Building Optimization Using Artificial Intelligence in the Modernism Life

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Abstract

We live in a new world in which technology has a permanent place. In this new world, we encounter new terms and words every day, what is the first thing that comes to your mind when you hear about smart home? The latest idea for energy conservation is the use of new equipment and systems designed for this purpose. These include building energy management systems. Using modern and electronic methods to make users comfortable, reduce costs and save energy in order to optimize energy consumption and prevent waste. A smart building is a building that "includes a dynamic and cost-effective environment by integrating the four core elements of systems, service structures, and management and the relationship between them." An intelligent building offers these benefits through intelligent control systems. In this article, while introducing energy management systems in buildings, we examine its types, implementation methods, and applications.

Keywords: Smart building, BMS, smart materials

1. Introduction

In 1966, the place that allowed automatic control of equipment and components was called the smart building. In 1970, the definition of smart buildings was as follows: "A mixture of technical and non-technical innovations with a complex management system on which capital has been invested. In general, it can be said that before the 1970s, only the ease of use and flexibility of management and control systems were considered. But after the 1970s, the context for the formation of intelligent systems in its modern sense began. Thus, intelligent buildings, or at least their conceptual discussion, date back to the early 1980s. In 1984, an article was published in the New York Times magazine about a new generation of buildings called smart buildings by building builders. These buildings are defined as the link between two technologies (telecommunications and the development of the personal computer industry). It was during this period that the first real connection between building builders and information and communication technologies was established. New telecommunications technology has given building owners the opportunity to sell technology services in their buildings and grow their business. In the next decade, advances in construction, including structured cabling systems, audio-visual systems, building automation controllers with direct digital control (DDC), limited space for network equipment, video access systems and video surveillance were made. In 1994, the Master Format standardization guide was published by the Institute for Construction Specifications (CSI). In the seventeenth part of this guide, the designers mentioned the technologies after the complete construction of the building. The latest version of the standard, published in 2004, made good progress in the application of building intelligence technologies. At the beginning of smartening, only automation of alarm, lighting and air conditioning systems was considered; After that, the automation of modern office and security systems began, and gradually,

building intelligence included the monitoring of all construction processes. Today we call a smart building in which the exchange of information in building systems is done automatically and seamlessly.

2. Definition of Intelligence

Intelligent is used for all structures and materials that are (Smart), Sensitive, Adaptive words and have the ability to adapt to environmental stimuli such as loads and external stimuli. (Actuator) including sensors and actuators) Afshari Basir (1331 Intelligent) architecture is dynamic: Dynamics means that it changes its main performance parameters according to the demand and needs of variable and dynamic conditions. Intelligent system is a system that is able to gain experience and use these experiences in new conditions. Becomes. The main features of smart architecture are as follows: 1. Dynamics and activism 2. Flexibility and adaptability to the environment 3. Reactivity and durability (useful), (1311), Smart materials are different from smart systems. Intelligent materials are often small parts and components of an intelligent system.

An intelligent system is a collection of intelligent people and materials and their multifunctional functions. Intelligent structures are simply made of either intelligent materials or a set of actuators, sensors, and software intelligence.

The need for smart architecture Today, with the progress of human beings in the fields of science and new technologies, they have left their mark in all fields of human life. On the other hand, due to the lack of resources and energy requirements, the need for optimal use of natural resources is necessary. Intelligent architecture creates environmental comfort for humans by managing the optimal use of resources and regulating living conditions.

Smart Buildings

Buildings themselves are a type of technology that adapts to and uses newer technologies. Although it is an innovation in buildings, it does not necessarily mean that the exchange of information in the building makes it smart. The smart building must be environmentally friendly. The main idea of a smart building is communication and integration between access, exposure, security, monitoring, management and telecommunications. Smart building is located as an interface between the user and the environment or in other words between the demands of users and the environment, which with intelligent behaviour allows the optimal use of the environment and resources. In fact, a smart building is a building that increases the efficiency and effectiveness of its residents and provides the possibility of effective management based on specific requirements and at the lowest cost. The definition of a smart building in the United States is: "A smart building is a building that incorporates a dynamic and cost-effective environment by integrating the four basic elements: systems, structure, services and management." And the relationship between them (Firoozi, 1332) Intelligent architecture not only adapts to the environmental conditions inside and outside the building, but also to social, political and historical conditions.

