Analysis and Design of Modern Houses Using Artificial Intelligence

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Abstract

The application of artificial intelligence in the construction industry is widespread and its development in recent decades has had a tremendous impact on human life. These changes are so fundamental and profound that they require the need to change the design thinking in order to adapt to the new stream of thought and benefit from the benefits of technological tools. Designing modern homes based on artificial intelligence and using car models can take big steps. The purpose of this study is to investigate artificial intelligence, smart homes, control and optimization of energy consumption and raise the level of culture of people's lives and urbanization. Building intelligence (BMS) and consequently smart homes did not have a real structure at first and were just an idea. But now homes have interactions that intelligently control remote control and security systems. How people interact with the environment and feel comfortable in home spaces are two examples of the goals of home architecture that is achieved using artificial intelligence. The research method is applied and the data collection tool is library. The results show that the smart home is focused on smart grid technology to reduce energy purchase tariffs, increase comfort and increase the reliability of energy distribution to consumers.

Keywords: design, modern homes, artificial intelligence

1. Introduction

After decades of evolution, artificial intelligence (AI) has taken root in our daily lives and has significantly influenced the fields of architecture and reliability. Applications of artificial intelligence in sustainable architecture include building design using energy efficiency, predicting and minimizing energy consumption, planning to reduce its effects on the environment and climate, as well as improving the security and comfort of the living environment. (Rezaei et al., 1398).

Smart home technology effectively focuses on consumption management and optimization in the home, and in addition to increasing the comfort and convenience of residents, helps to reset the daily schedule and create a high quality of living conditions. The smart home management system, first introduced in the United States, is one of the most fundamental smart home design technologies. These microcontrollers are used to monitor appliances, lighting systems and air conditioning equipment (heating / cooling) according to defined conditions and operate in accordance with the needs of residents (Nunes, 1998: 259)

In construction projects, including residential, office, hospital, road, bridge, dam, power plant, factory, etc., the groups

involved in the projects mostly include specialized groups of architecture and urban planning, structures, facilities, geotechnics, environmental engineering, engineering Are traffic. However, at the time of studies and project design, the presence of an energy specialist to optimize energy consumption seems to be absolutely necessary (Shah Hosseini, Platonian, 2014). The intelligent management system of residential buildings needs to learn the behavior and interests of its residents in order to provide a favorable environment (Rezaee, 2012: 26).

Modeling methods with machine learning methods require a stage of data processing including categorization and prioritization using the proposed algorithms. The data were also routed with the distance between the minimum and maximum attribute values (ZekićSušac, 2018: 57-66) to detect defects or errors in the obtained data and correct them by defining a specific algorithm for integrating the structural characteristics of the information. And database storage is required for large-scale residential buildings (Krstic, 2018: 213).

The purpose of optimizing energy consumption in these buildings is to select patterns, adopt and apply methods and policies in energy consumption. Residential buildings are an important part of energy consumers, and the introduction of intelligent management system technology into these types of buildings has somewhat optimized energy consumption, and finally it can be said that all these factors show only one thing and That is, the future will see a lot of effort in designing modern homes using smart technologies and meeting all the needs of the homeless with the help of artificial intelligence.

2. Research Method

This research is an applied research that has been done by descriptive and analytical methods. In order to collect the required information and data, the desired library study as well as documentary studies and documents have been used, and finally, attention should be paid to the information obtained and then the findings and information should be analyzed. Finally, the necessary solutions and suggestions for smart home using artificial intelligence are provided.

Research background

The name artificial intelligence and smart home is used for systems that control electronic and wireless devices, features that use remote control systems, and wireless security systems for smart home devices. It is one of the cases that has not been done much research so far. The following table shows an example of research related to this topic.

Table 1 - Sample of discounts made on artificial intelligence in buildings (Source: Author)

Year of the author / s Title Source of Conclusion

2014 Roya Shah Hosseini, Zein Al-Abedin Platonian The Importance of Optimizing Energy Consumption in Buildings The Fourth International Conference on New Approaches to Energy Conservation is a field study of current research on construction projects and potentials for achieving energy around buildings in cities. In this paper, the results of the analysis of the information obtained are presented in the form of tables

and figures, so that it can be used to advance the goals of sustainable architecture.

