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STUDY OF INTELLIGENT DIAGNOSIS TECHNOLOGY FOR BUILDING ELECTRICAL TEST SYSTEM

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ABSTRACT

Intelligent building mainly utilizes the energy instruments to conduct relative effective management, which helps rapidly improve the comfort of usage, prolong the lifetime, improve the efficiency and reduce the energy consumption as possible as it could. Its situation and management will have direct effects on building operation. Improving the completion of management and using advanced scientific intelligent system becomes a powerful tool to improve the comfort and prolong the lifetime gradually. To different analysis views, classifications, and objects, the methods are different. So the preparation for detailed diagnosis process is essential. This paper discusses the diagnosis process for building electrical test system, thinking in building diagnosis system and optimal methods, etc.

Keywords: *Building Electricity; Test System; Intelligent Diagnosis Technology*

1. INTRODUCTION

As social economy develops rapidly and the trends of global warming becomes more and more seriously, the resource shortage and environment is outstanding, which stimulates the close attention to effective make use of and save energy. The building energy saving is the most obvious. Besides the building designs, it is also important to enhance the energy saving in all process. The intelligent system is the main platform and tool, which is key to proper design and energy saving. Large amounts of resource are consumed in the whole process. Meanwhile it will have bad effects on environment. The energy saving protection refers to various resources including the building itself and corresponding energy saving measures. The main power is electricity. Others is a little, like oil and gas, etc. The electrical energy includes dynamic system, lighting system and warming system. The electrical qualities such as harmonic content, three-phase balance degree and power factor, etc will also generate energy consumption. The intelligent system mainly utilizes the energy instruments to conduct relative effective management, which helps rapidly improve the comfort of usage, prolong the lifetime, improve the efficiency and reduce the energy consumption as possible as it could. Its situation and management will have direct effects on building operation. Improving the completion of management and using advanced scientific intelligent system becomes a powerful tool to improve the comfort and prolong the lifetime gradually. Our total of electricity consumption is about 28% of that of our country, about 80 billion RMB. The energy consumptions of dynamic instruments, air conditioner and lighting, etc are most. Classified in types, 20~50% is the lighting, and 20~30% is draining and other dynamic instruments. 40%~60% is air conditioner. In 2006, our country began to propose the “eleven five-year “object of energy consumption reduction, which is, until its end, to decrease energy gross value by 0.98, and the utilization rate of energy saving per year reaches 4 percentage. It demands the rigid energy saving. Design scientifically. Conduct relative energy saving modification. The energy saving diagnosis is the key. Relative staffs should study deeply and practice, rapidly make the effective methods and procedures. The main factors are positions, air system, instrument operation time, indoor staff density, lighting density, indoor temperature, maintenance thermal and lighting density, etc. From perspective of external environment, it can be classified into management and maintenance, electrical instrument energy consumption, internal function plan and external environment effects, shown as Figure 1[1-4].

Energy saving diagnosis refers to methods such as questionnaire, comparison, energy consumption simulation, and field investigation, etc, correctly mastering some basic operation situations in the building, such as operation efficiency, load state,

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energy consumption, etc. Specialists analyze the potential points and propose corresponding measures. It mainly focuses on graph analysis of dynamic instruments, lighting, air conditioner, and electricity distribution, etc and collection record and relative supervision. But the total energy consumption isn't solved. The effective measures haven't been proposed. Energy consumption diagnosis can propose the points according to different buildings, whose finally demonstration is in electrical instruments. According to positions and functions, analyze the different energy consumption rates. The bigger ones should be noticed. For example, in a hotel, air conditioner has the biggest energy consumption, and the socket and lighting are less. In an office, the socket and lighting consume most, and dynamic instruments and air conditioner are less. According to different scales of buildings, different diagnosis plans should be made. Comparing to single building, timely analysis should be made on classified energy consumption level and unit energy consumption level. To group buildings, conduct the diagnosis analysis from the whole to individual parts. Make relative judgment on energy consumption of group building. Stress the energy saving objects. According to different classifications, judge the electrical instruments and single building one by one. Due to different analysis view, classification and object, the diagnosis methods are different, which requires relative preparations and detailed diagnosis process.

