Application of Energy Efficiency Supervision System Based on Internet of Things in Building Planning and Reconstruction

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Abstract. Nowadays, the requirement of energy saving and emission reduction for large-scale public buildings is higher. This paper presents a kind of energy efficiency monitoring system based on the Internet of Things, which has been applied to the energy saving renovation of electric, lighting and air conditioning equipment. The application value of IOT technology in the design, construction, cost control, operation and maintenance management of construction projects is discussed, and the advantages of BIM technology in the renovation of existing buildings are analyzed. In addition, we will also summarize the issues that need to be considered in the creation and use of IoT models, including model accuracy and delivery requirements.

Keywords: Internet of Things; Energy efficiency supervision system; Architectural planning and reconstruction

1 Introduction

The Internet of Things, also known as the sensor network, is a network concept that extends the clients to articles and exchanges information. The Internet of Things connects the material world with the information world, and obtains the physical quantity, such as temperature, mark and location by RF recognition, infrared sensors, laser scanners, GPS and other information sensing devices [1]. Then, with some simple processing and computation, useful information is extracted and processed, and connected to the Internet according to a certain protocol for communication and exchange, thus enabling intelligent identification, tracking, localization, monitoring and management functions. The Internet of Things consists of three main components: sensor network, transmission network and application network. Communication between things can be realized at any time and any place through the Internet of Things technology. The Internet of Things combines the physical and virtual worlds, requiring things in the physical world to generate digital signals that can be transmitted in the virtual world. This requires the use of various sensing devices, with real objects as the only symbols, to make the objects intelligent and thus enable IoT technology.

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2 Application of Internet of Things in Intelligent Building

When the concept of intelligent buildings was first proposed, automated control systems were used to solve building management problems. Later, on the basis of the rapid development of many information technologies, the "Internet of Things" technology was widely used in smart buildings, and began to make systems such as control devices, automatic fire alarms, control and protection, elevators, and power distribution. very well integrated and coordinated [2]. Water, Intelligent Card Access Control, Office Automation, Energy Monitoring, etc., can provide the residents with comfortable, convenient, fast and secure home. The Internet is a bridge that connects "objects" and "objects". It achieves mutual understanding and data transmission of "things" through technologies such as infrared sensors, image sensors, and wireless sensors. The entire design of Internet-based smart buildings has undergone a radical change. The Internet of Things is commonly used in five smart buildings.

The reliability appraisal of building structure is based on building drawings, technical data, maintenance records and the current situation of building use. Through on-the-spot investigation, sampling inspection and other methods, the field sampling and testing data, such as mechanical properties of materials, crack distribution of structural members, structural deformation degree, structural defects, structural corrosion and service load conditions, are analyzed (structural damage degree and structural resistance), and the "three characteristics" of the actual structure are identified.

The reliability appraisal of existing buildings should be carried out according to three levels: component, subunit and appraisal unit, and each level is divided into four levels. Based on the above-mentioned contents of building structure detection, combined with the difficulty and cost of reconstruction of components or units, the structural reliability evaluation and analysis of existing buildings are comprehensively evaluated from components and subunits. In a word, in the process of reliability evaluation of existing buildings, the structural system of existing buildings should be checked and appraised based on the test results and original data of existing buildings, and reinforcement measures and suggestions should be given. Combined with the present situation of the existing building structure system and materials and equipment, the possible remaining service life and possible changes in the future building are judged under normal use and maintenance conditions, and the scheduled function transformation in the next target service life is completed based on the current standards and specifications.

3 Energy efficiency supervision system based on the Internet of Things

IOT energy efficiency monitoring system is a kind of integrated energy efficiency monitoring, intelligent control and management service platform, multi-building energy consumption statistics, analysis, diagnosis, and early warning functions. At the same time, household appliances are well managed and managed, sensor data is collected in the home, all kinds of valuable numbers are put on the Internet, big data is

analyzed and compared, and finally electronic equipment is well managed and managed.

