Research on urban modern architectural art based on artificial intelligence and GIS image recognition system

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Abstract
At present, the Chinese construction industry has begun to apply artificial intelligence technology to the research of the construction industry, and it has attracted the attention of many researchers. At present, the main application method is in the construction of the internal system of the intelligent building, use the neural network system, the mold control system, the expert system, and the intelligent decision-making system to achieve the goal of the intelligent building service. This article will analyze the overall situation of artificial intelligence applications in intelligent construction at this stage, based on artificial intelligence technology, and study in detail the application of artificial intelligence systems in various aspects of intelligent construction. Re-excavate the connotation of the urban texture with the methods of quantification and data analysis. Take the texture data of multiple cities as an example, and use methods such as image dimensionality reduction, k-means clustering, convolutional neural network classification, and machine learning to build urban images. The identification and evaluation system finally concludes that in the existing evaluation system, the total economic score, the total soft economic score, the environmental score, and the sanitation score have the greatest correlation with the recognition results of urban texture. Among them is the environmental score. The correlation of health scores is in line with the common cognition of urban research scholars, and the calculation results of total economic scores and total soft economic scores indicate that urban architectural planning and its layout are hidden from the economic situation of the city, and also prove artificial intelligence based on image recognition is necessary to mine city information and evaluate it.

Keywords Artificial intelligence · GIS · Image recognition · Urban architecture

Introduction
The first use of digital technology in urban planning began in 1970, and after more than 40 years of development, I hope to find the most suitable project site with the help of computers, and make relevant suggestions for urban planning. Since the artificial intelligence player Alphago defeated the human world champion in 2016, image recognition technology in particular has been widely used in various industries, and smart technology has become an innovative driving force for the transformation of the country’s economic structure and the search for a new round of growth (Shang et al. 2019). The city’s policy orientation towards “intelligence” and the development trend of smart cities put forward the need for creative application of artificial intelligence and deep learning technology. At the same time, the huge amount of image data and complex design parameters in the field of architectural planning are also naturally combined with deep learning point. So far, the application of artificial intelligence technology in the field of urban planning has mainly focused on the recognition and analysis of building and street images.

Artificial intelligence (AI) technology was born in the middle of the last century and is a frontier subject of rapid development (Shirzad et al. 2014). Artificial intelligence technology can simulate human feelings and thinking patterns through...
non-biological mechanical equipment and information equipment, developed in a direction close to human needs, and can provide more service possibilities. In recent years, technology has promoted the development of artificial intelligence and has been widely used in the construction industry, changing the previous construction methods. Modern construction technology is also constantly developing in the direction of intelligence and science. Intelligent buildings and anthropomorphic intelligent services based on computer control have also emerged with the requirements of the times (Broomhead and Lowe 1988). This is a research trend in the field of modern architecture and an important project for future construction and development. Artificial intelligence technology simulates the human brain through computer networks, a digital technology developed in modern times. Its rapid development is closely related to the rapid development of current network computer technology. AI not only includes service systems but also includes multiple sub-modules related to various principles, such as problem intelligence analysis, expert systems, voice understanding, pattern recognition, automatic theory, intelligent robots, intelligent decisions, molds, and control. These modules will unite to build an overall combination of AI service models.

The concept of artificial intelligence and smart buildings

Artificial intelligence

Artificial intelligence (AI) is the most popular technological science in recent years. This is a technology that can expand human wisdom by imitating human thinking and ideology. As a field of computer science, artificial intelligence technology includes language and image recognition, intelligent robots, expert management systems, and other fields (Soleymani et al. 2016). The artificial intelligence technology published by Hans News, together with space technology and energy technology, is one of the three most advanced technologies in the world since the 1970s. At the same time, in genetic engineering, nanotechnology is widely known as the three most advanced technologies in the twenty-first century. With people’s extensive research in the field of artificial intelligence, more and more people have begun to pay attention to the field of artificial intelligence. Through the continuous development of artificial intelligence over the years, it has now become a brand new research field with an independent research system.