Intelligent System Common Terms

BMS, Home Automation, Smart Home, LOT, Green Buildings, Management System, Solar System Smart Grid.

What is BMS? Building Management System (BMS) refers to a set of hardware and software that is installed to monitor and control critical and critical parts of the building. The task of this complex is to

continuously monitor different parts of the building and apply orders to them in such a way that the performance of different building components is balanced with each other and in optimal conditions with the aim of reducing unwanted consumption and allocating energy resources only to spaces during operation. It can include all electrical, mechanical and protective services of the building. These services include heating, cooling, air conditioning, elevator, emergency power plant, escalator, lighting control, CCTV, fire alarm, extinguishing, traffic control and etc.

3. Difference Between BMS and Home Automation

Buildings are generally divided into two categories industrial and non-industrial: Industrial buildings such as factories, warehouses, sports facilities, power plants and etc.

Non-industrial buildings such as residential, office, commercial, hotel and etc.

These buildings have two main parts: Common areas such as parking lots, lobbies, stairs, elevators, courtyards, motorhomes, swimming pools, sports facilities, and private areas such as residential units that make up the privacy of individuals. BMS is used in common areas and is mostly focused on the home engine and manages these parts. Therefore, the use of this system is common in government offices, business centres, hospitals, etc. In this system, all control points of a room, with one system and under the supervision, control and monitoring of only one trained person. Home Automation focuses on controlling the interior space of a unit and controls the equipment inside the house, such as lighting, electric curtains, sound, etc. In this system, there is a central control unit that is controlled by one person and is concentrated in only one space No, and everyone in the house is able to control indoor systems. In fact, Home Automation in combination with BMS provides complete control over buildings.

HOME AUTOMATION Capabilities: Brightness control individually or in groups, combining natural light, artificial light, adjusting brightness, presence-sensitive lighting and remote or close control. Adjust the temperature of the rooms separately and as needed automatically or sensitive to the presence of the person. Control curtains, blinds, awnings, doors, windows and etc. simply with the touch of a button or according to a schedule. Irrigation of flowers, plants, setting artificial fountains and waterfalls by phone or automatically according to the previous plan. Use music and movie archives, according to personal taste of each room without moving the player. Control the doors using a fingerprint sensor and magnetic cards or through a touch graphic touch panel. Management of alarm systems, CCTV cameras and other security and protection systems. Zoning the covered area, detecting smoke, gas and flooding or any other leakage. You are the smart controller of all the devices in the building and are aware of their operation status. Different parts of the smart home in order for a smart home to work well, different parts are put together to create a smart collection. These parts are interconnected and work well together to make the smart home work well.

4. The different parts of Smart Home

1. **Central control:** The controller is the brain of smart home. All components of the smart home are connected via central central control system and all commands are sent through the central controller to the various components of the home. This

central device is like a smart home offensive line player, receives information from home devices and controls everything in the home.

2. **User Interface:** Smart home users can use to communicate with the home. These tools range from intelligent remote control that replaces all home remotes to smart keys, touch screens or the same mobile phone and tablet that everyone uses. You can easily command the smart home or apply simpler scheduling yourself

3.**Communication Protocols**In order for the various parts of the smart home to be able to easily communicate with each other and with the central controller, it is necessary to have a clear and defined communication path. Communication protocol is in fact a standard and acceptable path for all parts of the system to be able to move information between themselves. These communication paths are both wireless and wired.

4.**Sensors:** Sensors are tools that can report various conditions of home: light, temperature, humidity or the presence of smoke and by sending these reports to the central controller with the help of communication protocols, they can apply pre-programmed scenarios, for example, by increasing the temperature to a certain extent, the cooling system turns on automatically.