1398 Rezaei, Reza, Shaham, Afshin, Mottaqi Somayeh, Samak, Sepehr Application of artificial intelligence in buildings 4th International Conference on New Approaches to Energy Conservation

This article emphasizes that artificial intelligence along with big data can increase energy efficiency and bring buildings with comfortable living environment design for residents.

1398 Yama Tavakoli Shirazi Practical study of energy management in construction projects 4th International Conference on New Approaches to Energy Conservation It should be noted that economic justification and investment constraints are the most important factors in any energy replacement program. Therefore, in the first step, all renewable energy sources must be carefully studied and the potential and density of energy in different places must be determined. In short, energy substitution requires decision-making, thinking and planning, and ultimately investment.

1400 Alireza Rezaei, Behnam Moradi Optimization of Electricity Consumption Based on Behavioral Patterns of Smart Home Residents Using Data Mining Algorithm Using Intelligent Network System and Computational Intelligence Renewable Energy Sources in Electrical Engineering, Year 12, Number 2, Management and Supervision of Supply and Demand Process Energy and the integration of home solar panels in the building to provide part of the energy consumption was the main advantage of implementing smart grid technology in the studied building. This study showed that 9 kwh of electricity is generated daily from household solar panels. Finally, by comparing each part of the building with a similar normal building in the presence scenario where residents have the highest energy consumption.

Theoretical Foundations

The concept of artificial intelligence is based on the hypothesis that the human thought process can be machine-made. Even before the Industrial Revolution, artificial intelligence speculations could be found in various civilizations. However, its first practical applications were seen in World War II.

Artificial intelligence is a difficult discipline, and for the first time researchers were unable to assess its complexity, but it was around this time that the world's most complete intelligent robot was first built in the WABOT project in Japan. However, their optimism raised the level of expectations of artificial intelligence, but the expected progress was not achieved. In the 1970s, artificial intelligence faced several financial scrutiny and setbacks, resulting in a significant reduction in its research budget. This was the first winter of artificial intelligence.

History of the use of artificial intelligence

Leading British mathematician and computer scientist Allen Turing and his teammates invented a machine that could decode complex code and laid the foundations for machine learning (ML). It was first coined in 1956 by American computer scientist John McCarthy to introduce "artificial intelligence" at Dartmouth College and was

formally recognized as an academic principle. During the early years of artificial intelligence development, programs expanded. They were amazed by artificial intelligence. Its uses at the time included algebra problems, proof-of-formula geometry, and learning to speak English. At the same time, artificial intelligence research received a large budget from government agencies. (Rezaei et al., 1398).

Artificial intelligence research was revived by expert systems in the early 1980s. It was initially a huge success. In one case, an expert named XCON raised $ 40 million (1986) annually. However, over time this system was considered too expensive to continue. The main weakness of the expert system was their complexity in updating and their vulnerabilities. This was the beginning of the second winter for artificial intelligence. But after this period, the field of artificial intelligence did not disappear completely and instead, under names like intelligence Computational, inferential systems, etc. began to grow. In the last decade, the modern age of artificial intelligence has emerged in which the ability to calculate quickly and especially the value of parallel computing, new disciplines such as deep learning, machine learning, general artificial intelligence and Created big data (Rezaei et al., 1398).

Nowadays, when huge amounts of data are generated every day, artificial intelligence systems are exposed to an endless amount of data for learning and improvement every day. Every business site becomes a potential data source for artificial intelligence. Data from images taken from mobile devices, videos

taken from drones, security sensors, building information modeling (BIM) and more have become a vast collection of information. This is an opportunity for architects in the construction industry to make the necessary analyzes and benefit from the insights gained from the data with the help of artificial intelligence and machine learning systems. During the History of Building Intelligence (BMS) Although home appliances are not what we call "smart", they were an incredible success in the early twentieth century.

These achievements began with the first vacuum cleaner equipped with a motor in 1901. In 1907 another functional electric vacuum was invented. Over two decades, refrigerators, dryers, washing machines, irons, toasters, and more were invented. It was advertised that by using these machines, one family member would be enough to do the work.