Intelligent building

Intelligent building refers to the comprehensive optimization and upgrading of the needs of building users through the internal structure of the building, system management and services, and improving the quality of life of users and the living environment. The intelligent building must rely on the latest communication technology and the latest control technology to realize the core management of the computer system (Su et al. 2015). Through the use of sensors to correctly check the structures inside and outside the building, and the collected information is sent to the core computer system for processing, the intelligent control effect of the building is realized. Building administrators can control the entire building from elevators, broadband networks, lighting, water, electricity, etc., through intelligent technology.

The impact of artificial intelligence technology on smart buildings

At present, artificial intelligence technology has become the focus of many researchers’ attention due to its convenient and efficient characteristics. Researchers first set up a database through the collection of data, and then through the integration and application of knowledge, they formulate service plans for specific things or individuals. Through the combination of expert control system and traditional control system, the knowledge of the expert can be integrated into the operation of the mathematical model. On this basis, the knowledge processing technology can be organically combined with the operation technology of the mathematical model, which can promote in depth the development of intelligent buildings. In recent years, the intelligent development of buildings has been steadily improved due to the use of artificial neural network systems (Buyukyildiz et al. 2014). The architectural design, control, and management of modern society cannot be separated from the support of artificial intelligence technology. Modern intelligent buildings, basically as an important means to solve related problems, use artificial intelligence technology to continue thorough analysis. Ask questions in all aspects, and then you can further optimize the current improvement model. At the same time, under the premise of gradually improving the artificial neural network system, the intelligent equipment in the building has made great progress in smooth operation, operational stability, and automatic control level. The capabilities of artificial networks have also greatly improved. With the rapid development of social modernization, database technology has obtained an opportunity for development. Artificial intelligence technology has also been gradually developed in other technical fields. Compared with the previous level of system intelligence, the construction of intelligent systems has also been greatly improved (Sulaiman et al. 2011). The development of artificial neural networks (Ann) has accelerated, and the previous computer chip model has been reformed, using large-scale integrated circuits to control and manage the system. With the continuous development and advancement of technology, the development cost of artificial intelligence will continue to decrease. Eventually, the
technology will reach the public and become a part of people’s daily life.

Materials and methods

Data source

This article takes the texture data of 10 cities as an example, uses python to crawl the map data of Baidu Maps open platform (scale 1: 500,000), and realizes the expression of the relationship between the bottom of the map by modifying the json file (Fig. 1).

Image dimensionality reduction and k-means clustering

Perceptual hash algorithm to achieve image dimensionality reduction

Distinguishing the land parcel attributes and spaces in the city is the primary task of city identification. After the data is collected, the data is preprocessed and annotated first, and the original data (1800×800×N) is cut into 5458 sheets with a size of 200×200 meta plot image; each meta plot is regarded as a single plot attribute or layout. “Perception HascheAlgorithm” is an important technology for similar image retrieval between Google and Baidu engines. Its function is to generate a “fingerprint” of each image, that is, to compare the fingerprints of different images after reducing the image size (Chen and Lin 2006). The more similar the images, the closer the results. The Hasche algorithm is used to reduce the image dimensions and generate the feature value of each image, that is, the “fingerprint” for the next step of image clustering. In the selection process of the dimensionality reduction algorithm, this paper compares three perceptual hashing algorithms at the same time. Based on the low-frequency mean hashing algorithm, enhanced hashing algorithm, and difference hashing algorithm, experiments are carried out respectively. The conclusions drawn are as follows: the average hash algorithm is the fastest, but the accuracy is poor; the enhanced hash algorithm is more accurate and slower; the difference hash algorithm is fast and accurate, but it does not change. It is robust. Considering that the data sample size in this article does not require additional image transformation to expand the data volume, the difference hash algorithm is chosen to reduce the image dimension. The main steps of the difference hash algorithm are as follows:

