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Application of Internet of Things Technology in Energy Saving Design of Building HVAC

Yingshan Ji, Jiahao Wang, Mingqiang Gao

School of Computer and Software Engineering, Science and Technology of Liaoning University, Anshan 114000, China

Abstract

Through Internet control technology to realize communication base station and the office of comfort air conditioning wireless remote monitoring, real-time collection and air conditioning power, set up, parameters such as temperature, environment temperature, remote adjust the air conditioning work in optimum operation state, to meet the requirements of comfort and the purpose of reducing energy consumption, realize the intelligent centralized management and energy saving management.

Keywords

Internet of Things; Air conditioning; Energy saving; control.

1. Introduction

With the progress of the society, air conditioning is popularized in every commercial building in the city, which not only improves people's working comfort, but also greatly increases the energy consumption. In the global energy shortage today, the real-time monitoring and energy saving control of air conditioning is particularly important. At present, most office buildings in China adopt unified manual debugging of single equipment for air conditioning control, but neglect the observability of system management. The maturing of Internet of Things technology also represents the upgrading of information technology. Therefore, in view of the serious energy consumption of air conditioning and the lack of systematic energy saving scheme, this paper will combine with the Internet of Things control technology to design the air conditioning energy saving control system, realize real-time monitoring and intelligent control, so as to realize the purpose of energy saving of intelligent system.

2. The Application Prospect of Internet of Things in HVAC

The crazy growth of the Internet of Things is also profoundly affecting and transforming heating, ventilation and refrigeration, known as HVAC systems. By embedding intelligence and connectivity into devices, more modern products and new business models are introduced to increase operational visibility of HVAC equipment, providing greater comfort, functionality and less energy consumption to users. Such as integrating smart devices with human motion sensors to continuously monitor occupancy in buildings. When no activity is detected for a long period of time, the system can suggest turning off heating (or cooling) to reduce power consumption by notifying the application.

In addition, the latest networking and artificial intelligence technologies can be used to understand the flow patterns and preferences of people within the building and automatically adopt solutions that adapt to their comfort needs over time. You can also integrate third-party data sources, such as weather forecasts. The system anticipates a rapid rise in temperature and can begin to cool the building gradually to maintain the user's comfort. It can prepare for the future in the most energy-efficient way.

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3. Performance Analysis and Design of HVAC Energy Saving System

In the Internet of HVAC energy saving system, need HVAC module, control module of actuators, send data to the gateway of wireless sensor network, a gateway to the local network connection to the cloud (the administrators can gain through the cloud view sensor data), and embedded devices (remote access and management of HVAC equipment), etc.

In terms of system optimization, intelligent platforms are embedded to automatically find the most energy-efficient configurations. This means that the controller will optimize parameters, such as fan and pump management thresholds, water temperature setting points, scheduling, etc., and quantify the benefits of various configurations in terms of energy use, so as to achieve intelligent energy conservation and emission reduction while ensuring user comfort.

Reasonable HVAC system of Internet of Things can also achieve seamless data accumulation, filtering and sharing; The device is connected directly to the analytics platform in the cloud for preventive maintenance and continuous optimization. For example, if a component's performance degrades, administrators can understand its maintenance requirements ahead of time and fix the equipment before it breaks, thereby avoiding costly repairs.

3.1. Energy Efficiency Formula of HVAC Energy Saving System

The function of the air conditioning system is to regulate the environment inside the building. As the external environment changes, the energy required to regulate the internal environment will also change accordingly. According to the law of conservation of energy, the equipment that makes up an air conditioning system also needs to change the energy input to maintain its operation according to the change of energy required by the environment. Since the air conditioning system serves people, human factors also have a great impact on the energy consumption of the air conditioning system. For example, the air conditioning system is still running when no one is around. If the influence of human factors is not taken into account first, the main influence on energy consumption of air-conditioning system is the operating efficiency of the air-conditioning system.

