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The Role of New Technologies in Smart Buildings and Their Impact on Social Welfare and Sustainable Architecture

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ABSTRACT

Technology can be defined as all the knowledge, products, processes, tools, methods, and systems that are used to create and manufacture goods and services. In today's world, the use of technologies based on central processing units is essential due to the low and affordable price of CPUs . In this regard, increasing the security of smart buildings using agent-based approaches has been analyzed in this paper . This approach considers all the potentials of devices in the smart environment and uses them to ensure the security of the building slow. Also, the use of modern technology, in addition to saving energy, also provides comfort, tranquility and well-being of the building 's residents.Orand. The use of new technologies to reduce the consumption of non-renewable energies as well as the storage of basic energies is one of the major topics that are discussed in sustainable architecture

Introduction

Years ago, a processor like the 1486 was as expensive as a machine, but today, a powerful little processor like a chocolate chip is inexpensive. Because of the affordable prices and flexible dimensions of processors, new technologies have been developed based on them today . In fact, they can be easily installed in small devices such as measuring instruments, lighting systems, Embedded telephone, etc. Therefore, we can rely on these small chips to make life easier, save energy, reduce operational costs, and increase productivity. In today's world, new technologies are bringing the latest methods to the design and construction of smart buildings.In this article, we have focused on the specific benefits and benefits of new technologies in the social welfare and sustainable architecture of smart buildings..

In today's world, new technologies offer the latest approaches to the design and construction of smart buildings. His smart home/building concept has become a prominent topic in recent years. The transformation of the smart product market and the energy management services industry has led to the growth of smart home technology globally. Many benefits of smart home/building systems have been reported through many studies, for example, increased thermal comfort and personal safety, reduced energy cost and flexibility, and various definitions of smart homes have been conceptualized and defined. Smart buildings are a set of buildings that have hardware and software that are used to monitor and control important and vital parts seamlessly Buildings are installed. Through a comprehensive review of the available literature on smart home/building applications, it becomes clear that the critical features of such technologies are data-driven and communication networks that connect various technological devices and systems with energy management systems and end-users. Through a comprehensive review of the available literature on smart home/building applications, it becomes clear that the critical features of such technologies are data-driven and communication networks that connect various technological devices and systems with energy management systems and end-users. These network devices and services enhance the daily activities of residents (e.g., convenience, savings Energy, Healthcare and Security) by incorporating intelligence into spaces. There are several types of classified smart services that offer a better quality of life and work environment in these places (Ejaz and Anpalaga, 2019)..

Technology can be defined as all the knowledge, products, processes, tools, methods, and systems that are used to create and manufacture goods and provide services. Information and communication technology (ICT) is the leading technology in smart cities and buildings that are used to implement smart initiatives using physical infrastructure and data processing tools (Sebestyen and Pollington, 2007).

The application of technology in the construction industry, especially materials and materials, can be an effective step in advancing the goals of sustainable architecture. Since the goal of sustainable architecture is to save energy, reduce non-renewable resources, strengthen and extend the life of the building, reduce pollution are environmental and also reduce costs, so by using new technologies in architecture and helping to make materials with the mentioned characteristics and applications, it can be expected to produce materials in a more economical way and also to harvest less from natural resources. With the development of materials, products, and innovative construction methods, moving towards buildings with higher efficiency and better economic and environmentally friendly construction becomes necessary (Jahanes, 2007).

Due to the increasing use of new technologies in the field of construction on the one hand, the increase in competition in the construction of modern and advanced buildings, as well as issues such as reducing energy consumption and promoting the social welfare and comfort of the building's residents, the use of new technologies in the construction of smart buildings has been greatly expanded. Therefore, this study aimed to evaluate the role of new technologies in smart buildings and its impact on the welfare of Social and architectural sustainability has been achieved.

Literature Review:

This review examines and searches related articles based on relevant keywords. Research articles published in reputable scientific journals based on the Google Scholar database and ScienceDirect have

been reviewed mainly since 2000 with topics focused on the research title and keywords including smart home/building, new technology, sustainable architecture, and social welfare. Inthis article, we focus on the specific benefits and benefits of technology deployment in particular. The second part explains the definition of IoT and its components in detail. The third section introduces the smart building and its components. The next section introduces the design and implementation of smart buildings with IoT solutions. The fifth section talks about social well-being. slow. The sixth part talks about sustainable architecture and the role of modern materials in sustainable architecture . The next part shows our agent-based smart building design based on the Internet of Things. And finally, the seventh part contains the results and discusses future research.

