Smart Buildings

Smart Window
Gas leak sensor
Smoke sensor
IR Camera
Socket
Light Switch
Air-conditioner
Wind&Rain Sensor
Camera
SOS button
3.5" Master panel
Home Sever
TV set
Wireless IR detector
Door magnet sensor
Video door phone system
Light Switch
Body Sensor

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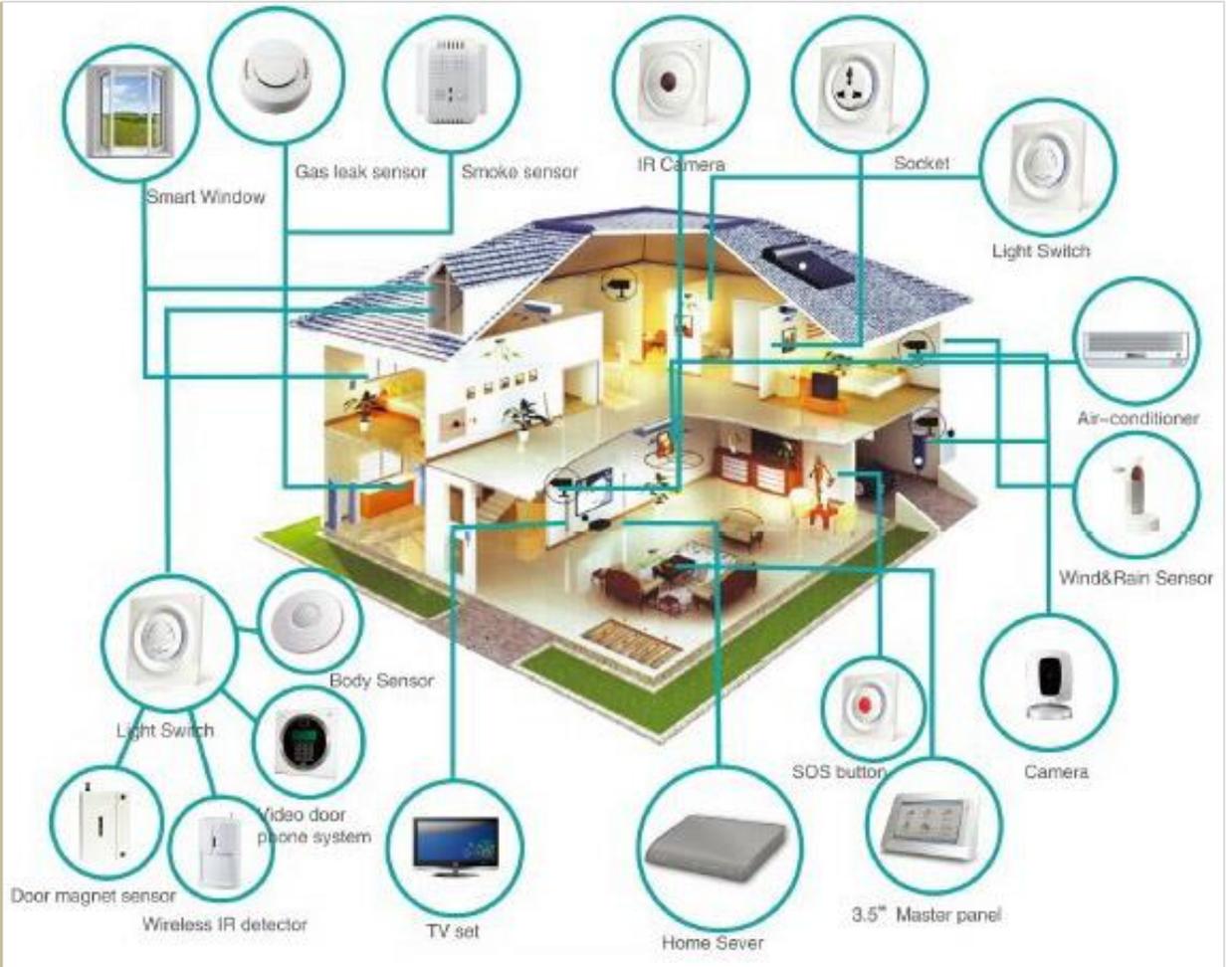
Introduction