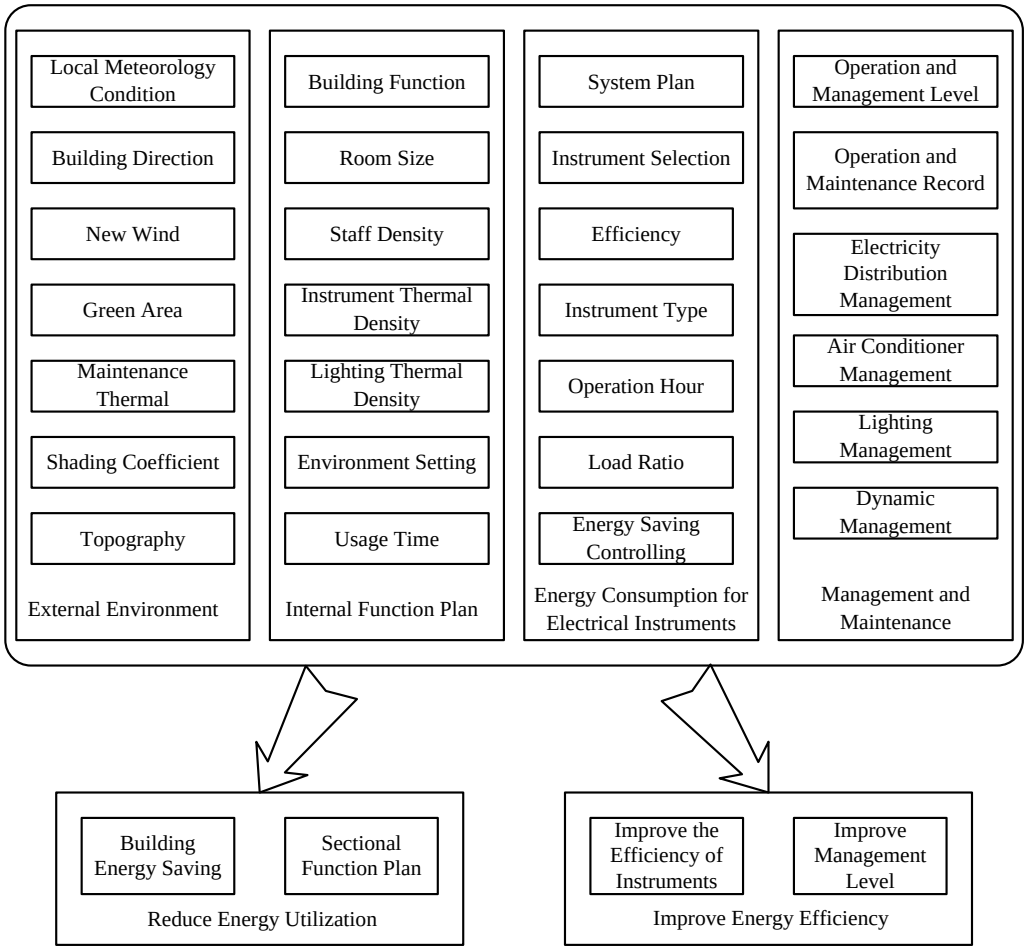

Figure 1: Factors of Building Energy Consumption

2. DIAGNOSIS PROCESS AND METHOD

2.1. Diagnosis Process

The diagnosis includes the investigation and research, field investigation, energy saving analysis, energy saving prediction, diagnosis report, and making modification plan, etc. To better regulate the diagnosis method and continuously

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improve the service quality, the diagnosis should conform to some rules, and make some processes with obvious effects, high professional degree and availability, shown as Figure 2.