5.**Operators:** Operators are one of the components of intelligent systems whose task is, for example, to open the parking door or move the electric curtain motors and turn on the pool treatment pump. Simply put, operators are a "driver" and execute commands. The operator needs a control signal and a power source. The control signal is usually relatively low energy and may be electrical voltage or current, pneumatic or hydraulic pressure or even manpower. Operators in the intelligent system include relays, dimmers, programming commands that can issue commands with the help of thermostats, solenoid valves, electric curtain motors, electronic boards of cooling-heating systems, audio, video systems, wireless locks and… Run from the smart home brain.

Smart System Features:

- Intelligent lighting system; Intelligent cooling and heating system;
- Intelligent audio and video system; Intelligent protection and security system;
- Intelligent fire alarm and extinguishing system;
- Intelligent remote control system;
- Application that can be installed on Android & IOS;
- Intelligent green space irrigation system;
- Intelligent electric curtain control system;
- Intelligent system of frosted glass smart engine room;
- Smart parking; Intelligent system features.

Intelligent Lighting System

- Ability to control a variety of ceiling lights, wall, table, decorative colour, fluorescent and LED;
- Ability to determine the maximum and minimum amount of brightness;
- Ability to control the lights individually or in groups;
- Ability to define a separate scenario for each area Determine the delay when turning on;
- Ability to set the performance time of a variable in each scenario from 0 seconds to 60 minute.

Intelligent Cooling and Heating System

- Ability to control all types of fan coils, splits, chiller coolers and dampers;
- Automatic selection of cooling, heating, fan operating modes in all seasons;
- Ability to stop or reduce the operation of the cooling and heating system if the door and window are open;
- Adjustable control of humidity, cooling and heating in the intelligent system;
- Functional modes of relaxation, night; Ability to announce fan speed and solenoid status;
- Ability to adjust the fan speed in three modes: fast, medium and slow;
- Ability to connect to 7 temperature sensors and average their temperature;
- Control dampers in multi-mode closed, fully open and semi-open.

Intelligent Sound System

- Radio broadcast from FM wave;
- Ability to play music from Card-SD;
- Ability to play audio file from HARD via FTP protocol;
- Play siren when accidents occur;
- Play recorded sounds in security situations;
- Ability to play the call to prayer automatically according to user demand;
- Ability to play different music in each area;
- Full control of the music system by smart keys and control software;
- Audio playback from external input (microphone) and public notification system support.

Intelligent Protection and Security System

- Ability to communicate with the SMS system in security situations;
- Ability to connect to the audio system in security situations;
- Ability to set delay times to execute arbitrary commands in times of danger;
- Ability to check all security cases of theft, water leakage, freezing alerts and etc.;
- Ability to support a variety of motion sensors, breaking glass and opening the door;
- Ability to define all security modes of vacation, departure, night, day, off and alarm.

Intelligent Fire Alarm and Extinguishing System

- Ability to support a variety of smoke, temperature and gas leak sensors;
- Multi-stage alert function in the form of pre-alert and main alert;
- Ability to connect to the SMS system in case of emergency;
- Prompt action in emergencies and prevent extensive damage; Ability to cut off power;
- Close the gas solenoid valve;
- To sound the siren;
- Close the air inlet dampers;
- Open the exit doors;
- Activation of fire extinguishing system in case of emergency;
- Ability to connect to the audio system in case of emergency.

Intelligent Remote Control System

- Control through software; User-customizable graphics;
- Design of all control and monitoring items by the user;

- Control all intelligent system states; Monitoring of installed cameras;
- Control and monitoring via the Internet;
- This software can run on IOS and Android operating systems;
- Control via SMS, Ability to send and receive different SMS to different people; Ability to provide group news in emergency situations.