-Technology and Architecture:

Recognizing and determining the degree and extent of technical knowledge of each society is one of the most important items in the analysis of each society. This is because technological innovations have a great impact on the development of population, cultures, social structures, and material production. In general, modernization refers to the transformations, growth, and advances that have been achieved in modern societies as a result of the Industrial Revolution and the mechanization of life. Technology refers to any scientific knowledge that is based on scientific experience or theory and increases the ability of society to produce goods and services and is embodied in the form of production skills and organizationsor machines. The impact of technology on architecture, and in particular the impact of technological changes on architecture, becomes apparent, especially when we consider the history of architecture. Technology has revolutionized the architecture industry, allowing architects to imagine and build structures that were previously unimaginable. Digital tools, from computer-aided design (CAD) software to building information modeling (BIM)have simplified the design process and improved accuracy, efficiency, and collaboration (Hennessy and Jouppi, 1991). In addition, advanced visualization technologies such as virtual reality and augmented reality have transformed the way architects relate to design concepts, providing clients and stakeholders with immersive experiences. In this article, we will discuss IoT solutions in architecture and the creation of smart buildings.

2. Definition of IoT and its components

To begin with, we are going to explain IoT as a few simple scenarios. (1) Your alarm clock will start ringing 5 minutes later than scheduled, because for example, the train schedule is delayed by 5 minutes and you have 5 minutes more to sleep more. (2) The patient has an at-home health care system that automatically notifies him to take his pills, and if the patient does not do so, it sends an email to the patient's doctor to let him know that his patient did not follow the prescriptions. (3) When the resident wants to leave the apartment, the umbrella light comes on, which means that the weather forecast website has predicted that it will be raining today and the resident should bring their umbrella with them (Rassia et al., 2017).

The aforementioned scenarios are implemented in today's smart buildings or as prototypes in smart building laboratories for research purposes. Especially smart residential buildings. All the components of the IoT are connected to the Internet network. They transmit information to or receive information from it. Everything that is connected in this environment is called objects. The Internet of Things is a global network of objects with unique addresses that can communicate through specific standard communication protocols. All of the above purposes can be achieved For example , a delayed train app can be searched via a smartphone, or weather forecast data can be accessed via the internet or a smartphone. However , the most important advantage of IoT technology in today's world is time-saving. In other words, residents of smart buildings (or In general, smart cities) can save a lot of time and also increase their productivity by using new technologies based on the Internet of Things (Schahra et al., 2017).

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Things in an IoT network can be virtual or physical, dynamic or static, however, they all have one thing in common. That is, they are all objects that are active in communication with other objects through the

Internet of Things network. Communication between objects/objects is called object-to-object communication. If an object communicates with a human, it is known as an object-to-human communication. Therefore, the concept of IoT is not limited to powerful tools such as smartphones, laptops, or music players, but it can also be extended to ordinary and personal tools and devices such as umbrellas, mirrors, bracelets, refrigerators, shoes, etc. Figure 1 shows an overview of IoT and its applications (Eini and Sherif., 2018).

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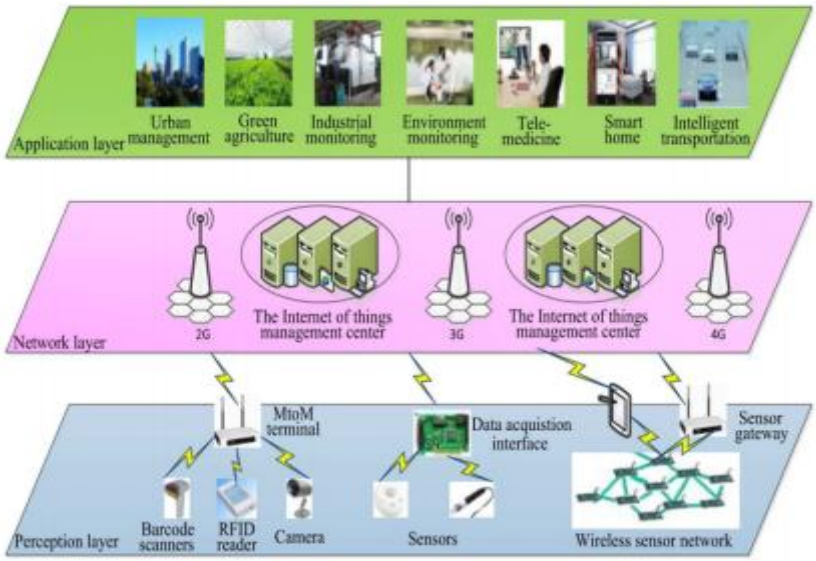

