorrectly identified during the intelligent digitisation of buildings. There is also a certain risk of theft of data loaded into digital buildings, so there are many areas where the intelligent digitisation process needs to be improved. It is not only artificial intelligence that can be developed overnight. In the future, words such as low pollution, low emissions, efficiency and green have become synonymous with the industrial operations of the future. In terms of construction, the use of artificial intelligence will be a powerful tool for achieving these conditions. This paper only provides a brief summary and generalisation of the current development and application of AI architecture in China, and provides some insights into future development. It does not deal with real data application studies, nor can we understand the specific implementation methods and shortcomings of the current AII building applications; relevant application data will be added in future studies.

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