3.1 Module of energy efficiency supervision system based on Internet of Things

The Internet of Tings-based EE is composed of three parts: collecting, analyzing, processing and concluding. Manage, configure and manage the service module; Customer Management and Operations Module 3 modules. The traditional type of work is where the professional information of the construction plan is independent of each other and can be solved under technical conditions. However, the one-way transmission of large-scale information can hardly solve many problems with only two-way communication and communication, so it is still necessary to continue the construction jointly. Not only will this increase the amount of work of all kinds, but the problems discovered during the construction phase will directly extend the construction time or increase the construction cost. After the design of a specific building model is completed, the operation of several parameters, such as water heating, electricity, wind, etc., can be viewed on a single data platform. On the one hand, the design work in a three-dimensional state will improve the efficiency of such installation specialties, and on the other hand, the collaborative work of various specialties can also avoid collisions between their specialties [3]. The 3D representation of the model facilitates project participants to see and receive information about the project in real time during the project implementation. A flowchart of the design process is shown in Fig. 1 below.

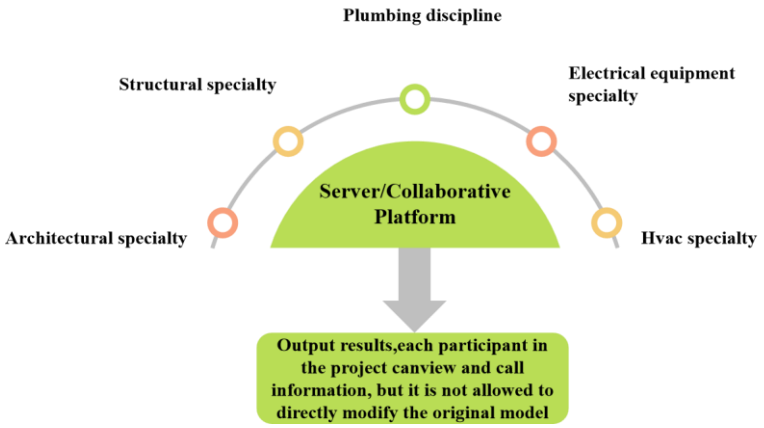

Fig. 1. Work form of BIM collaborative design

3.2 Energy-saving monitoring network

Based on the data of temperature, humidity, key climatic features, and energy consumption of four buildings in a working day, a population based model was established. Based on the model of energy consumption, four related factors of building energy

consumption are predicted. The BP neural network based electronic analytical model is researched and validated[4]. Algorithm flow for BP neural network model, including initialization, data definition, output calculation of hidden layer and output layer, variable cost calculation, comparison, difference provision, correction defect detection, and model acquisition [5]. As shown in Figure 2:

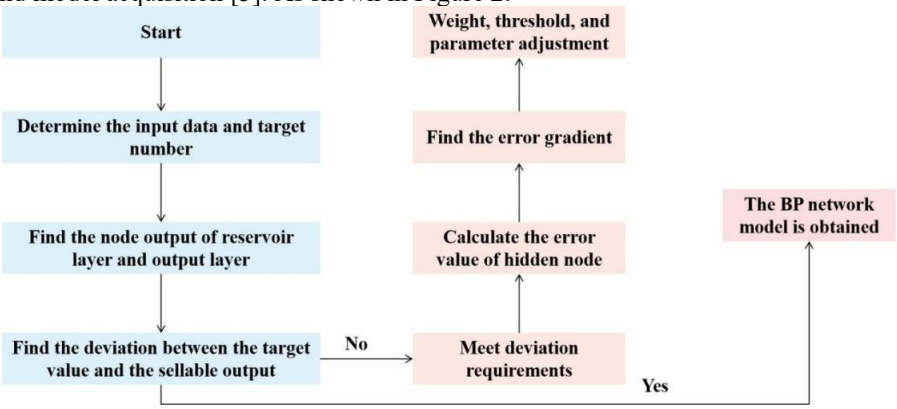

Fig. 2. FLOW chart of BP network model

First, the input and destination data of the model are defined, and then the output of each node is produced. By comparing the target price with the production profit, the difference between the target price and the actual profit is calculated.When the conversion error is less than a certain value, the algorithm is stopped and the BP network model is obtained.If the transformation error is larger than the limit, it will calculate and set the node error of the hidden layer, and make the target and the real error output.The BP network model is constructed, and the model parameters, thresholds, and weights are acquired until the error is found[6].

The learning process of BP Neural Network is based on the minimum error. The training process is composed of input vector X and target vector Y, and the model's weights and thresholds are adjusted according to the error.