Figure 1 - IoT configuration and its main applications

It may be confusing in distinguishing comprehensive computing from IoT. The most important difference between IoT and other Internet-based technologies is that virtual physical objects communicate through IoT-based technology. For example, a freshener can be programmed to act when a person enters a place. To do this, you don't need to connect to other devices, just on a flag basis. Technologies based on immersive computing help humans control objects based on decisions that are made based on real-world inputs, and they don't need to be subject to network communications. that inclusive computational methods are not able to perform (Qingping et al., 2014)..

The IoT network consists of control units, sensors, and actuators. All these components are explained here in detail.

- **IoT Controller**

The control unit in IoT is responsible for analyzing sensor inputs and generating commands based on specific control algorithms. These commands are then transmitted to the actuators through standard IoT communication protocols. The control framework can be developed based on different architectures: decentralized, distributed, centralized. Each of these architectures has its own advantages and disadvantages and should be selected based on the system architecture and its components. Today, distributed control frameworks have received special attention, and many researchers have used these architectures in the design of smart building controllers, intelligent traffic systems **(**Roja, and Sherif, 2019**),** smart parking, etc. (Al-Turjman, 2019)..

IoT solutions can help designers design smarter structures more reliable, convenient, and secure. Aspects listed in Smart Building (mentioned above). Convenience, security, and efficiency are analyzed in detail here in smart buildings built on IoT solutions.

- **IoT sensors**

Sensor networks are a very important part of the IoT network. Sensors collect sensed data (such as light exposure, heart rate, car speed, ...), store it, and send it to decision-making units in IoT. In this regard, real-world inputs, such as the number of times building occupants sit in a chair, are collected and sent to the device via the Internet network It is also used in other contexts (Roja, and Sherif, 2019**).**

- **IoT drivers**

The outputs are generated and sent to the actuators for action. These outputs are the results of data analyzed on the Internet. For example, when the occupant sitting on it receives an email, it is possible to program for a chair to vibrate . Therefore, all of the components mentioned can be addressed in the Internet environment and communicate over the network, under standard IoT protocols. A network of connected things makes up an IoT network (Alisha and Gordon, 2019)...

-Smart building and its components

A smart building is a building that encompasses a cost-effective environment that integrates the four main elements, namely structure, service , management, and the relationship between them. A smart building is a building structure in which a network of devices communicate with each other to best manage and control the building system. The first question is what smart devices are called in a smart building. Almost all appliances and appliances that are connected to the outlets of the building are considered smart appliances, such as central controls for the lighting system, temperature control, ventilation controls, door locks, curtain and cover controls, surveillance system controls, etc. (Buckman et al., 2014).

The benefits of a smart building can be categorized into three main aspects: comfort, security, and efficiency. Comfort: Smart buildings significantly improve the comfort level of residents. They help residents plan their schedules, carry out their daily activities, and generally make life easier for them.

Security: The security aspect is very important in a smart environment, because in an IoT network, residents' information can be misused in an insecure way at any time. Smart devices in buildings can be used to protect residents from natural disasters such as fires, floods, or gas leaks, sensors can be implemented in doors, windows. Elevators, so that they can detect an unusual activity and notify residents with alarms, hazard lights, sirens, and any other stimuli (Buckman et al., 2014).

Efficiency: Thanks to new smart building technologies based on IoT solutions, the efficiency and flexibility of buildings have increased significantly. Residents can check their energy consumption every day and try to reduce their energy consumption. Also, smart technologies help residents save energy, for example, smart lighting system when residents leave the environment It automatically turns off or smart technologies adjust the position of the curtains during the day and night to take advantage of natural light. The optimal way of smart grids is also considered (Al-Turjman, 2019).

- BMS and BMS integration with smart building technologies

BMS stands for Building Management System, which is a software-based platform that controls and monitors various aspects of building performance, such as heating, ventilation, air conditioning, lighting, firefighting, security, and access. BMS can help you optimize building operations, reduce costs, increase safety, and comply with regulations (Chamari et al., 2022).

