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Research on Carbon Emission Reduction of Green Building in Urban Engineering Based on Internet of Things Algorithm

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Abstract: As the Internet of Things (IoT) has become more prevalent in everyday life, there has been a concomitant rise in interest in and use of the Internet of Construction Energy System (iBES) in the field of sustainable construction. It does this by installing a series of sensors in the Intelligent Gateway (IG), which gathers data on the building's energy use, and it unifies a data standard by basing it on the idea, technology, and standard of the Internet of Things. Following the completion of the data collection and software process, a timely report on building consumption data may be generated. This will make it possible for additional adjustments to be made to the building's energy consumption, which will ultimately help achieve the goal of energy efficiency and reduction. According to the results of the application, using technology that is connected to the Internet of Things to make adjustments to the power supply in buildings may be an effective method for lowering the amount of energy used and the amount of carbon dioxide emissions.

1. Introduction

An incredible amount of energy consumes by buildings. This amount is roughly 40% of national energy consumption in western industrialised nations. The air conditioners and ventilators equipment are the major factors, up to 70% for the consuming. The building sector has evolved into a significant energy user and emitter of carbon dioxide. Green construction, by applying environmental protection methods declines the building resource waste and energy consumption. Resource consumption shall be controlled by site selection, demolition, design, construction, and operation and maintenance of structures. This controlling can be led to saving energy and reducing pollution. Biodiversity, controlling systems, and pollution and greenhouse emissions reduction are indicators of green buildings. It provides healthier, happier and more productive lives. This efficiency saves cost on utility bills.

The major challenge of green building is the lack of awareness about administrative support. The majority of individuals remain uninformed about the advantages of green building and sustainable living, resulting in their lack of interest in the concept. Future building appraisals must include criteria for reducing construction energy use, and this is a critical element of a low-carbon society. In recent years, the IOT has grown quickly. Green IoT can be defined as the energy efficient procedures (hardware or software) adopted by IoT either to facilitate reducing the greenhouse effect of existing applications and services or to reduce the impact of greenhouse effect of IoT itself. Examples of IoT technologies include video recognition technology (RFID), infrared sensors, gas detection sensors, global positioning systems, laser scanners, and so on. To facilitate item identification, tracking, administration, and regulation, these sensors are networked together through the Internet, with the help of high-speed server processing.

2. Methodology

Global environmental and resource challenges have grown more conspicuous and conflicting, as we all know. Countries have started looking for solutions to safeguard the environment and conserve energy. Lighting is carried out every day to meet the necessities of social growth and people's lives. Lighting consumes a significant amount of world energy. Reducing the quantity of energy needed to generate power and effectively managing the environmental challenges caused by power generation are both possible outcomes if countries can eliminate wasteful consumption of lighting power [1]. As a result, nations all over the globe started to push for and invest in intelligent lighting initiatives. People started to become interested in the subject of intelligent lighting.

Efficient and precise data exchange is crucial to the Internet of Things. A variety of considerations, such as the network structure, communication distance, and cost, must be taken into account while designing an energy management system's wireless connection. In addition to Bluetooth, UBW and Wi-Fi are now accessible. IEEE 802.15.3a defines UWB as a well-established wireless communication standard. 1 GHz wireless carrier communication is used in this device. Both ZigBee and Wi-Fi are characterized by robust and user-friendly networks; nevertheless, ZigBee is not suitable for use in large-scale building energy consumption collection systems due to its point-to-point nature. ZigBee is widely utilized in many different industries, and its capability for multi-node wireless networking makes its development easy and inexpensive. As the system's principal wireless communication technology, GSM delivers high speed and dependability, but it also depends on communication service providers. As many as seven subordinate units may be used in a one-to-many network using Bluetooth wireless networking [2]. According to the examples above, a large-scale building energy consumption collection system may be communicated wirelessly using GSM and ZigBee networks. To eliminate dead corners and blind spots, energy consumption acquisition nodes should be arranged in a tightly packed pattern, with no dead corners or voids. Due to cost and productivity restrictions and low annual utilization rates of certain building parts, energy consumption figures have a low reference value. Nodes that gather data on a building's energy use are strategically placed using weight analysis [3].

The data centralization end performs duties such as receiving, transferring, analysing, and connecting to data terminals through TCP/IP and gateway. Data centralization will be led by Samsung's Galaxy 4412 dual-core CPU. A wide range of operations are within the CPU's capabilities. Running Linux on a computer's CPU allows it to do a broad variety of complicated tasks. Consequently, the CPU port is also provided with an Ethernet card. This card is utilized for processing and analyzing data packets supplied by the acquisition and management terminals, as well as to swiftly reflect commands from various wireless connections and TCP/IP protocols. It is possible to greatly improve this system's ability to manage massive amounts of data by adding flash memory made of NAND, SDRAM, which is and an SD extension card adapter. Fuzzy reasoning, a fuzzy knowledge base, clarity, and a controller that is fuzzy are the four main parts of this type of controller [4].