- Reduce the picture: reduce the picture to 9×8 pixel size; at this time, there are 72-bit pixels;
- Convert into grayscale: the image after scaling to 256-level grayscale (see the program of the average Hasche algorithm).
- Calculate difference: the dHash algorithm runs between adjacent pixels, so each row of 9 pixels produces 8 different differences, a total of 8 rows, and then 64 differences are generated.
- Get fingerprint: if the pixel on the left is brighter than the right, it is recorded as 1; otherwise, it is 0. Use python combined with openCV to program, calculate the similarity of each row of pixels for visualization, and calculate the hash algorithm fingerprint of the image to get the degree of similarity (Kisi et al. 2015). Taking two meta-plot images as an example, the calculation result is shown in Fig. 2. Calculate the fingerprints of all the cropped meta plots and prepare for the next step of image clustering.

K-means clustering

After obtaining the fingerprints of each meta-block, applying an unsupervised high-dimensional clustering algorithm K-means, all meta-blocks can be divided into 5 types of block attributes. K-means algorithm is a simple iterative clustering
algorithm that uses distance as a similarity index to find k categories in a specific data set. The center of each class is based on the average of all values in the class, and each class is explained (Tabari 2016), according to the cluster center. For a specific data set x containing N D maintenance data points and scoring classification K, EUCLIDEAN distance is selected as the similarity index, and the purpose of clustering is to minimize the sum of squares of each cluster.

$$J = \sum_{k=1}^{k} \sum_{i=1}^{n} ||x_i - u_k||^2$$

(1)

Combining the least square method and the principle of Joseph-Louis Lagrange, the center of the cluster is the average value of the data points of the corresponding category. After adjusting the algorithm parameters and removing the noise, the clustering results are classified into 5 categories (Fig. 3). After the processing of the original data and image annotations is completed, it enters the classification recognizer to build a deep learning convolutional neural network.

**Convolutional neural network classification**

In a narrow sense, deep learning is a neural network with a specific structure, training method, and some hidden layers (Fig. 4). Machine learning methods with any level can be called deep learning. In the deep learning process, the overall network parameters are updated through no-teacher training and learning image features from the input image. The teacher and training minimize the loss function to achieve correct classification in the output layer. Convolutional neural network is one of the most popular network structures for deep learning and the highest recognition accuracy (Kisi et al. 2012). It has now been promoted and applied in many fields. The previous extraction of image feature values can only judge the mechanical similarity of the image. The clustering results added to K-means have large noise and outliers, which need to be manually eliminated. This is not difficult for a small amount of data labeling, but once the amount of data increases, the credibility of clustering will decrease. As a whole to calculate the feature value of a complex image, the convolutional neural network divides the complete image into multiple parts, convolution processes each part and extracts features. Then, these small parts of the features are summed up through mathematical operations to realize machine recognition image processing. This paper builds the network structure shown in Fig. 5 based on python Keras.

Taking the texture image of a piece of land as an example, the feature extraction of the convolutional neural network is divided into the following three steps.

1. In a convolutional neural network, first read the data set through the input layer and enter the first convolutional layer. The nature of the convolution operation retains the relationship between pixels and pixels in the original image. The convolution layer uses different sizes of convolution kernels to extract features of different scales from the urban texture data, and the convolution kernels with different sizes realize the image optimize, such as using edge detection dimensionality increase, dimensionality reduction, and non-linear transformation (Labani et al. 2010). To achieve the recognition of texture pictures from different sizes, after multiple convolution and pooling operations, the data reaches the final fully connected layer. Taking the texture of the medium-density urban area as an example, as shown in Fig. 6, first, the first layer of good accumulation of all m features extracts the overall contour information of the picture, and the second and third layers deeply extract the local feature information of the picture layer by layer.