Smart building technologies are devices and systems that use sensors, data, and automation to adjust and optimize building conditions and performance according to the needs and preferences of residents and the environment. Some examples of smart building technologies include smart thermostats, smart lighting, smart locks, smart cameras, smart meters, and smart speakers. Smart building technologies can enhance user experience, productivity to increase the use of energy, and provide insights and feedback. BMS saves 60% of the electrical energy consumption of the lighting system, 45% savings in the electrical energy consumption of the cooling and air conditioning system, and 25% savings in the heating

energy

Integrating a BMS with smart building technologies can create a smarter, more responsive, and more adaptable building that can deliver better results for owners, managers, and users. The benefits of this integration include improved efficiency, increased comfort, increased security, and greater flexibility. For example, the integration of BMS data and control capabilities And smart devices can optimize the energy consumption and performance of building systems and devices, while adjusting settings and services to the individual and collective needs of residents can improve their comfort. In addition, integrating security and access systems can monitor and protect the building from unauthorized access or emergencies. Finally, enabling communication between the BMS and smart devices can adapt the building to changing conditions and provide users with more options (Eseosa and Temitope, 2019)..

Integrating a BMS with smart building technologies can be challenging due to compatibility, complexity, and cost issues. Not all BMS and smart devices use the same protocols, standards, and interfaces to communicate and exchange data, making it difficult to ensure their functionality and interoperability. The more devices and systems you connect to your BMS, the more complex they become to manage and maintain. You may need to invest in new devices, systems, software, hardware, networking, installation, training, and maintenance for integration. In addition, there may be significant upfront and ongoing costs associated with the integration process (Singh et al., 2015)..

-Smart building with IoT solutions

IoT strategies can help designers design smart structures more reliable, convenient, and secure. The aforementioned aspects in a smart building (mentioned above). Convenience, security, and efficiency, are analyzed in detail here in smart buildings built on IoT solutions. As the top smart technologies that lead to energy savings (Alisha and Gordon, 2019).

Well-being and comfort: In a smart building, a thermostat not only monitors the temperature of the room and the ventilation system, but also communicates with the garage door opener to detect when residents leave the premises. In addition, the dishwasher communicates with PIR sensors to detect when residents are going to work. The lighting system can be facilitated by dimming technology to help residents wake up or fall asleep on a schedule.

The monitoring system can be connected to the police station in an emergency or intrusion. All building materials can adapt themselves to the activities of the residents, for example, the lighting system is adjusted based on the activities that the residents are involved with. Watching TV, studying, sleeping, listening to music, entering the room, leaving the building, etc. Residents can also intervene with the automated system whenever they want. For example, residents can adjust the temperature or condition of windows or curtains through their smartphones (Hyman et al., 2019).

Security: Smart technologies allow residents to have a more secure building. For example, cameras are built throughout the building to monitor the area whenever needed, via phone or computer. In addition, security cameras connect with other smart systems to manage the building more effectively based on occupancy status. can interact with the security system through their phone or smart interfaces. The safety system is connected to the building lighting system, bells, locks, police station, etc. . The security system works when it detects unusual movement or movement or detects intruders in the building. So, you can see that this smart security is much more efficient and professional than an emergency siren. In addition, the appliance maintenance schedule can be sent to the residents to make sure that all the devices are operating safely and efficiently. For example, if the refrigerator If there is a need for repair, this message will be sent to the residents' phone to be informed of this issue and take action as soon as possible. If a building appliance needs repairs and the occupant is not nearby, the building can contact the repair shop and schedule the service without the need for the occupant to be present. (Alisha, Z., & Gordon, 2019).

Social welfare: Social welfare can be considered as social measures and protections that rely on the participation of the public and social and governmental institutions to meet human needs and maintain high human dignity, which is consistent with the definition of well-being. Social behavior studies since it is the most common type of behavior.In fact, urban designers are trying to provide a platform for desirable social behavior to take place easily and encourage people to interact with each other (Taghizadeh Orangi & Shafizadeh, 2015).

- Designing a secure system for smart buildings based on IoT solutions

To design a reliable security platform for a smart building, we must first consider two technical aspects. First, coordination between heterogeneous tools, and second, task management. The first technical problem can be solved by implementing an agent-based framework for the smart system. The second issue can be solved by building a dynamic security system based on tasks. Figure 3 A It demonstrates agent-based infrastructure for smart buildings based on IoT solutions. The infrastructure consists of four main layers: the implementation layer, the performance coordination layer, the task management layer, and the security service delivery layer (Razzaque et al., 2015).