Reviewing the history of building intelligence (BMS) in the years 1920-1940. As women spent less time at home during this period, the introduction of new home technologies improved the standard of living. For example, using a washing machine causes clothes to be washed many times. Likewise, the use of vacuum cleaners makes the surfaces more clean. In the 1930s, inventors turned their ideas to building automation. Although the technology was still discontinued for decades, the World's Fair introduced the concept of automated and intelligent home appliances. Not surprisingly, viewers were fascinated by the idea.

Tracing the history of building intelligence goes back to World War II. During World War II, governments mandated women to

replace men sent for military service. The urgency of allocating women instead of men working abroad provided new frontiers for women to participate in experiences outside the home. This paved the way for the absorption of new domestic technologies after the war. These technologies supported women to keep their jobs outside the home because housework was done faster.

As a post-war approach, governments expanded to send women home and free up job opportunities for men returning to civilian life. Over the years, smart home design has begun to reflect new lifestyles alongside modern technology. New kitchen designs were created to accommodate refrigerators, stoves, washing machines, and more.

After the invention of the digital computer in the 1940s, the 1940s and 1960s saw computer technology become unique. In 1966, Jim Sutherland, an engineer at Westinghouse, developed ECHO IV, the first real-building automation device to control temperature and home appliances, allowing the retrieval and retrieval of shopping lists, instructions and other family notes. Provided. 1969 Introduces real-world communications with the introduction of ARPAnet, the Internet forerunner we know today.

The term smart home was first officially used in 1984 by the American Association of Home Builders. They created a group called Smart House with the aim of combining several innovative technologies in the design of new homes.

Intelligent energy consumption in the building

The construction sector in each country accounts for more than a third of the country's energy consumption, valued at $ 6 billion annually at global prices. Due to this cultural problem, where the value of energy is underestimated, the vast majority of buildings in the country do not have known technical criteria to prevent the waste of cold or heat energy. The issue of limited energy shortages on Earth is no longer a mystery to anyone today, and therefore this research, in turn, finds a way to deal with this problem and to improve project management in order to conserve energy and national assets (Marcus , 1382: 133).

Architects usually consider past designs and data generated during the construction of a building when creating new designs. Instead of spending a lot of time and energy creating something new, it is claimed that a computer will be able to analyze data in a short period of time and make recommendations accordingly. By doing this, an architect will be able to perform experiments and research simultaneously and sometimes without pen and paper. This seems to lead to the return of organizations or customers to computers for original designs and construction. However, the value of architects and human endeavors to analyze a problem and find great solutions always remains unchallenged. Building a building is not a one-day task because it requires a lot of initial planning. However, sometimes this pre-planning is not enough and you need a little more effort to get an architect's opinion. Artificial intelligence greatly simplifies the task of the architect by analyzing all the data and creating models that can save a lot of architect time and energy. In general, artificial intelligence can be called a tool for estimating various aspects

during the construction of a building. However, when it comes to construction, artificial intelligence can help minimize human effort.

The attitude of the architectural community towards how to provide human comfort in residential buildings has undergone significant changes since the beginning of the present century. From the first decades of the century, the use of thermal and cold mechanical devices to regulate the temperature of the environment inside the building has been considered by architects (Razjouyan, 1379: 67).

The rational use of energy has been at the forefront of the work of countries without fossil fuels, forcing them to take the issue of energy efficiency seriously in one of the main centers of energy consumption, namely residential buildings. Thus, this issue was raised and for several years, countries such as Germany, Sweden, Italy, England, etc. have special laws in the field of construction and the use of thermal insulation, improving heating and cooling methods and the overall structure of the building in order to optimize Energy consumption has been formulated in it, which is mandatory.

The implementation of these cases has had interesting results, so that they have succeeded in saving up to 30% in energy consumption by applying these rules. According to the balance sheet of 1387, energy consumption in the residential and commercial buildings of Iran is about 40% of total energy consumption, which will save about 30% in that figure will be very significant (Rezapour, 1382: 87).