With the increasing cost of climate change and its devastating repercussions and effects, an increasing number of cities and countries around the world have set ambitious goals to significantly reduce or eliminate carbon emissions, as many researchers believe that smart buildings are the key to transforming energy sectors in entire countries and their entry into a low future. Carbon, and it is clear that buildings consume more energy than one thinks, whether it is to talk about huge commercial areas, high-rise apartment buildings, large retail centers, or other homes, buildings have an undeniable significant impact on the environment being the center of energy consumption. Rapid urbanization and climate change are closely intertwined, making the decarbonization of the building environment a necessary step towards making the world sustainable for the nearly 10 billion people expected to be on the planet by 2050. It has enormous capabilities and capabilities that enable it to play a pivotal role in combating climate change by reducing energy consumption in buildings, which plays a major role in reducing carbon emissions levels, and ultimately slowing global warming.

❖ **Definition of the smart building**

The definition of a smart building in general, according to the American Smart Building Institute in Washington, "is a building that contains different systems for managing the operation of the building and the energy used in it in order to increase operating efficiency." As for the smart home, its first model appeared under the name PFEIFFER HOUSE in California, United States. In 1988, it is a test model for the use of the standard automatic control system prepared for this type of house. It was developed by a group of American companies and the aim of establishing it was to create a new generation of buildings with special specifications for certain groups of individuals or families with special requirements - and it can be said that the concept of housing It means: "The housing equipped in a technical way, by which it acquired the ability to think, in order to change its behavior according to the needs of the inhabitant, and by adapting to the external conditions. That is, it means the ability to program the housing in an electronic way with a set of possible possibilities and different possible possibilities according to the possible occurrences. It is matched by pre-known circumstances and variables. The degree of housing intelligence depends on the amount of technology achieved and used, the possibilities it uses within its limits, and the extent of the urban area in which it works and deals with buildings and facilities.[1]

❖ **Smart Building Projects in the Ministry of Energy and Infrastructure**

As part of the country's celebration of the UAE Innovation Week 2021, Suhail bin Mohammed Faraj Faris Al Mazrouei, Minister of Energy and Infrastructure, said, "The activities of the UAE Innovation Week are a national event that expresses the government's vision to encourage the adoption of innovation as an approach to work and a societal culture that enables the UAE to smoothly cross over the next fifty years With a set of ambitious achievements, leading to the achievement of the UAE Centennial 2071 and consolidating the UAE's leadership globally", he stressed that the UAE's interest in innovation stems from the vision of its forward-looking leadership aimed at creating tools and means to transform challenges into opportunities capable of shaping a sustainable future for future generations. This week, the Minister of Energy and Infrastructure launched the smart government building model, which is an interactive government project based on artificial intelligence and uses modern technologies that support effective communication with building elements and users. He also launched the Smart Green Building Initiative, which is applied for the first time in government buildings and aims to raise energy efficiency, reduce consumption, harmful emissions and data security.[3]

❖ **Historical development of smart buildings**

1- The first generation (1981 - 1985) automated buildings:

o The first appearance of the smart building was in 1982 AD in the building of the American Telegraph and Telegraph Authority in New York, designed by Philip Johnson, this building shows how information technology from different sources can be used in the smart building as the latest technology was used in the building at that time Which is represented in displaying the performance of the different systems through a screen.

o As for smart buildings in Japan, they witnessed a great development in the United States, where Japan adopted the topic of smart housing, and built many smart buildings, such as the Toshiba company building in 1984, and the Nippon Telephone and Telegraph Authority building in 1986 in the capital, Tokyo, represented

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by Tokyo. The Minister of Construction encourages the development of smart buildings by setting large financial incentives for projects that apply the rules of smart building, which are:

- Information technology and telecommunication systems and equipment, or the prior preparation for these services in the future.
- Maintenance and control to conserve energy and manpower in air conditioning and lighting systems.
- Disaster prevention, security and safety equipment.
- Willingness to operate the security services and to communicate remotely.
- Connecting buildings through communication networks.

From the above it is clear that the models of smart buildings in the first generation confirm that both the Japanese and the Americans focused on information technology in the smart building, the more computer applications are in the building, the more intelligent the building is, and so is the value of that building.