Intelligent Green Space Irrigation System

- Ability to determine the duration and number of irrigations of plants according to factors such as plant type, plant age, plant root depth and etc.;
- Investigating and considering environmental and influential variables such as rain, snow, frost and temperature changes in different seasons;
- Investigate and identify suitable irrigation times that minimize plant transpiration;
- Ability to irrigate plants with different water requirements with an appropriate, irrigation flow rate according to the type of season;
- Save and display the next irrigation intervals and the number and frequency of previous irrigations for use in statistical matters and etc.;
- Ability to connect different sensors to the system according to the type of place where it is installed, such as tank water level sensor or soil moisture sensor;
- Ability to command the system to a variety of solenoid valves with different voltage levels.

Intelligent Electric Curtain Control System

- Ability to control a variety of roller blinds, rails, plain and canopies;
- Ability to open or close, go up or down and change the curtain angle;
- Ability to determine the duration of curtain movement according to the length and weight of the curtain;
- Ability to determine the maximum allowable angle in angled curtains;
- Ability to determine the maximum and minimum amount of opening or closing the curtain;
- Ability to set priorities in executing commands received from weather conditions;
- Ability to set the delay time to change the curtain mode;
- Ability to open and close the curtain with a small hand gesture.

Intelligent System of Frosted Glass

- Ability to transition from opaque to transparent in a fraction of a second;
- Ability to adjust the transparency of the glass;
- Protection and privacy;
- Safety and durability against heat due to the use of laminated glass;
- Prevents sound penetration due to the use of laminated glass;
- Solar energy controller, blocking more than 99% of ultraviolet and infrared rays.

Smart Engine Room

- Control of heating consumption during the use of the building (residential and non-residential);
- Shut down or be ready engine room after working hours of non-residential buildings; (office-educational-public-commercial);

- Double optimization of fuel consumption during the closing hours of non-residential buildings;
- Stabilizing the thermal comfort range of the building occupants;
- Reduce the production and emission of environmental pollutants;
- Reduce equipment depreciation and related costs; Reduce service costs - maintenance of thermal installations; Optimize and prevent waste of fuel and electricity;
- Proper operation and control of engine room equipment including burners and pumps;
- Appropriate time for installation and operation of intelligent engine room control systems.
- **Smart Parking**
- Ease of service; Increase the
- security factor of the parking lot by reducing the possibility of theft;
- Ability to display the number of empty spaces at the entrance to the parking lot;
- Update the screens in the shortest possible time and thus direct the incoming vehicles to Empty space available in minimum time;
- Ability to consider reserved spaces and prevent parking of cars in those spaces;
- Ability to not accept the customer when the parking capacity is full or in special cases;
- Ability to plan all kinds of discounts or tariffs for VIP users;
- Notification of empty parking capacity and address by SMS for users;
- Ability to display statistics on a daily and monthly basis as well as requested time intervals;
- Ability to monitor parking information online and receive images of parked and empty spaces in different parking spaces; Ability to prepare financial reports;

- **Steps of Implementing a Smart Project:**

1. Initial visit of the project or detailed review of the architectural plan and its facilities.
2. Examining the needs and wants of the employer.
3. Preparation of LOM (list of equipment required for the project).
4. Preparing a traditional and smart electrical plan of the building.
5. Wiring the building according to the prepared plans.
6. Installation of panel and wall parts in the project.
7. Planning parts with the relevant software or application.
8. Providing traditional and smart electricity tickets if needed.

Step One - Preliminary Visit or Detailed Review of the Architectural Plan and Project Facilities to Start the Project

It is necessary to carefully study the available maps and data, the best design based on the needs of the project. This design must be done by a team that has complete control over the mechanical and electrical systems of the building in order to be able to obtain the best control points and turn them into a complete Datasheet. The most important factor when designing intelligent subsystems is choosing the right system communication protocol and how it connects and communicates with available networks, protocols that connect equipment They are in charge of active intelligent control. In fact, performance coordination between different subsystems Intelligent in

order to have more control, the most important goal of the intelligent system.