The model has n layers of neural networks, and S_i^m and R_i^m .Node A_{ij} is the link weight of node I, and the node j is output, and the node f is input/output.

$$R_i^m = f\left(S_i^m\right) \tag{1}$$

$$S_i^m = \sum A_{ij} R^{m-1} \tag{2}$$

Set C_j as the target output value of the model. R_i^n is the calculated actual output value of the grid system. It is a function obtained from the combination of weights and input nodes. The operational error is defined as the error E, which is the square of the difference between the actual result and the planned output, and is expressed as

$$e = \frac{1}{2}\sum\left(R_i^n - c_j\right)^2 \tag{3}$$

The goal of this work is to approximate the real output with minimal error. In order to minimize the error, the nonlinear programming technique is used to minimize the error function along the gradient direction, and the error induced result is achieved by adjusting the weights and thresholds[7]. According to BP neural network application analysis model, 20 selection criteria are used in this paper based on 7 days of analysis of the university during construction test from February 13, 2019 to April 23, 2019. The network training rate is 0.1, the training goal is 0.1, and the network model is only 4-8. Fig.3 shows network power forecast results, Fig. 4 shows network power forecast error, Fig.5 shows relative power forecast error.

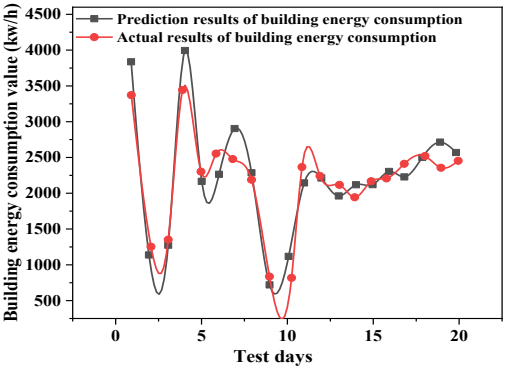

Fig. 3. The predicted values are compared with the actual values

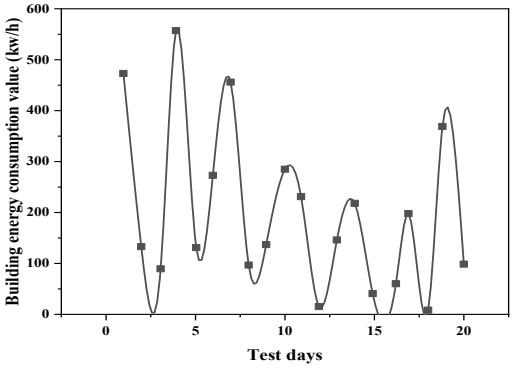

Fig. 4. Energy consumption prediction error plot for the BP network

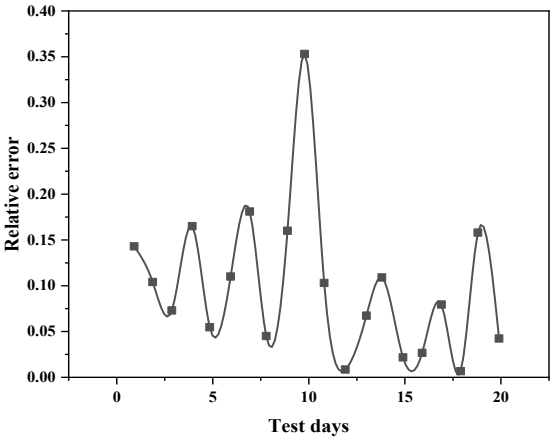

Fig. 5. Relative error diagram of energy consumption prediction at BP net end

The BP neural network model is used to calculate the applied data. The mean RSD of training network is 9.9, MSE is 13.08, maximum RSD is 35.21, mean RSD is 10.08, MSE is 12.68.It can be seen that large-scale electrical engineering using BP neural network-based electrical analysis models is still a work in progress[8-10].

4 Conclusion

Based on the features of machine vision, information integration, and management cooperation, this article further explains the concept and implementation value of Internet of Things technology, and the connection between the development and application of Internet technology in domestic and foreign business development. Writing the main language from the point of view of Internet technology platform and design. Modeling the reality of IoT models, defining the models and descriptions to be delivered during the creation and use of IoT models for different purposes in various industries. Different levels of IoT design. This paper shows that the application of IoT technology in China's construction industry is broad based on research guidelines, good information and standards.

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