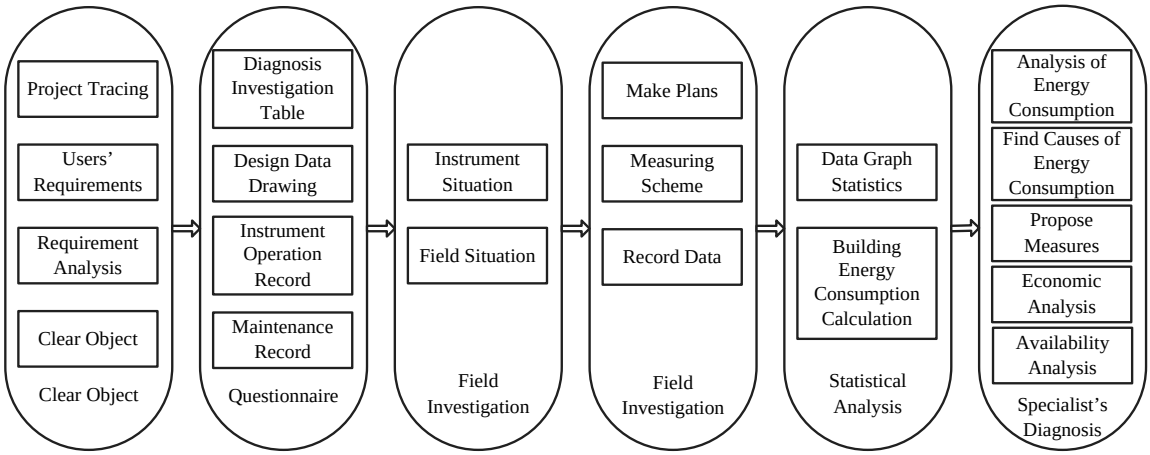

Figure 2: Diagnosis Process

Table 1: Basic Content for Building

Number	Unit Introduction	Building Group	Building	Electricity Usage	Instrument
1	Unit name	Total area of building	Building area	Price for electricity in winter	Instrument classification
2	Address	Electricity content per year	Occupation area	Price for electricity in summer	Brand
3	Contactor	Number of buildings	Area of air conditioner	Price for electricity in transition	Type
4	Unit quality	Building structure	Building direction	Price for electricity in tip	Instrument type
5	Operation	Roof	Sectional function	Price for electricity in peak	Unit power
6	Staff structure	External window	Building structure	General price for electricity	Load coordination way
7	Understanding of energy saving	External wall	Roof	Price for electricity in nadir	Operation hour for time section
8	Instrument management system	Layers	External window	Electricity quantity for warming air conditioner	Lighting type
9	Energy consumption	Building direction	External wall	Electricity quantity for lighting	Number of lighting devices
10	Operation controlling	Main function	Layers	Electricity quantity for dynamic	
11	Electricity saving production	Electricity fee per year	Situations	Electricity quantity for loop	

In the contacting process, firstly, it should have clear recognition. Conduct detailed analysis and investigation on users' requirements and their willingness. After getting information initially, communicate with users. On such basis, apply the process according to the purpose. Collect relative data, including instrument, property and management, etc. It decides the risk. Invest the field instruments and operation situation. Fill in relative tables. Design the plan specifically, to promise its availability and accuracy. While testing the main loop electrical instruments, professional instruments should be used. According to object characters, data and operation, use special software to analyze, to provide references for economic and available analysis of energy saving plans[5-6].

2.2. Diagnosis Method

The object information should be mastered completely. Due to the big differences of objects and parameters, the acquisition methods are different. The general ways are questionnaire, software simulation and field investigation.

Questionnaire. It refers to record in observation, asking and questionnaire. Record and collect with tools such as camera, building plane figure and

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investigation table. The operation management is the point. Stress the data in field management and usage of instruments. The main content is the basic situation of building, usage and management of building electrical instruments, electrical instruments, staff and instrument density and energy saving methods. The basic situation of building should use unit investigation table, instrument usage investigation table, building investigation table and building group investigation table to introduce the specific situations. The content is shown as Table 1.

The statistics on building electrical instruments can use dynamic instrument investigation, lighting investigation and warming air conditioner investigation. The content is shown as following Table 2.

Table 2: Main Content for Investigation in Electrical Instruments

Number	Transformation and Electricity Distribution Instruments	Warming Air Conditioner	Lighting Instrument	Dynamic Instrument
1	Investigation in transformation and electricity distribution instruments	Investigation in warming air conditioner	Investigation in lighting instrument	Investigation in dynamic instrument
2	Transformer	Electrical cooling/ obtaining host	Lighting instrument usage	Pump
3	Specific investigation in transformer	Boiler	Lighting instrument test	Pollution exhaustion pump
4	Electricity for electricity distribution loop record	First cooling water pump	Lights	Ventilation system
5	Electricity for electricity distribution loop record	Thermal pump	Lighting controlling System	Elevator
	Electricity distribution loop detection and conclusion	Second system/ cooling pump	Lighting section	Commercial official instruments
	Transformation loop	Cooling system	Lighting loop	Park dynamic instrument
	Electricity distribution instrument	Fresh air handling unit/ fan-coil unit		