2- The second generation (1986-1991) responsive buildings:

The definitions of building intelligence crystallized in the mid-eighties. A group of architects prepared a research known as tropical studies, during which they chose the interaction and mutual influence between architectural systems and information technology during the rapid change in the work environment, and as a result, buildings were unable to deal with changes in their operating systems or operating systems. The information used, which leads to the buildings becoming abandoned and unused and the result will be either restoration or demolition. Accordingly, the definition of smart buildings has been modified to become smart responsive, which has the ability to respond to the desires of its users as a result of smart solutions. It has the ability to respond intelligently to the indoor and outdoor environment and to the needs of its users, and the response is of two types: static response and kinetic response, static response can be in temperature or intensity of lighting, and kinetic are the potential decisions in the responses of building control systems. To renew the air of an architectural vacuum, the system decides to filter or open the window to renew the air.

Examples of responsive buildings are: the revolving house, which is considered a mobile architecture where it can rotate once in one direction in its entirety using a motor and sensors, for example, through sensors, the location of the bedrooms is changed to move away from the sun and its light, and the sensors are the kinetic treatment that transformed the building from a responsive, moving building An intelligent transponder, designed by German architect Rolf Disch. It is based on the concept of "the sun tree house" and is based on a moving base that rotates at different hours of the day to face the sun in winter or reflect it in summer, according to the desire and its idea is inspired by the heliotrope flower where its leaves rotate towards the sun.

3- The third generation (1992 - until now) effective buildings:

It means the presence of a database in the system that stores the situations that occur and the reaction to it to suggest it when necessary, as well as the administration's entry into the design process with the help of the computer and includes environmental control in the building and reducing the costs of operation, storage and transmission of information. In the year (1991-1992) a team of architects and information technology consultants B (TEKNIBANK) conducted a research to evaluate smart buildings in Europe, and defined the smart building as "a building that provides a responsive, supportive and effective smart environment in which the objectives of its work and the previous project were achieved. The occupants of the building and their jobs instead of computer systems." - In the project, three goals were identified for the smart building:

- **Building management:** in terms of the natural and physical environment, including human systems and building automation, meaning "environmental control of the building's systems and occupant control".
- **Space management:** It is the management of the interior spaces of the building in the sense of controlling changes by achieving compatibility and flexibility.
- **Work management:** It is the management of organized work activities or through the storage, provision and communication of information - and through the process of coordinating work between buildings and people, infrastructure, energy, water and sanitation in order to compatibility of services and extend the life span of building components and services.

❖ Smart housing and the social dimension

Bill Gates believes that the expected social isolation in the future will not occur due to living in smart homes, and he says, "One of the many concerns that have been talked about regarding the Information Highway is that it will reduce the time that people spend communicating socially." Some believe that homes will turn into places of entertainment that we cannot leave, and that we will turn into isolated people. But the incident actually contradicted Bill Gates' belief completely. We see great social isolation within the same family due to the use of technology inside homes and the preoccupation of family members with technology and their lack of integration despite their spatial proximity. Internet. On the other hand, the smart home can contribute to solving the problem of the loss of privacy that our traditional homes suffer from. The capabilities expected in the smart home, such as the ability of facades and windows to match the vision from inside and outside, will contribute to solving the issue of privacy that many suffer from, and this can happen from Through the use of glass that achieves vision from one side and prevents it from the other. And also achieving the security requirement in the home - two of the necessary social needs - for example, children will not be exposed to the risk of electric shock because the child's fingerprint will be registered in the system when requesting the current when the child puts his finger in the outlet, and also protecting the house against thefts, by alerting the occupant that when he goes out One of the doors or windows is open, and other systems can make the house contact its owner or the police station. Also, smart housing will contribute to modifying human behavior, making the city safer than the traditional city, through the ability to monitor, and also smart housing can suit the needs of the disabled. Undoubtedly, we want technology in our lives. But to what extent does this desire extend. Imagine your entire home connected to technology. For example, we find that a screen in the kitchen displays an electronic clock showing the time in different cities of the world and weather information in each of them connected to the Internet to obtain information. And your refrigerator records your purchases and the bedroom records the times you wake up and sleep and the times you listen to music, and the devices record all your privacy and desires from food, clothing and lifestyle, then technology companies know your privacy and here we ask about confidentiality and personal information as a social aspect.

