Design of Energy Consumption Monitoring and Energy-saving Management System of Intelligent Building based on the Internet of Things

Chuyuan Wei
Dept. of Computer Teaching and Network Information
Beijing Institute of Civil Engineering and Architecture
Beijing, China
weicy@bucea.edu.cn

Yongzhen Li
Dept. of Computer Teaching and Network Information
Beijing Institute of Civil Engineering and Architecture
Beijing, China
liyongzhen@bucea.edu.cn

***Abstract*—for people improving the energy-saving performances of buildings, the applications of information communication, computer network, automation control and etc. are the current building energy-saving technologies. They form with a serial of technique measures for buildings with energy management systems running implementation and intelligent monitoring. This paper introduces and analyzes the information technology in building energy-saving. For building energy-saving on the demand for intelligent building energy monitoring, this paper proposed a system framework of Building Energy Monitoring and Analysis System based on the Internet of things, which has some enlightening in Building energy consumption further to achieve real-time monitoring and control, and improve the energy-saving of intelligent building.**

Keywords-Building energy-saving, Intelligent Building, Wireless sensor network, Internet of things

I. INTRODUCTION

Building energy-saving is initially to reduce loss of energy in buildings in developed countries. Now commonly referred to 'improving the energy efficiency of buildings', rational use of energy, improves energy efficiency in ensuring the conditions of building comfort. Building energy-saving specifically refers to that In the building planning, design, construction (reconstruction and expansion), the process of transformation and using, doing implementation of energy efficiency standards, using energy-saving technology, technique, equipment, materials and products, improving the performance of thermal insulation and heating, air conditioning refrigeration and heating system efficiency, strengthening the operation and management of energy systems, using renewable energy, In ensuring the quality of the indoor thermal environment, reducing energy consumption of heat, air conditioning and heating, lighting, hot water supply.

Building energy-saving is clearly focused on energy-saving building, the energy is the cost of electricity, coal, oil energy that create a lot of heat (cold) to achieve the environmental requirements of modern buildings. Information technology, intelligence technology as the main technology can effectively enhance the 'building energy-saving' technology level from the effect of building energy-saving abroad, provides a new revelation for the construction industry to achieve higher energy efficiency target. Therefore, Intelligent Technology that Support technology development in construction projects which reflect the salient features of modern technology. Building energy-saving has been gradually applied in recent years.

At present, building energy consumption has been accounted for the total energy consumption of the whole society about 1/3. Building energy-saving reduces building energy consumption; effectively alleviate our energy, resources supply and demand in the architectural planning, design, construction and operational management process, through the implementation of existing building energy-saving standards. Using intelligent technology for optimization of building energy systems integration design, building of strong and weak electrical equipment, intelligent system of unified planning, unified design a variety of equipment and systems to achieve resource sharing, information exchange. Energy consumption, personnel inputs and operational costs greatly reduced through the development of integrated optimization, saving investment to meet the construction side and the requirements of energy saving[1]. This paper discusses the comprehensive analysis of energy consumption monitoring and management system from the Internet of Things technology combined with intelligent building applications.

II. INTELLIGENT BUILDING ENERGY-SAVING TECHNOLOGIES

A. The basic concept of intelligent building

On the definition of intelligent buildings, a more common internal definition is that Intelligent Building is safe, efficient, comfortable, convenient and flexible, using of system integration method, computer technology, communication technology, information technology and the combination of architectural art, through automatic monitoring equipment, information resources management and information services to users and optimal combination of architecture, obtaining reasonable investment, for the information needs of the community.

978-1-4577-0321-8/11/$26.00 ©2011 IEEE

There are several related key technologies of information networks from the definition of intelligent buildings: computer technology, communication technology, information technology, information resources, information service; system integration of the various subsystems within the building, forming a whole large system, making these systems work together[2].