TCP/IP and a gateway are used to link the data centralization end to the data terminals, which receive, transmit, and analyze data. Complex operations cannot be implemented by a standard DSP controller, Consequently, the data centralized end's principal control portion employs the dual-core Samsung Galaxy 4412. The processing power is impressive.

A wide range of sophisticated tasks may be carried out using the Linux operating system running on the CPU [5]. Connecting a network card to the CPU port enables real-time processing and analysis of data packets acquired by purchasing and handling terminals, as well as the rapid reflection of various wireless orders.

At now, there is a divide in the construction of network software platforms between C/S and B/S. Traditional C/S architecture, or client/server, is often used in the prior platform for managing building energy use. Client software establishes a connection to a specialised server for each user, and the server handles the rest [6]. C/S design requires that a dedicated local server be established to complete numerous connections and information exchanges, making it less versatile than other architectures. It is also difficult to update and maintain the client software, which has a poor level of generalizability.

You can say that the B/S design is a step up from the C/S one. The initial C/S architecture was not very ubiquitous or flexible, but with the addition of web-side capabilities and the Internet, that problem is solved. Using technologies like cloud servers and dynamic web pages, the B/S architecture may be created and used across spaces and platforms[7]. Customers need merely visit the web page via a browser to access C/S architecture's complicated client software features, which considerably saves both platform development and platform operation/maintenance expenses.

3. Results

The ZigBee protocol's various components are listed below. The ZigBee MAC and physical layers have been supplied by the CC2530 chip. Development of ZigBee primarily targets a wide range of niche markets. The ZigBee protocol stack, which is implemented in code, must be used for the upper-layer protocol. Devices on a single network must all adhere to the same protocol stack standard. The ZigBee Organization and TI collaborated to create a protocol stack, known as Z-stack, was released. It may be used with TI's CC2530 line of microcontrollers. The Z-stack protocol stack is used to construct an intelligent lighting system using the CC2530 microprocessor. Z-stack is based on the operating system and uses the event round robin process to distribute tasks. The system goes into low-power mode after completing the startup of each layer. interrupt processing begins when the system is aroused by an occurrence. After the event is over, it returns to its normal low-power state [8]. When many events occur at once, the system prioritises them based on their relative importance and handles them one at a time. With this solution in place, the system's power usage may be drastically cut in half. The main process of Z-Stack begins after the system starts up and includes driver setup, osal setup, and the beginning of the job monitoring of the OS. Here, you can see the Z-stack protocol stack.

The application layer protects the APS layer, while the network layer links ZDO to it. The network layer serves as a bridge between the network and application layers, providing two service entries: data service and management service. Protocol-specific routing is an example of this.

There are a variety of things it can do, from setting up a new device to joining or leaving a network. Key generation, key transfer, framework protection, and device administration are all covered by the security standard. This layer is responsible for creating, sustaining, and terminating wireless data exchanges between devices across diverse network topologies. Network devices have a 16-bit identifier for each one [9]. Even though the free software behind this protocol architecture has not changed, the creators have made available a full range of API methods, so users can tailor and expand it to their own needs. Building a network and adding nodes to it requires utilizing the networking functionality and adding it to the Z-stack network stack. The transmitting node executes the protocol stack's wireless data transmission function to deliver wireless data to the receiving node. The protocol stack's wireless data reception function is invoked by the receiving node.

A personal computer (PC) serves as the host for the intelligent lighting method's sensor and control system. Computer hosts, sensor and control networks, and ZigBee are all components of a larger system for data measurement and processing. An LED dimming and intensity node are included, as well as a coordinator. With the help of the ZigBee wireless network, the ZigBee coordinator communicates with the intensity of light and dimming nodes. The intensity of light and dimming nodes each include LED bulbs, and the node that measures light intensity is also fitted with an intensity of light sensor.

Locating devices, identifying them, and setting up networks are the three main responsibilities of a ZigBee coordinator. The ZigBee coordinator uploads data on light intensity measurement and receives control instructions via serial connection via the PC upper computing for control and measurement center.

The ZigBee network is established by the coordinator following the above seven stages. Once the network is up and running and the channels have been chosen, the coordinator acts as a router.