Step Three - How to Prepare a LOM

Considering the cost of the system to reduce the initial financial burden of the system. High system performance, which depends on the number of current inputs and outputs of the project. Compatibility and compatibility of intelligent equipment with each other and according to the needs of the employer. Long service life of parts due to their internal parts and the amount of current passing through them and etc. Ability to update and add some other functions to the system in the future. Having the necessary software capabilities for remote control using smartphones.

Conclusion

A smart building is a building that was equipped with a strong communication infrastructure that could continuously react to and adapt to changing environmental conditions, as well as allow building occupants to use available resources. Use them more effectively and increase their security and comfort. Article Nineteen (National Building Regulations) refers to the use of new technologies and methods to reduce There is energy loss in the building. So far, most of the items in this topic have been sufficiently addressed and there are acceptable products in this regard in the country market. The only thing that may require more attention and culture is the need to implement a more intelligent building system. Because in the smart system, after the initial system settings, all controls are done by the computer Admittedly, the concern of mistakes and shortcomings on the part of residents and staff as a result of damages disappears. System users with different levels of access can access different components. So far in our country, due to the allocation of energy subsidies and even assuming the waste of energy, building owners and builders have refused to accept the initial cost of the intelligent system during construction, and continue to insist on the traditional operation of the facility. However, according to the discussions related to the realization of energy prices and the elimination of subsidies related to it in the country, it will help reduce the reception time for the implementation of intelligent systems in buildings. On the other hand, creating a culture in the field of proper energy consumption, will cause a fair enjoyment of God-given blessings and pave the way for the implementation of energy projects in the country and ultimately increase national income. The intelligent building system, in addition to its role in optimizing energy consumption, also brings comfort and well-being, and we can hope that in today's busy and modern life, a suitable solution to create more comfort and speed up daily affairs.

References

[1] Afshari Basir, Nafiseh, Afshari Basir, Mohammad Reza, "Smart buildings are a step towards new technologies in construction", the second International Conference on Architecture and Structure, University of Tehran, 1331

[2] Mofidi, Majid, Roshanzamir, Shima, 1311 ("Smart shells", Abadi, No. 63, p. 121, Tehran 1311

[3] Turquoise, spring; Pejman Tortiz and Marzieh Nahavandi, 2931, Armanshahr Sustainable Smart Homes and Zero Force, a new step in the direction Sustainable Development, the first conference on architecture and sustainable urban spaces, Mashhad, Perman Applied Research Group

[4] Jokar, Ali, "Smart Building and Building Management System", Quarterly Report of Fars Province Building Engineering Organization No. 85, p. 07, Fall 7850.

[5] Najafi, Matie, Mansour, "Smart Buildings." Abadi Magazine Volume 13, Number 3, Tehran 1336

[6] Dibazer Sales Seed, Farnaz, 2931, Analysis and Study of Concepts Used in Smart Building

Architecture, First National Conference Geography, Urban Planning and Sustainable Development, Tehran, Koomesh Environmental Association, University of Aviation Industry

[7] Nakhchi, Mohammad Hossein, "Intelligent Building Management", Smart Industry, 11th year, 2934

[8] Turani, Ahmad Reza, The Future of Basic Particle Technology in Architecture and Building, No. 26, Summer 2987

[9] Smart Home Automation Whit linux / Steven Goodwin / 2010/ 16 pg

[10] Wigginton, Michael and Harris Jude. Intelligent Skin, A Division of reed educational and professional, Publishing, 2002

[11] Ritter, Axel, (2007). "Smart Materials in Architecture, Interior Architecture and Design", Birkhauser, Switzerland

[12] Addington, D. Michelle; Schodek, Daniel L. (2005). "Smart Materials and Technologies for theArchitecture and Design Professions", Architectural Press/Elsevier: Oxford.

[13] Atkins, Ronald L. and Partners, (2004). “Advanced Energetic Materials”,The National AcademicsPress,Washington, DC.

[14] Sue, Roaf, (2007). "Ecohouse", Architectural Press.

[15] www.mibcco.com

[16] www.aepdco.ir