In this article, a scenario is considered when an intruder comes into the building. Several operators and sensors are coordinated in this project. We assume that the intruder has left the building. When the intruder enters the building, the sensor detects its door and sends the signal to other devices, especially the underlayer devices to track the intruder. First, the light is turned on to Stick the intruder with better image quality. A robot then arrives at the door and films the attacker. When the signals of the sensor networks are received by the drones (with HD cameras), the attacker is tracked by these drones, while trying to flee the area. The reliability and flexibility of security systems designed based on the Internet of Things are very evident in this project (Razzaque et al., 2015).

- Sustainable Architecture:

Sustainable architecture is one of the newest methods of growth and promotion based on climatic characteristics. Sustainable architecture is an economical solution for controlling and growing the environment through construction. This style has been in the world for many years and has been a modern philosophy and executive methods in the world for many years, and recently sustainable architecture has played a major role in Iran. Charles Jenkins isone of the greatest theorists of sustainable architecture with philosophical definitions. The application of sustainability concepts and sustainable development goals in order to reduce energy waste and environmental pollution in architecture has created a topic called sustainable architecture. In this type of architecture, the building not only adapts itself to the climatic conditions of the region, but also establishes a mutual relationship with it (Sassi, 2006).

In recent decades, due to climate change and the increase in environmental pollutants caused by excessive human use of fossil energy, it has become more important than ever to pay attention to optimizing energy consumption and taking steps towards sustainable living. Ultimately, it leads to a reduction in the production of environmental pollutants and the society moves towards sustainability standards, especially sustainable architecture. Also, more use of smart building materials on the one hand leads to an increase in the efficiency of the use of energy resources and on the other hand, provides significant comfort for the people living in the building. The use of technology in the production of smart materials makes smart energy management in buildings more effective, and this is a step towards sustainable architecture .

Intelligent materials and their role in the sustainable architecture of smart materials or smart materials or smart structures, a complex (or a part of a complex) has an engineering function in which the structure has the ability to understand and activate in order to perform the work. Memory alloys are a type of smart materials. From these materials, they predict any kind of damage and failure in their structure and remove their defects. One or more of the properties of these materials such as their shape, hardness, frequency, and color change significantly in a controlled state or under the influence of electric force stimulation or magnetic fields (Jahanes, 2007)..

With advances in materials research, there is a growing interest in the knowledge of smart materials and their application in improving the energy efficiency and environmental quality of the interior of buildings. Smart materials can sense and react to their environment and, therefore, behave like living systems. Smart materials and technology create beneficial effects in response to external conditions.

Variable and dynamic combined for the problems encountered when designing for energy efficiency. This means that smart materials adapt themselves to environmental changes in the most optimal way, and as a result, the final efficiency of energy consumption in the building will be the most desirable (Jahanes, 2007).
These materials and products are able to store energy, both visible and invisible, such as in the form of light, heat, hydrogen, or electricity. It is worth mentioning that these materials are also reversible, so these materials are able to store energy in different ways. But in the meantime, smart materials that store heat have been more considered, and these materials have an intrinsic property that enables them to store energy in a different way. Heat or cold (the inverse of heat) is stored in the form of latent energy. These materials are widely used in architecture. The most widely used of these materials, which are known as modulating materials
(PCM), refer to those materials and productsthatcan act as a temperature regulating medium, for example, as an intermediate element in cold storage or latent heat of room temperature regulation. PCM alloys have the property of changing their state from a liquid state They change to the solid by crystallization and release a certain amount of heat energy that they had previously stored at a higher temperature, and in the reverse case, by changing the state from solid to liquid at the time of the entry of heat energy, they keep the amount of heat or temperature constant (Alikhani, 2005).

Discussion and conclusion

In agent-based design, if any of the components fail, the other components will continue to work, and this helps the system to maintain its performance. Therefore, IoT solutions are considered as the most efficient solutions used in the design of security systems. Over time, IoT-based devices will be implemented more and more in smart environments, smart cities, smart buildings, etc.
According to the studies conducted and the analysis of researches, we concluded that smart buildings are controlled by software and hardware.The goals of this intelligent building management system are to create a favorable environment for the people present in the building, optimize the use of equipment, and increase their useful life.In smart buildings, BMS and the Internet of Things provide facilities that ensure the peace and well-being of the people living in the buildings so that the residents of the buildings feel safe. In addition to human tranquility, these buildings also make it easier to manage and monitor in smart buildings, and tasks are done with less time. This results in a beneficial outcome for human beings.

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