In order for any piece of hardware to join the coordinator's network, it must first go through the network accessibility procedure using a dedicated app. After the network administrator is up and running, it does nothing more until another device on the network asks to join. There are eight main methods that a node device can utilize to apply to join an internet connection through the media access control (MAC) layer.

3.1 The Internet of Building Energy Systems: Concept and Significance (Ibes)

The Internet of Building Energy Systems (iBES) is the use of a range of sensors to detect varied energy consumption data of buildings in real time, standardise distinct information using the Internet of Things (IOT) protocol, and aggregate and send to the server side. At present, the application of IBES in building energy saving and emission reduction has been widely valued, and it has been applied in northeast, northwest and some southern areas, and has begun to play a certain role. In the process of building low-carbon campus, A vocation College has introduced and applied iBES system. Three teaching buildings and ten teachers' dormitories were selected as the test objects. A total of three hundred power consumption detection modules, one hundred and twenty water pressure and flow detection modules, two hundred indoor temperature control modules and fifty fresh air system control modules have been installed. Each building collects data through Huawei 3024 switch, uses campus Internet facilities to connect through underground optical cables. The intelligent energy consumption algorithm is used to evaluate and make judgments on the data, and then the control information is delivered to the terminal of each piece of equipment, resulting in intelligent and autonomous building energy management. The six stages that comprise IBES are as follows: perception, transmission via the network, information aggregation, data analysis, decision-making, and information output. Investigations into iBES have centered on three layers: the perceptual control, information aggregation, and diagnostic decision-making layers[10].

The pressure in the water pipe is transferred in real time to the control end of the pump intelligent system through the sensor. The control signal is transmitted to the pump frequency converter motor using the optimal pump control algorithm. The water flow in the water pipe remains constant, reducing the pump's energy usage significantly. When water consumption falls, for example, the sensor gathers the change in the pipeline network's pressure difference signal, and the controller decides to reduce the power supply frequency and power supply, lowering the water pressure and attaining the aim of lower energy consumption.

According to the study, buildings fitted with intelligent control electric heating and ventilation systems use around half as much energy as conventional structures. It is no issue to save more than 50% of power when paired with a human body sensor, brightness sensor, and dimming actuator. As a result, studying the IOT of building energy systems is important for social development in order to limit the use of materials in the construction phase, decrease energy and water usage in structures, keep a healthy air condition, and mitigate climate change from buildings. To begin with, in our country, building carbon reduction and emission reduction is becoming a sunrise industry with a wide range of needs, particularly studies on the combination of IoT and building emission reduction is also included in Outcome. Second, IBES can effectively improve and increase the monitoring, safety protection, and early warning of different building energy subsystems, as well as lower the cost of human resources. Finally, IBES can effectively improve the efficiency of building energy consumption monitoring, statistics, and auditing, and it can provide a scientific effective performance evaluation basic technology platform for reducing carbon emissions of buildings through the optimization of operation leadership and energy-saving transformation of various energy subsystems. As a result, IBES will be well-known.

In China, application opportunities in building energy conservation and pollution reduction, as well as Internet of Things (IOT) technology will be promoted. The industrial value of development is immense.

3.2. Key Internet Technologies for Building Energy Systems (IBES)

1) Perception Control Layer Intelligent Gateway (IG)

This is the smart entryway. When it comes to the perception layer of the Internet of Things, which consists of heterogeneous networks, IG is the central device and the information transmission hub. Its primary function is to execute protocol conversion, which entails changing the format of sensing data so that it can be sent and understood by the network. It relays information to the application layer and interprets commands from the application layer into binary commands that may be used to control a wide range of intelligent devices. Assuring the reliable transmission of all sensor data, it is an essential part of the Internet of Things in the building energy system.

In-Gamma gadgets often use active timed polling to collect data from acquisition gadgets.

The capture time and sampling rate may be adjusted in the parameters to better fit certain use cases. Data collected by polling may either be sent instantly or stored on a buffer SD card before being sent to a remote database via network at a later time. Most IG devices and data centers are not connected to the same LAN, so they are more vulnerable to the effects of different network configurations or to the poor network communication quality that results from working under less-than-ideal conditions. With this approach, data messages can be preserved even when the network is temporarily down, and the authentication normally required to re-establish data connections can be avoided.