2. Set 80% of the sample data as the training set, and 20% as the training set. Without cross verification, after parameter adjustments, Xunle produces an
urban plot attribute classifier with a better 1H rate, and the accuracy of the training set is up to 97.3%, the loss (Loss) of the training set is 0.1017, and the accuracy of the validation set is slightly lower at 91.0%. As shown in Fig. 7, it can be seen that in the three-dimensional space, the convolutional neural network can clearly identify five urban textures.

(3) Verify the classifier, use the trained classifier to read a certain mid-density urban area map, and test the classification effect; the result is shown in Fig. 8. The classifier has a good recognition effect on the input image, the image is considered to have 98% probability of being a medium-density urban area, which matches the label. The verification proves that the classifier can distinguish the five types of plots and can be used in the subsequent city identification process.

Image segmentation and city recognition

The trained convolutional neural network classifier has been able to identify specific types of plots. The problem faced is how to identify the city as a whole. Limited by the data source platform and scale, in order to maximize the architectural details of the city, the size of the original data is determined to be 1800 × 800 pixels, and each city is composed of several images (Meng et al. 2019). Firstly, each image is processed separately, the 1800×800 image is segmented, and each slice is read into the plot classifier to obtain the classification result,
and the position is returned to form a matrix (A: high-density urban area; B: medium-density urban area; C: low-density urban areas; D: arterial roads and three-dimensional traffic; E: public buildings and factories):

\[
\text{img} = \begin{pmatrix}
A & A & A & \ldots & B \\
B & A & B & \ldots & C \\
\vdots & \vdots & \vdots & \ddots & \vdots \\
E & E & B & \ldots & A
\end{pmatrix}
\]

Count the number of plots of each type in the matrix divided by the total number, which is the distribution proportion of each type of plot in the city. The proportion of land area in high-density urban areas, CountIF(A), is calculated as follows:

\[
\text{RatioA} = \frac{\text{CountIF}(A)}{M \times N}
\]

In the formula, Count IF(A) is the number of statistics of A in a matrix, that is, the number of occurrences of high-density plots; M—the total number of slices of a single 1800 × 800; and N—the number of 1800 × 800 texture images of a certain city. Combine the sliced image data into the original satellite image and visualize the discrimination result (Tayfur et al. 2014). As can be seen from the figure, for the local urban texture of Huangpu District, the results of machine recognition are basically consistent with the evaluation of artificial cognition.

### GIS-based energy consumption analysis of urban modern buildings

Energy consumption analysis of smart buildings is based on a certain building energy consumption index and a certain building energy benchmark evaluation method to evaluate and analyze the current building energy consumption status, and then determine the building’s energy consumption level, energy efficiency, etc.

### Building energy consumption indicators

Traditional indicators for evaluating building energy consumption mainly include total building load (kWh), annual energy consumption per unit of total rentable area (kWh/(M²a)), and building energy consumption per person (M'/l(GJ)) etc. The load of a building is formed by internal and external factors such as the number of people, the use of equipment, and the external climate environment. Regarding the space concept of the energy consumption per capita of the building, the author of reference Mwale et al. (2014) based on the ecological footprint method. Through the introduction of ecological footprint method, the space of energy consumption in building energy consumption can be interpreted as the space conditions needed to meet the needs of building environment, including specific technical level, management level and population. The
energy occupied and the building occupy a certain degree, therefore, the energy occupied by the building and the energy requirement for the building. The formula is as follows:

$$S = \frac{A^2}{E \cdot N}$$  \hspace{1cm} (4)

The formula is as follows. A is the total area of the building, e is the total energy consumption of the building. N is the total number of people in the building. Ignoring the influence of indoor personnel and equipment on the heating load, when the heating load changes with time, the energy consumption of the building is proportional to the load of the building during a certain period. The energy consumption of the building can be replaced as follows. Building load Q, this can be written as follows:

$$S = \frac{A^2}{Q \cdot N}$$  \hspace{1cm} (5)

The meaning of building energy consumption benchmark evaluation

In the business process, benchmarks are an indispensable part of TQM and also part of the learning process. The learning process provides a guiding framework for analyzing the differences between an organization and other organizations in the business process (Valizadeh and El-Shafie 2013). The benchmark energy and evaluation process are similar. First, determine the main issues of the assessment; then, collect internal and external data; and finally, analyze and compare. In response to the analysis results, improvement measures are proposed and implemented.