Design of intelligent construction systems

Building information modeling is a three-dimensional model-based process that can provide architecture, engineering, and construction professionals with the vision to efficiently plan, design, construct, and manage buildings and infrastructure. To plan and design the construction of a building, three-dimensional models must consider the architectural, engineering, mechanical, electrical, and plumbing (MEP) plans and the sequence of activities of the respective teams. The challenge is to make sure different models of sub-teams are not involved with each other. The industry seeks to identify and reduce conflicts between different models produced by different teams in the planning and design phase by using machine learning in the form of productive design to prevent rework. There is software that uses machine learning algorithms to examine all changes to a solution and create design options. The software uses machine learning to create three-dimensional models of mechanical, electrical and plumbing systems while simultaneously ensuring that the entire paths of MEP systems do not conflict with the structure of the building while each iteration. Learns to provide an optimal solution.

Automatic smart home design

A smart home is a set of technologies and services in a home network to improve the quality of life. This smart network includes communication facilities, entertainment, security, comfort and information and services for the disabled and the elderly. The smart home also saves energy. This is due to systems such as the Z-Wave and Zig Bee, which make home appliances less functional,

put them to sleep and wake up with commands. Room lights are turned off automatically when occupants leave the room, and room temperatures are adjusted based on whether or not someone is there.

A smart home is a small bms and is not much different from a bms. Smart homes are also known by other names, such as: Smart Home, Intelligent House, Home Automation, so with a little leeway we can say that Smart Home is the same as a small BMS. The smart home makes the home fully automatic, making it easy and convenient to do all the daily activities in the home. The smart home network includes subsystems including: 1- Home entertainment 2- Access control and monitoring and care 3- Energy management 4- Home autonomy (home automation) 5- Support and treatment calculations and a residential gateway that these subsystems Manages.

To form an automatic smart home, first monitoring the behavior of residents based on daily activities, tastes of house members, habits of residents and their interests in different scenarios such as (presence - absence - visitors come home - party) were examined. To learn the behavior of residents and form their behavioral pattern in the face of energy consumption and the amount of electricity consumed during the day, residents' actions in the smart home management system are collected and recorded in the first stage. The work was performed using intelligent meters that were installed on the distributed power lines in different parts of the building and the type of device consumed, time of consumption, amount of power consumption or measured

and recorded. Data recorded with intelligent meters divides the consumed electrical power into two parts; Constant power consumption data and variable power consumption.

Constant power consumption data is information from electrical equipment that consumes a constant amount of electrical energy around the clock. These devices must always be plugged in at home; Such as refrigerators, fire alarm and extinguishing systems, etc. Variable power consumption data includes information on the consumption of household electrical systems based on the behavior of the occupants in using them; Such as lighting and entertainment systems, cooking, cooling and heating systems and so on. Of course, environmental conditions also affect the amount of power consumption of the variable; Such as brightness, temperature, oxygen, etc .; Therefore, the total power consumption in an automatic smart home is calculated equal to the power consumption (variable and constant). After modeling the characteristics of consumption loads and distributing power lines to different parts of the building, by installing the power of smart meters on these lines, the final information of consumption is defined as the following table. Table 2 - Supplementary form for data collection (Rezaei, Moradi, 1400)

Amount of power consumption Length of use Time of use Type of application Name of power lines

kwh 00:00 00:00 - -

In accordance with the standards of the Institute of Standards and Research on the practice of part-time construction in Jardaval No. 2 and 3 are presented as follows.

Table No. 3 - Lighting intensity standard by the Institute of Standards and Research (Rezaei, Moradi, 1400)

Suggested minimum location (lux)	(lux)
Living room and reception	70 200
Study room	150 500
Kitchen	100 200
Bedroom	50 100
Bathroom	50 100
Toilet and mirror	200 500
Stairs	100 150
Corridor and elevator	50 150

Table 4 - Temperature standard presented by the Institute of Standards and Research (Rezaei, Moradi, 1400)

	Spring and summer (c)		Autumn and winter (c)	
	Minimum	Maximum	Minimum	Maximum
Catering	23	26	20	23
Other rooms	25	28	18	21

After collecting data, analyzing and shaping them based on techniques, the data mining algorithm is divided into two groups of repeated data and binary data in the database system in a general and comprehensive form of electrical power. Consumption of each system is stored at different hours of the day and night. This amount of registered electrical power in the home smart grid system with ideas and control over the amount of energy requested at different times to provide them with regard to the amount of renewable energy sources of the home.