XML and HTML5 are common data storage and presentation formats in IG devices; this is done to overcome the problem of data consistency in cross-device communication. It adopts the STM32F103VE main control chip, a 12V DC power supply and the M4100T serial network module. Data packets are immune to delays in transmission to the data center thanks to the time calibration mechanism included into this gateway equipment. In all, the iBES software suite includes ten different modules and five different kinds of specialized databases. Here is the structure of the iBES software system:

Building energy consumption decision-making control system, building energy consumption data analysis software, middle-level server software, sensor interface software, and energy consumption sensor are listed in order from top to bottom in the software architecture of iBES. Electricity, water, temperature, and dangerous gas sensors automatically collect data, which is then automatically collected by interface software. Data communication standards are unified through mid-level software, and large-capacity real-time data is submitted to the server for cloud computing. The system then automatically sends control commands choice of the most appropriate building energy consumption strategy, and adjusts ventilation, lighting, air conditioning, and water volume of intelligent buildings to achieve energy savings.

3.3 The IBES in Application

The usage of IBES has grown significantly in recent years, particularly in the northwestern and southern parts of the country. The iBES technology has been employed in the development of a vocational college's low-carbon campus. We used three school buildings and ten faculty residences as test cases. There are 300 modules for tracking energy use, 120 for sensing water pressure and flow, 200 for regulating the temperature inside, and 50 for regulating the ventilation system. Each structure on campus is equipped with a Huawei 3024 switch for data collection and is linked through underground fiber optic cables for access to the school-wide network.

It connects remote locations to the central 6505 switch. The system's basic framework, which went live in June 2013, is as follows:

The system architecture of the vocation's low-cost campus monitoring platform is shown in Figure 1. The system relies on tried and true IOT components, such as a dawn server for data collection and a Dell 64-bit 16-core server for data computing. In the first stage of this system's implementation, 1556 information collection stations will be set up. The duration of the acquisition is 30 seconds. The annualized energy consumption is calculated to be 365G, or roughly 1000M per day. Ten years is the maximum time that data may be kept on the server. Current shared storage servers can be fully functional without increasing the required storage space, and intramural LAN can be used to simplify network connections within the building.

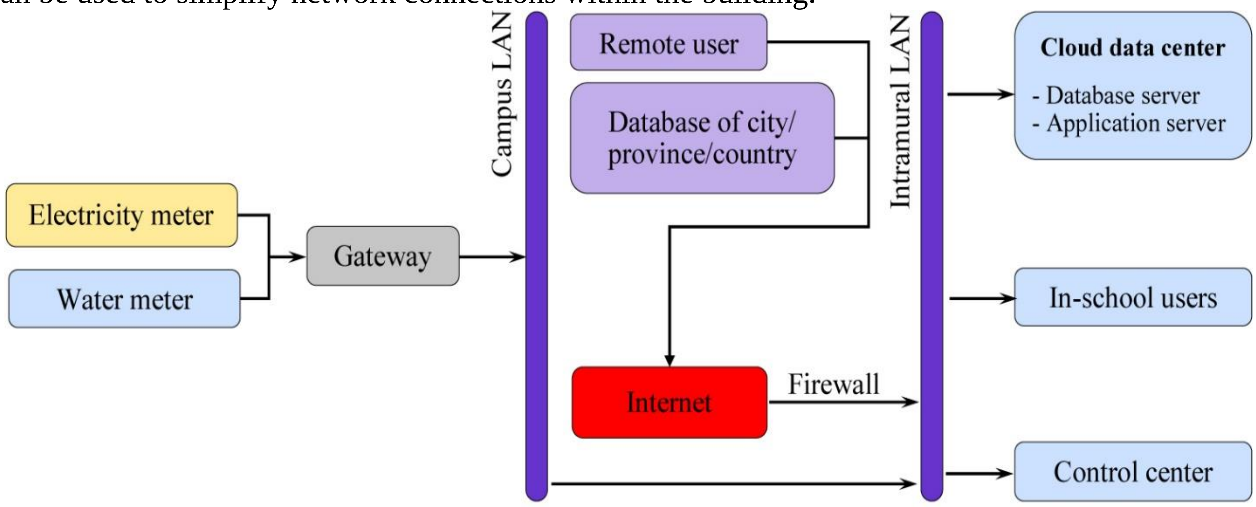

Figure 1 The architecture of the cheap campus surveillance system at the polytechnic university.

When the Platform is finished, it will include the following features. The iBES platform at the Vocational Institute was developed in Java and communicates with other nodes in the network using the SNMP protocol. It clearly classifies functions, compares energy use across different building units or nodes, and compares data in a horizontal fashion. For instance, Building 1 and

Building 2 each have their own set of energy-saving controls. The system can analyze the energy savings of both buildings and determine which one is more efficient, as well as query the energy consumption statistics of each node (Figure 2).