In order to improve the operating efficiency of the equipment, the traditional energy saving control strategy is to control the lowest input energy when the internal environment energy demand is fixed, so as to achieve the purpose of energy saving. The evaluation mechanism of energy efficiency is also proposed, such as COP of refrigerating machine in air conditioning system. This control strategy evaluation method is undoubtedly very effective for isolated electromechanical equipment such as elevator, water pump, etc. Since COP can reflect the energy usage of isolated devices, it can also analyze the most energy-efficient operating conditions of the devices. If the energy efficiency of air conditioning system (SCOP) can be established, the operation status of the whole system can be evaluated, and the control and scheduling system can be operated in the most energy-saving state according to the SCOP comparison of the operation status of the system.

The energy efficiency model of the system is constructed by referring to the definition of energy efficiency of refrigerator. If the load of the system at time T (expressed in power) is Q (T), the energy consumed by the conveying load Q (T) is P(T), and COP(T) is the energy efficiency at time T, then

$$\frac{1}{COP(t)} = \frac{q(t)}{p(t)} \tag{1}$$

Where, P (t) is the accumulation of power PI of all links (equipment) in the system. The total load can be obtained from multiple parts of the system. Then, equation (1) can be rewritten as:

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$$COP(t) = \frac{q(t)}{p_0 + p_1 + \ldots + p_i} \tag{2}$$

Invert equation (2) to get Equation 3:

$$\frac{1}{COP(t)} = \frac{p_0}{q(t)} + \frac{p_1}{q(t)} + \ldots + \frac{p_i}{q(t)} = \frac{1}{cop_0} + \frac{1}{cop_1} + \ldots + \frac{1}{cop_i} \tag{3}$$

Cop_i is called equipment system energy efficiency (equipment energy efficiency). Formula (3) provides a theoretical basis for building the system energy efficiency model.

3.2. Design Scheme of HVAC Energy Saving System

For HVAC systems, "things" in the Internet of Things refers to central air-conditioning equipment, end-user buildings and outdoor environments. Sensors that perceive properties refer to pressure, temperature, humidity, current, voltage and power sensors, etc., and increase the man-machine interface's interference function to the state of the object.

The system obtains real-time indoor temperature information and user status through all kinds of sensors, compares it with the third-party data source in the cloud, USES the intelligent algorithm in the background to find the optimal parameters of air conditioning operation, and optimizes the running time and temperature of air conditioning through the controller, so as to reduce the energy consumption of air conditioning while ensuring the most appropriate indoor temperature.

The background software system optimizes and adjusts the operation data and air conditioning state by building a virtual model, which can not only compare the historical data of the same room, but also conduct intelligent comparison and analysis with the data of the same type of room. The background transmits the intelligent analysis results to the cloud, and the administrator can adopt the visual data and adjustment scheme through embedded devices, and at the same time of monitoring, also adopt manual control to implement the centralized management.

HVAC by environmental temperature sensor identification space compared with air conditioning setting temperature, the actual temperature and when the actual room temperature is below the set temperature to a certain value, the automatic ascending air conditioning setting temperature, when the actual room temperature is higher than the set temperature reaches a certain value, the automatic reduce air conditioning setting temperature to the original value, so as to achieve the aim of on-demand cooling, save ineffective energy consumption of air conditioning. When it is detected that the ambient temperature is lower than a certain value, it will automatically turn off the corresponding air conditioner, and automatically turn on when it is higher than a certain value.

The HVAC continuously monitors occupancy within the building through integration with motion sensors, and when no activity is detected for an extended period, the system can advise the application to turn off heating (or cooling) to reduce power consumption. At the same time, continuous attention can be paid to the operation stability and failure of the equipment to reduce or even avoid the failure rate of the equipment.

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4. Conclusion

To sum up, energy saving design of HVAC plays an extremely important role in buildings, and the combination with Internet of Things technology is the trend of future development. Energy-saving design of building HVAC system based on Internet of Things technology needs to be considered from the perspectives of intelligent control, energy and environmental protection, etc. Appropriate heat source should be selected in practice, renewable resources should be used to reduce resource consumption, and scientific methods should be adopted to improve the design of air-conditioning system. There are still many problems to be solved in the application of Internet of Things technology in the energy-saving design of building HVAC system, and designers need to strengthen their business ability, constantly improve the design technology and optimize the design scheme, so as to promote the upgrading of the intelligent energy-saving development of the building industry.

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