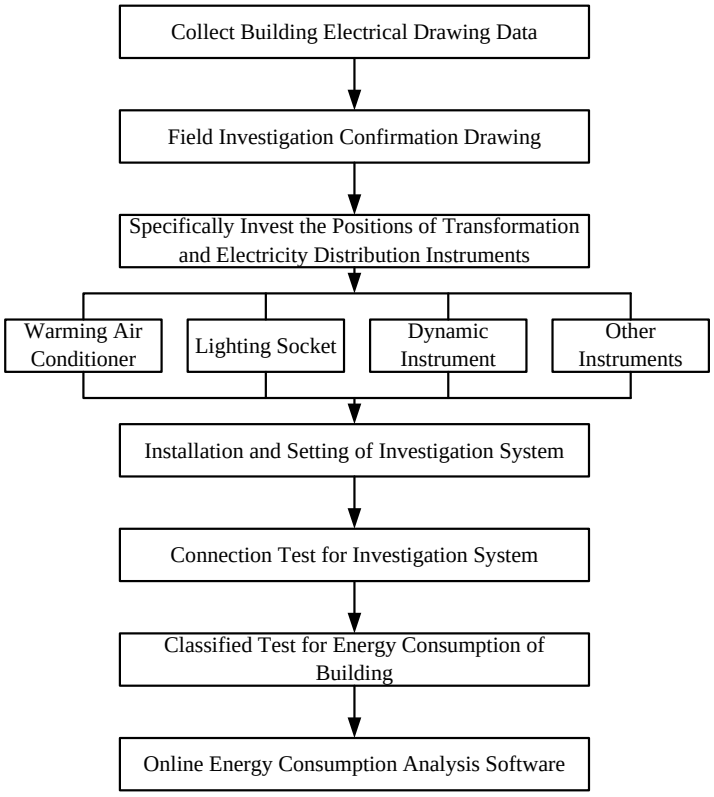

Figure 3: Investigation Process

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The electrical instruments have big effects on energy consumption, which should be stressed in questionnaire, including the professional and structural level, main skills for managers and main organization mechanisms, etc. The investigation includes the energy saving methods and measures. Conduct specific statistics on electrical instruments and query according to willingness[7].

2) field investigation. After questionnaire, stress some parameters. Before the record files generated, some essential data should be collected, including density of carbon dioxide, lighting degree, moisture, traffic, temperature, electrical parameter, etc.

2.3. Data Analysis

It concludes the relative instrument operation records and data information. Analyze in software. Classify the energy consumption data according to the graph. Find the main potential point by comparing the data. The basic tools include frequency distribution figure, columnar section, and trend figure, etc. They can be transformed or used in complex forms. The main types are shown as Figure 3.

3. THINKING IN BUILDING DIAGNOSIS SYSTEM

3.1. System Introduction

Diagnosis system is a computer instrument to simulate specialists' decisions, including professional knowledge of energy saving, which can processes many special problems. It has reasonable and deducing programs. Base on professional knowledge, it is used for solving some special and complex problems, which is progressing continuously and supplements itself. The specialists provide lots of experiences and knowledge in different areas. After certain processing and addition, it provides some reasonable plans and countermeasures in diagnosis system.

3.2. System Structure

It is shown as Figure 4, including knowledge base, reasoning mechanism, work memory area, knowledge acquisition interface and user interface, etc. Knowledge base is core, mainly for storing some methods and countermeasures. It includes many data about energy saving, specialists' experiences and plans, etc. Reasoning mechanism is used for controlling and processing the specialists' reasoning. According to the energy consumption, it gets corresponding results. Memory area is the temporary storage for information from reasoning. Knowledge acquisition interface deals with the specialists' experiences and knowledge. Then transform them to the structure for computer. User interface is friendly. It can communicate with specialist system timely. During its development, knowledge acquisition is the most important. Knowledge reasoning and demonstration is also important. So-called knowledge acquisition refers to the way to conclude the specialists' experiences and knowledge. The methods are machine learning, PC conversation and interpersonal communication. So-called knowledge acquisition is to transform the effective knowledge into one understood by computer. The demonstration ways can be classified into part, logic, frame and rule. Knowledge reasoning is to build the mechanism to solve relative problems, which has ways such as forward reasoning, backward reasoning and mixture reasoning, etc[8].