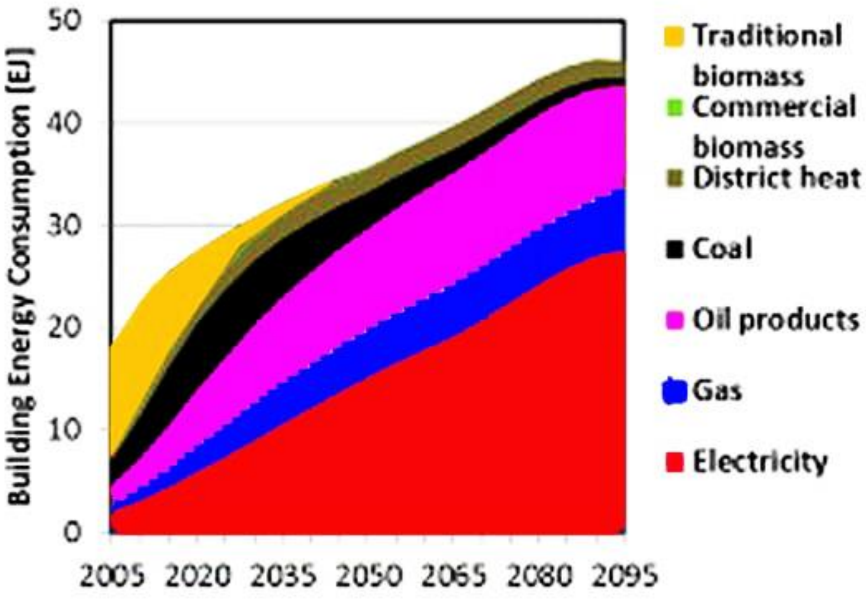

Figure 2 The utilisation of energy.

The preceding reports and statistics may give scientific data support for the college's energy consumption control and energy conservation transformation.

The fuzzy input space consists of different hypothetical languages found in the applicable fuzzy control regulations, while the fuzzy output space is the language used to indicate the associated solutions. This collection of language names makes up the fuzzy set of different hypothetical languages, and the variables that hold the values of all these different hypothetical scenarios belong to the fuzzier language pseudonym Lu. The degree to which a fuzzy set can be controlled depends solely on the order of magnitude, and each fuzzy syntax name is linked to a specific fuzzy set. Negative B i is short for negative large, NB; Negative medium is short for negative medium; Negative small is short for negative small; Zero is short for zero; Positive small is short for positive small; PS stands for positive small; PM for positive medium; Pb for Zhengda is short for positive big. In a perfect world, the amount of fuzzy rules is equal to the quantity of fuzzy segmentations. As an illustration, the fuzzy segmentation numbers for a two-input, one-output fuzzy system are 3 and 7, while the rule for the ideal number of products is 21. Fuzzy segments cannot be excessively large since then additional controllable rules would be required, further complicating matters; hence, the number of controlled criteria increases as the quantity of fuzzy segmentations increases. Similarly, rules will be overly generic and meaningful circumstance adjustments will be difficult with a small number of fuzzy segmentations. Unfortunately, there is currently no set procedure or methodology that can reliably produce high-quality fuzzy segmentation; instead, practitioners must rely on their own experience and trial and error.

4. Conclusion

In response to the 14th Five-Year Plan's important energy-saving initiative “green lighting,” IoT-based smart lighting systems for green buildings have been developed. Effort is broken down into four stages: creating smart lighting solutions, equipment, technology, and fuzzy control algorithms.

The first step is to examine how well the intelligent lighting system for green buildings performs its intended purpose. Interior light intensity may be detected, intelligently reduced, and data on lighting source conditions can be sent to the lighting control system. The functional needs of an intelligent lighting structure should be carefully considered while developing the hardware circuit. First, for the wireless sensor and control network, the ZigBee protocol was chosen. In conclusion, the system's light source sensor is bh1750fvi, and the ZigBee chip is cc2530f256 for the mobile sensor control system. The whole software architecture of an intelligent lighting system is built using hardware circuit architecture and implementation function design. We have laid the groundwork for the smart lighting system. This chapter details the development of the ZigBee coordinator, illumination node, and LED dimming node programs for the wireless sensor control system, as well as the implementation of an intelligent illumination system for green buildings in LabVIEW for the PC higher computer measurement and analysis center.

Lastly, intelligent illumination design and research are approached using the fuzzy control method. This paper lays down the groundwork for intelligent lighting's fuzzy controller and describes the fuzzy control system. Employing the fuzzy control method, the smart lighting structure generates query tables and fuzzy control rules. Using a fuzzy query table, one can find an intelligent brightness adjustment value. It is possible to use commands to regulate the brightness of an automated lighting system. More research is required to broaden the types of data enabling can be gathered from the system, so that the node structure approach for energy consumption data gathering may be applied to a range of building types.

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