B. Intelligent building energy-saving technologies

Effect of applying high technology to improve building energy-saving, energy-saving technologies can promote the development of intelligent building energy-saving. To achieve the building "to improve energy efficiency and reduce energy consumption " target, comprehensive application of information and communication, computer network, automatic control, intelligent technology, developed into various types of energy use within the building energy management system operation and intelligent monitoring, is currently building a new energy saving technology. The focus of this technology is based on building envelope energy efficiency, building energy-using equipment and facilities, and building energy-saving function. Through the combination of modern technology and energy use management methods of intelligent systems, so that building energy efficient and energy utilization rate further decreased to a higher level of energy-saving target standard values of the function and effect.

For public buildings' energy conservation, Integrated use of information and telecommunications, computer networks, intelligent automation and intelligent control technology, integrated management of building energy-saving, air-conditioning energy monitoring, energy supply and drainage control, power distribution energy monitoring, lighting energy monitoring, control and use of renewable energy and the doors and windows shading Intelligent energy-saving monitoring system. There should be based on building size, energy saving accuracy and efficiency targets and the needs of property management, Select Configure-related intelligent systems and ascertain the system energy monitoring requirements, for energy efficient building intelligent systems engineering and technical measures.

In all types of building intelligent systems engineering, usually construction equipment are equipped with management systems and property management systems and related intelligent systems. Therefore, the application of intelligent integrated systems technology, establish information collection and energy utilization management platform for information sharing and collaborative work framework[3]. For building energy utilization within the operation of the system information to be collected, display, analysis, processing, maintenance and optimal management, form a real-time, global and systematic construction able to run comprehensive monitoring and analysis and optimization of energy efficiency integrated management capabilities through the integration of resources.

III. THE DESIGN OF ENERGY MONITORING SYSTEM

A. The Internet of Things in Intelligent Buildings

Internet of Things is the "sensor network" known in the international arena, is an expansion of the concept of sensor networks. More simply, Internet of Things are things that access to the Internet, objects connect through Radio frequency identification device infrared sensors, GPS or other means, then through the mobile communication network or other access connect to the Internet, eventually form a smart network, via computer or mobile phone to achieve the object of the intelligent management and information collection and analysis.

Internet of Things refers to the concept of ubiquitous of the terminal devices and facilities, including with "inner intelligence " of sensors, mobile devices, industrial systems, building automation systems, smart home installations, Video Monitoring Systems and personal portable wireless terminals or vehicles, and other intelligent devices, through a variety of wireless and / or wire line long distance and / or short distance communication network to achieve interoperability, application integration. Provide safe and controlled and even personal, real-time online monitoring, location tracking, alarm linkage, command, plan management, process control, security, process security dimension, online upgrade, statistical reporting, decision support, management and service functions, by use of appropriate information security mechanisms, in the network (Intranet), private network (Extranet), and / or the Internet environment.

Established Internet of things data center information system as the core is the key to solve the problem of building energy management, is conducive to establishing post-decision support system, to enhance the basis of modern management, to provide the basis for future planning and decision-making. Combined with other information systems, play the role of data aggregation, Improving management capacity and efficiency. Internet of Things technology-based monitoring system for building energy consumption, combine all energy consumption equipment and building energy efficient. The core technology is the sensor network and computer information processing, for building an advanced, powerful information acquisition and processing platform. The system is suitable for a variety of existing and new construction. It is the most suitable technique for transferring data in Building energy consumption monitoring system.

B. Building the integrated management system framework of energy-saving based on Internet of Things

Internet of Things usually has three characteristics. First, overall perception, is Obtaining information objects using RFID, sensors, and other two-dimensional code anywhere & anytime; Second, Reliable Delivery, Real-time accurate information on the object is to pass out through the integration of telecommunications networks and the Internet; third, Intelligent Processing, Massive data and information is to be analysis and process, implementation of intelligent control of the object, by use of cloud computing, fuzzy recognition and other intelligent computing techniques. Internet of Things has generally been recognized as three levels. Bottom is used to

perceive sensory data; the second layer is the network layer for data transmission; the top is the application layer[5].