Benchmark evaluation method for building energy consumption

STARTOR and other overseas scholars divide the evaluation methods of building energy consumption benchmarks into...
four categories. Statistical analysis methods are based on support for large-scale data sets (Nadiri et al. 2017). This method is not effective for benchmark evaluation of buildings with different functions and building data. Energy Star and Cal-Arch, which have different manifestations and results, use statistical analysis methods.

The evaluation-based system evaluates the energy consumption of the building by comparing the target building with the highest standard building and adding its score to Leed’s total score.

In the model-based simulation evaluation, building energy analysis software such as DOE-2 is used to construct a standard building model and calculate the building energy consumption of the model. The energy consumption of the target building is evaluated by comparing the actual energy consumption of the target building with the energy consumption of the standard building model simulation building. In the modeling process, the input data are actual buildings such as the residence of the building, the maintenance structure of the building, building materials, operating rate, air exchange, temperature and humidity, air conditioning equipment, warm and cold water units, lighting, and equipment working hours data.

The graded terminal energy consumption performance index is to grade the terminal energy consumption performance index and evaluate the building level by level. In general, the performance parameter classification of a building is shown in Table 1.

### Benchmark evaluation tool for building energy consumption

At present, China has not established a relatively complete national or regional building energy consumption database. The evaluation of building energy consumption indicators is in the early stage, and the research on building energy consumption benchmark evaluation tools is worldwide. The benchmark evaluation tool for building energy consumption is a new type of energy consumption evaluation tool.

Compare buildings, compare buildings, compare buildings, compare buildings, analyze buildings, and compare buildings (Nadiri et al. 2019). Currently, the development of benchmark evaluation tools for building energy consumption beyond the country is underway. Energy Star and Cal-Arch are two typical benchmark evaluation tools for constructing energy consumption.

### GIS energy consumption analysis plan

The actual energy consumption of a building directly depends on its use. The main purpose of a building is people, and the energy consumption of a building is actually the people who use energy, and the building is only a platform for energy consumption. Therefore, the so-called energy consumption of buildings is actually not the building itself, but the people who consume energy. If the building is empty, it is a “zero energy” building. Although there are many factors that affect the energy consumption of buildings, people are the most unstable. Based on the building performance index of energy consumption per unit area or unit volume, this paper introduces the definition of energy consumption per person per square meter, establishes indexes, and evaluates it. The energy consumption per person per unit area is shown below.

\[
q = \frac{Q}{S \cdot N}
\]

### Results

#### City image evaluation system based on machine learning

This paper divides the image into 200×200, 100×100, and 50×50 slices (Fig. 9) and discusses the sensitivity of the slice.

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**Table 1** Building performance parameter level

| Performance level | Building information                                                                                                                                 |
|-------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| 1                 | Annual electricity consumption and cost, annual fuel consumption and cost, total construction area, etc.                                         |
| 2                 | Building attributes (location), building type, building use function (residential, office, etc.), design air velocity, positive air pressure, air conditioning type, host cooling and heat, etc. |
| 3                 | The amount of fuel consumed each month, the amount of electricity used each month, the weather conditions each month                                 |
| 4                 | Hourly energy consumption data with changes in weather parameters                                                                                  |
| 5                 | Monthly energy consumption data for air conditioning, lighting, etc.                                                                               |
| 6                 | Hourly data at the end of the fan power, temperature difference, temperature rise, air velocity, water velocity, etc.                             |
| 7                 | Hydraulic loss, air resistance loss and other parameters                                                                                           |
size to the accuracy of the result, and the recognition performance of 100×100 pixels is the best.