Smart home with artificial intelligence

The vision of smart homes is to increase resource management, security, productivity and ensure the health of homeowners. Currently, there are softwares that allow homeowners to enter the house or home network without a key and password by face recognition. Or a CCTV monitoring system that allows them to remotely monitor the condition of their home. But all the possibilities of smart homes are unlimited, and as long as science is advancing, the future progress of smart homes with artificial intelligence is undeniable. Some of the smart home technologies that are being upgraded day by day are:

Automated robots

We are still far from a fully-fledged, humanoid robot that can operate freely. However, there are now automated robots used in some smart homes. For example, devices like iRobot and Neato are designed to move independently in your home and clean the floor.

But a prototype robot recently unveiled by scientists in Germany does more than just clean the floor. For example, he can arrange the utensils, use different devices and even serve drinks to the guests! Such robots can be easily controlled through a full touch screen embedded on them. However, they also respond to voice commands. These robots will respond even to pre-programmed movements. Of course, this is just a type of robot that some models are currently in production. It will not be long before we see artificially intelligent humanoid robots doing most of the housework in the future of smart homes with artificial intelligence.

Smarter home appliances

As devices such as cell phones, watches, and computers become more and more intelligent, and we are well aware of the benefits of advancing technology in our lives, we can

also better understand the benefits of having smart home appliances.

For example, imagine that before entering the kitchen, you can ask your refrigerator to provide you with a glass of refreshing water. You can order your request directly via mobile. In fact, you can pre-program the refrigerator, dishwasher, washing machine, dryer and other devices equipped with touch screens and sensitive sensors, as well as connected to the Internet. Another interesting thing about the idea of smarter devices is that the big companies that make these devices, by understanding and gaining more knowledge of your preferences for a more comfortable life, use new possibilities every day to make their devices smarter.

More advanced lighting controls

It is now a very old way to turn on the lights via a wall switch. In today's smart home, home lighting can be easily controlled via mobile devices, touch screens or an automatic sensor and system. A smart thermostat can even be programmed to turn on your lights and cool the air inside as soon as you return from vacation or work. It goes without saying that advanced lighting controls are one of the most common features of smart homes, and many hope that these technologies will soon become a standard feature for all new homes. But imagine that you can program your system to turn the lights on or off at different times of the day or night. In addition, do you think that in the near future an AI device can be smart enough to detect your sleep and automatically reduce the lights to a minimum? So we have to wait for more improvements in smart home lighting controls.

Better energy management at home

Your car will let you know when it needs to change the oil. So why not give your house such information? Think of an air conditioner that can send you alerts when you need to change the air filter. Or think of an energy system that can tell you when energy costs in a month exceed the amount you set.

One of the companies that works in the field of the future of smart homes has just unveiled its total home energy management plan, which does exactly that. This smart app tracks home energy consumption, related costs and related information in minutes to allow homeowners to better manage their energy consumption.

. This smart app can even analyze appliances used in the home to notify homeowners if they need to upgrade products for less energy. In addition, it is constantly evolving to add new features and become a useful system for the future of smart homes with artificial intelligence. It will not be long before these power tracking systems also become a standard for the modern home.

Games and entertainment devices

The future of smart home entertainment is changing to provide homeowners and their guests with instant access to a variety of digital entertainment. Thanks to Internet-based sharing services, homeowners can stream relatively inexpensive content directly from their TV and play virtual world games. Of course, this depends on a good and fast internet connection.

Conclusion

In general, the best solution to complement the benefits of smart home to reduce energy purchase tariffs, increase comfort and increase the reliability of energy distribution to consumers, demand side management, demand response, optimal distributed generation, requires focus Is based on technology called smart grid. In addition to supply management, smart grid equipment controls and monitors the energy demanded by consumers, which according to the consumption information in case of supply shortage, cuts off or shifts the energy load and purposefully eliminates the supply shortage from other sources. Compensate. By implementing an intelligent network in the management system of intelligent residential buildings, renewable production sources (wind, solar or combined) can be used to supply part of the energy required according to the geographical location of the building. The integration of renewable energy sources reduces the emission of environmental pollution. It also increases residents' satisfaction and reduces their costs of purchasing electricity. Optimizing energy consumption and increasing the comfort of residents is the main topic of research and practical and research plans in the field of smart homes.

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