Intelligent building, including 20-30 weak subsystem and control subsystem, most of these subsystems has achieved the network, IP network architecture; Construction equipment monitoring, security, card, and so had constituted the ITP / IP network of subsystems integrated on the platform. Internet of Things on the intelligent building technology, especially energy-saving technology has a more profound application, a variety of building energy consumption have been throughout most of the subsystems by sensor networking technology, for example, building intelligent building automation systems, HVAC systems, smart meters, drainage, construction equipment monitoring, security, card and other applications. This paper presents an integrated building energy management and control system for intelligent building[4]. The system framework is shown in Figure 1. It contains the following three aspects[6]:

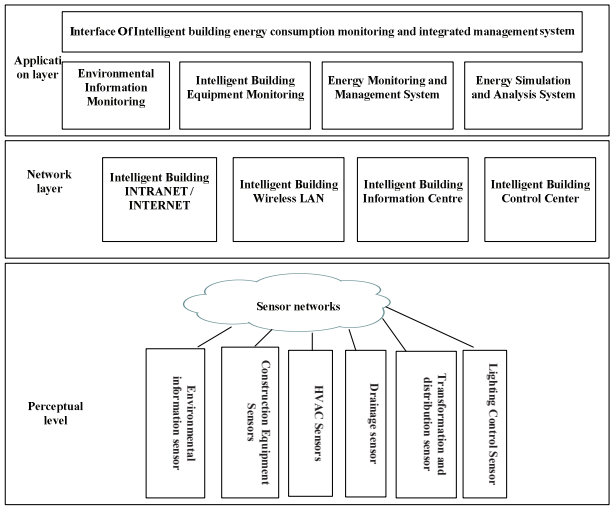

Figure 1. Framework of our system

- Perception layer. Perceived level task is to complete the acquisition of intelligent building energy consumption information. Using sensor networks for intelligent building environmental information (temperature and humidity, etc.), construction equipment, HVAC, plumbing, power distribution systems, lighting systems and other subsystems, using real-time acquisition of data in various systems through sensors, send to intelligent building center or control center..
- Network layer. Both for the TCP / IP network, or non-TCP / IP, such as field bus and other industrial control networking, Internet of Things can integrate multiple connectivity options, achieve interconnection for individual sensor nodes, the information center, management control center, local area network of intelligent building (LAN), wireless local area network (WLAN), Complete data communication.
- Application layer. Application layer, mainly from the perspective of software design, provides the interface of integrated management of building energy consumption monitoring and analysis system through the platform to the cloud; integrate various data and information to achieve fault analysis, energy management, equipment monitoring, monitor and management on building energy consumption equipment through system.

IV. CONLUSION

Wireless sensor networks can be widely used in intelligent building HVAC system, intelligent building automation systems, environmental monitoring systems, lighting control system. In this paper, based on wireless sensor networks, using Internet of Things technology, a comprehensive analysis of building energy consumption on intelligent building automation systems and equipment, make full use of the inherent advantages of sensor networks collecting environmental information on energy consumption, propose a design framework based on integrated management of building energy consumption monitoring and analysis system through Internet of Things, to make the role of better ideas for the level of building energy-saving technologies.

ACKNOWLEDGMENT

This article research work obtained the Scientific Technology Development Plan of Beijing Education Council.

REFERENCES

[1] Zhang gongzhong. The internet of Things and Intelligent Building . Intelligent Building & City Information,2011.

[2] Xu lei,Huang he,Peng kefa. Design on Building environmental monitoring sensor network platform. Digital technology and application.p.38-39.

[3] Xie Yang Lu Jiale Li Chuanwe .Application of W ireless Sensor Networks in the Intelligent Buildings. Building Electricty;2007,p.25-28.

[4] Kang Yanbing. Survey on key techologies of building energy-saving.Chinese Energy,2003.p.18-25.

[5] The Ministry of housing and Urban-Rural Development.Software development guidelines of the state organ office buildings and large public building energy monitoring system .Technical Report,2009.

[6] Angelo P. Castellani, Nicola Bui, Paolo Casari. Architecture and Protocols for the Internet of Things: A Case Study. IEEE International Conference on Pervasive Computing and Communications Workshops, p.673-678,2011.