Take a local city texture image as an example, the result of machine recognition is shown in Fig. 10. Combine the sliced image data into the original satellite image and visualize the discrimination result. As can be seen from the figure, for the local urban texture of Huangpu District, the results of machine recognition are basically consistent with the evaluation of artificial cognition.

Facing the rich and multi-dimensional data information in urban texture images, machine learning technology has great potential in tapping its internal hidden value. Researches on city evaluation indicators such as economy, culture, and health are often carried out on the basis of government policies and urban POI data. In the following, machine learning will be used to dig out city texture images, reflecting the hidden connection between urban architectural planning and urban evaluation indicators to guide future planning and government decision-making. According to the data given in the “China City Statistical Yearbook” (Nadiri et al. 2018) and the “2018 China Top 100 Cities Ranking” compiled by the Wharton Institute of Economics, the data in Table 2 can be obtained.

According to MatlabR 2018b data analysis and machine learning toolbox (statistics and machine learning toolbox), compared with various machine learning algorithms, if the above data approximates the root mean square error (RMMSE) in Table 3, then RMMSE is the square root. The sum of the squares of the deviation between the observed value and the number of observations M is used to measure the deviation between the observed value and the true value. The smaller the RMMSE, the better the regression result, and the stronger the correlation between image recognition and city index.

**Urban modern building materials based on building websites**

In the case of the planned layout of domestic high-rise residential buildings, in order to select suitable residential materials, it is estimated that a preliminary investigation of its
residential style is required. In the architectural case network, there is a wealth of data to help architects grasp the architectural style and communicate with project owners during the planning stage (Opricovic and Tzeng 2004). Based on archidaily and Gude’s design network as the basic data source, this paper analyzes the material form of the residential database of the two websites and proposes a plan. The choice of building materials greatly reflects the characteristics of the architectural style, so in the architectural plan of the sub-project, there are certain standards in the form planning.

Archidaily website data analysis

First, extract the data of 1031 projects from the apartment classified by archidaily project/residential building/residential/residential. In order to facilitate data extraction and analysis, archidaily classified several information from the case. Building materials are used most frequently and come from various countries. This is because reinforced concrete plays a structural role in many high-rise residential buildings and is widely used in various countries (Zhao et al. 2020). In the USA, the birthplace of modern high-rise buildings, there are the most glazed houses in the country. There are many countries where wood is used, and the gap is not big. Wood used as a building material not only brews the atmosphere but also approaches the environment of the role. The use of bricks shows the characteristics of countries in Europe and the USA that use bricks as a historical tradition.

Gude design network

In order to make a certain comparison with the housing situation data of archidaily website (which is using for Spread World Architecture), the paper cloned 433 housing situations of Grude design network. If you have not selected any relevant content, please click on this website. Therefore, more accurate data collection and classification are needed. After collection, the data is saved on the basis of residential cases and can be updated in real time. This can provide a reference for the following building information screening (Opricovic and Tzeng 2007). We select 433 residential web addresses and data information, using the mesh cropping framework and Train Crower to clone the website, using the simple steps of the mesh cropping framework, the corresponding clone code and the detailed steps of the TRAIN collector. According to the company’s name and design, the project name and name were finally released. The information in the house is explained in detail, but the information in the house is not explained in detail, conceptual design and other occasions.