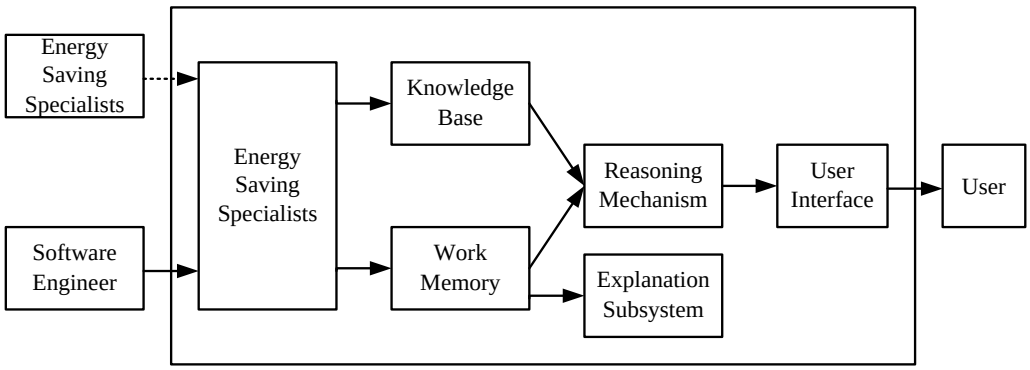

Figure 4: Diagnosis System Structure

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System function. The diagnosis system has two functions, which are energy consumption levels and electrical instruments operation and energy consumption diagnosis. Conduct comparison of mean energy consumption on buildings in same type to judge the energy consumption level of building. Consider decision tree as the main diagnosis mode, the strange energy consumption can be detected. Decision tree is a system comprising of some decision factors and decision values. It is in tree form. Each node in each decision tree represents a decision factor. Its terminal is in leaf form. A leaf is a decision value. It can demonstrate the specialist knowledge.

4. THE WAYS TO OPTIMALLY DESIGN BUILDING INTELLIGENT SYSTEM

Building energy saving refers to reasonable utilization. It is accomplished by using new and effective energy saving technology. It is essential to enhance the operation management of intelligent diagnosis system. As an effective tool, intelligent system can exert the mutual functions among varied systems well, especially in Hongkong, England and America, etc. It takes amounts of time to study the operation management and they have good performances. But our study is still backward. We should learn from foreign advanced experiences and management ideas to maximum exert our advantages.

4.1. Optimize the Diagnosis System Design

The future building intelligence will be optimized continuously. It should combine with its features closely and conduct the integration of electricity and machine. It refers to the comprehensive consideration according to individual characters of strong power and weak power. It should be considered on the beginning to promise the complete parameters and the high-efficiency system. It should consider the characters of varied sections. Group the system instruments and terminals according to the sections. Design the execution and test terminals. Flexibly control states of instruments according to indoor staff distribution.

4.2. Promise its Fine Operation

There are professional study team on building intelligent diagnosis system, who works on its diagnosis. With the science and technology progressing continuously, its technology becomes an industry. After the building energy saving appearing, debuggers should conduct professional debugging under load state. Only when the intelligent system can pass through the serious test after fitting with other system instruments and the correct parameters are collected, the design is proper and the system is available. Besides the scientific management is essential. Training the team mastering such system. Build the perfect management mechanism. Reduce the energy consumption continuously. Enhance the reasonability of practice. To realize its functions, it must optimize the operation states of system, to promise its proper operating. Conduct optimal debugging timely to make it to meet the real requirements. Try to avoid the bad states and great wastes. Enhance instrument operation in technology and management. Intelligent system has complete instruments and supervision terminals, which can manage energy saving. Understand the states of instruments in building area timely. Enhance the supervision on instruments in some administrative methods, to judge the field situations correctly[9-10].

5. CONCLUSION

To current situation, in China, the development of building electrical diagnosis system is backward. On basis of macro development, understand its building and operation deeply. Its definition of criterion, regulations and policies and studies of relative theories and technology are the same. It can complete the energy saving, from aspects of dynamic system, lighting system and air conditioner system, etc. As modern science and technology progresses, it is more convenient. As the main platform, it should exert the supervision function correctly to realize the proper utilization of system resources. Regulate the problems intelligently. Try to avoid the great wastes of people and materials. Exert its management function truly. To the future and current systems, it should consider and add the supervision management.

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