| City | GDP score | Savings points | Total economic score | Environmental score | Science and education score | Cultural score | Health score | Total soft economy score |
|------|-----------|----------------|----------------------|---------------------|-----------------------------|---------------|-------------|-------------------------|
| 1    | 86.98     | 100.00        | 93.49                | 95.88               | 100.00                     | 98.05         | 82.62       | 94.14                    |
| 2    | 83.73     | 81.67         | 82.70                | 78.86               | 97.48                       | 88.96         | 72.84       | 84.53                    |
| 3    | 88.96     | 90.81         | 89.89                | 76.25               | 90.25                       | 100.00        | 75.72       | 85.56                    |
| 4    | 86.63     | 73.22         | 79.92                | 84.76               | 43.97                       | 94.77         | 45.73       | 67.31                    |
| 5    | 28.00     | 24.87         | 26.44                | 78.35               | 38.91                       | 53.41         | 52.05       | 55.68                    |
| 6    | 44.06     | 63.51         | 53.78                | 79.64               | 91.29                       | 77.81         | 62.71       | 77.86                    |
| 7    | 30.27     | 50.08         | 40.18                | 77.90               | 11.02                       | 70.38         | 44.06       | 50.84                    |
| 8    | 22.54     | 23.62         | 23.08                | 79.58               | 20.29                       | 64.90         | 44.45       | 52.30                    |
| 9    | 17.82     | 22.08         | 19.95                | 62.88               | 39.97                       | 49.36         | 45.86       | 49.52                    |
| 10   | 30.84     | 44.21         | 37.52                | 80.77               | 16.73                       | 74.10         | 40.79       | 53.10                    |

Table 2 Index scores of cities in the “2018 China Top 100 Cities Ranking”

Table 3 Regression analysis results of different machine learning algorithms on city texture and index scores

| Root mean square error (RMSE) | GDP score | Savings points | Total economic score | Environmental score | Science and education score | Cultural score | Health score | Total soft economy score |
|-------------------------------|-----------|----------------|----------------------|---------------------|-----------------------------|---------------|-------------|-------------------------|
| Linear regression             | 14.678    | 15.817         | 10.378               | 10.772              | 22.462                      | 14.764        | 5.0808      | 6.1395                  |
| Regression tree               | 32.185    | 30.392         | 30.784               | 8.5251              | 37.842                      | 19.085        | 16.302      | 17.952                  |
| Support vector                | 14.186    | 13.943         | 10.534               | 8.1475              | 15.813                      | 8.3584        | 8.9241      | 5.8742                  |
| Machine Gaussian process      | 16.047    | 12.420         | 8.5379               | 9.0241              | 16.315                      | 10.085        | 9.0853      | 8.1266                  |
Discussion

The application of artificial intelligence in urban modern architectural art

The exterior design of the building mainly includes the texture design of the exterior materials, color design, door and window design, volume design, etc. Today, with the development of intelligence, many stimulating methods have appeared in the exterior design of buildings. It is worth referring to some representative overseas cases.

External texture reproduction

The outer layer of the building is like human skin, the texture of the organization. It should be able to suck as freely as the skin. The appearance of the initial building is often expressed in a "one-off" method. The original design of the building can only be constructed before death (this does not include the impact on the building’s age, external environment, and human factors) (Ren et al. 2020). Today, with the help of information science, buildings can not only change the exterior color at any time but also change the exterior pattern effect for further self-organization.

Dynamic opening and closing patterns

The designs of doors, windows, ventilation, and sunshading on the outer layer of the building are more flexible and diverse after the introduction of intelligent technology. The building has a “mouth” that can talk to nature. The “pores” of air exchange, and the architectural design is humanized and personified.

Alternative interpretation of structures

The outer layer of the building is like human skin, the texture and texture of the organization. It should be able to suck as freely as the skin. The appearance of the initial building is often expressed in a “one-off” method. The original design of the building can only be constructed before death (this does not include the impact on the building’s age, external environment, and human factors). Today, with the help of information science, buildings can not only change the exterior color at any time but also change the exterior pattern effect for further self-organization.

Probe into the development of intelligent buildings

After more than 10 years of rapid development, the construction of China’s modern intelligent building was first integrated into a simple artificial intelligence automation system. At the same time, due to the continuous improvement of people’s requirements for the quality of life, simple artificial intelligence systems no longer meet the needs of people’s daily lives (Rumelhart et al. 1986). At this stage, the application of artificial intelligence optimization technology to Chinese intelligent buildings is still very immature, and many important issues cannot be solved in time.

Single smart application

Modern construction enterprises and construction units do not have the overall concept of artificial intelligence technology, and the coordinated use of artificial intelligence optimization technology among various optimization subsystems is insufficient. If a single subsystem or service function is embedded in a building, it is called a smart building, which lacks system compatibility and cannot meet the psychological expectations of residents or building users. Related construction units should make full use of the overall advantages of AI optimization and apply these advantages to smart buildings, not just as a fashion.

The intelligent system is too simple

There are still many technological bubbles in smart buildings, and many technological applications are still in the early stages. If the working environment or external factors exert excessive influence on the system, or exceed the scope of logic operation, the system will be in a blind state (Sammen et al. 2017). Operation or failure will only cause the system to crash, system maintenance is difficult, maintenance is inconvenient, and then enter the parameters to restart the operation. With operation troubles and other adverse effects, the application technology is not yet mature and there is still a big gap between artificial intelligence.

Each intelligent subsystem is independent and lacks the ability to coordinate operation

Modern Chinese artificial intelligence technology, computer internal main control system, and each sub-control system mainly use independent operation control methods. Each system has its own database and port transmission database. At present, my country’s artificial intelligence technology and computer intelligent network will only affect the entire quality and operation of the building. Since the internal hardware of the building cannot be mutually controlled and there is no communication interface, for the development and update of China’s artificial intelligence system, every module in the system needs to be optimized to improve the overall operating efficiency of the system and bring about the huge artificial intelligence system leap to make smart buildings a reality.
Application analysis of artificial intelligence optimization technology in intelligent buildings

Smart buildings have become the mainstream of the future development of the construction industry. How to apply artificial intelligence technology to modern intelligent buildings is a big difficulty in China’s construction industry. After years of investigation, artificial intelligence technology expert control systems, neural network systems, and intelligent decision-making systems have all been successfully applied to the construction of China’s intelligent buildings.

Application of expert control system in intelligent building

The core of the artificial intelligence technology expert control system is to establish an expert information database. The system controls the entire system by comparing the data in the database and simulating the actual situation. The basic construction and operation of other control systems are based on the internal knowledge of expert control systems and information databases (Shamim et al. 2015). This kind of artificial intelligence technology that uses computer systems to simulate is equivalent to experts in the field handling the state of the system, or just copying their knowledge and experience. Through the establishment of a database, the professional knowledge of experts in various fields is applied to people’s daily life, and experts in various fields are simulated to investigate the problems facing in detail and put forward reasonable suggestions.

Application analysis of artificial neural network control system in intelligent buildings

The artificial neural network control system is one of the core technologies in the current intelligent building applications. It has the optimization of intelligent building system functions, the optimization of safety technology, the automation of daily life, unique functions, speech recognition, pattern recognition, reasonable resource calculation, and information processing. Complex control systems, image recognition, etc., have been widely used in the field of modern intelligent construction. A kind of simulation system, you can build a complex simulation system based on the principle of network operation to improve your efficiency.

Application of intelligent decision system in intelligent building

According to the latest computing technology and the development of network big data, based on the establishment of the database and the intelligent control of the database, the technical support corresponding to the intelligent service of the intelligent building can be provided. Especially with the improvement of the latest database hierachical technology, the intelligent decision-making system has realized the use of the database, and the latest intelligent building has realized the real intelligent service.

Conclusion

In recent years, due to the rapid development of network technology and information technology due to social development and technological progress, artificial intelligence has made tremendous progress. In the construction of smart buildings, in order to meet the needs of modern human activities, artificial intelligence technology is more and more widely used in smart buildings. Whether it is expert control systems, artificial neural network control systems, decision support systems, or future new intelligent subsystems, great progress has been made, and will continue to develop to meet the needs of people’s lives and improve people’s quality of life.

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Declarations

Conflict of interest

The authors declare that they have no competing interests.

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