❖ Smart housing and the economic dimension

Smart buildings are generally considered to have a higher cost than traditional buildings, due to the high cost of configuring digital infrastructure, technological equipment and programs, when taking into account the monopoly of industry and the production of technology by a specific number of countries and institutions, and we differ in the ability of countries to own those technology based on their capabilities In addition, the shift of the thinking and visions of smart architecture towards meeting environmental needs and achieving the requirements of preservation and sustainability by making use of the latent, renewable and non-polluting sources of energy that do not pollute the environment led to a high cost of construction and operation. In a study conducted in 2004, it was found that the initial cost of generating electricity China's solar energy units amounted to about 2.5 times the initial cost of generating them using traditional methods. The economic factor is one of the most important factors affecting design and operation. For example, because the operation of smart systems has a high cost, the administration of the Arab World Institute building in Paris was forced to stop operating the smart mashrabiyas whose openings move automatically according to the intensity of the lighting outside the building.

It is no secret to those working in the architectural field locally and globally that the use of advanced technologies in smart buildings usually adds an additional investment cost ranging between 20-40% of the initial estimated cost represented in energy, security and information systems, which have become one of the basics of the smart building. These additional investments may be one of the reasons for the scarcity of this type of buildings in Egypt." But although smart buildings are more expensive than traditional buildings, they are more economical in the long run "as the actual cost of the whole life cycle of the smart building is less From the cost of the life cycle of an ordinary building, due to its extreme energy savings, ease of maintenance, control of its systems, and easy development with the development of technology. We believe that smart homes are currently of high value for generations, even those that contain simple systems for controlling lighting and controlling lighting Currently, it will be accessible to everyone tomorrow, and the evidence is the amazing development in personal computers and the drop in their prices.

❖ The idea of the smart home business

In a traditional house, operating decisions are made in a traditional way. When the ignition key is pressed, the electrical current is connected or cut off in the wires connected to the lighting devices. In a smart home, the operating switch takes its decision by sending a signal to the connected network through a transmitter called BUS SYSTEM and a control unit that controls the CONTROLLER. Commands and regulation, such as regulating the passage of electric current to various degrees in the lighting units connected to them, the intensity of illumination is controlled by the control unit and the transmission system instead of the switch, so the devices become able to change their status through compatibility with network signals and equipment connected to the network and become able Orders to start or stop devices, for example, the bedroom lighting can be programmed to gradually decrease until it becomes dark when needed, and the MOTION DETECTOR also informs the owner of the house when there is a person in the house.
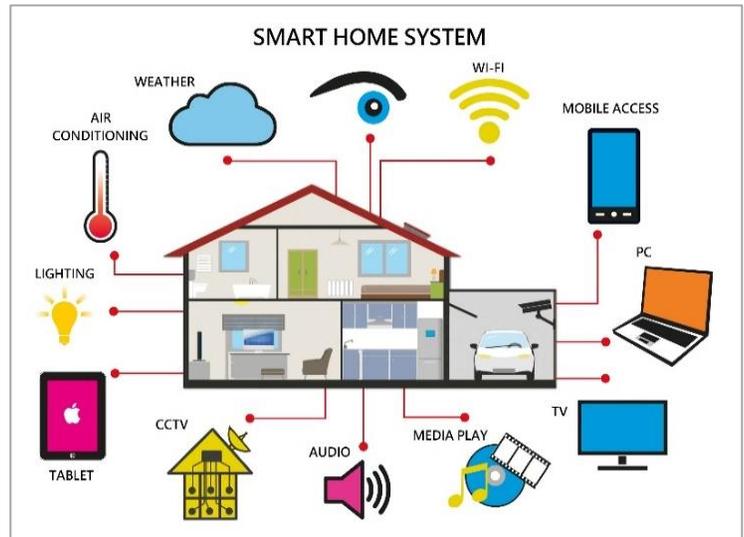
❖ Integrated Building Management Systems

These systems are considered as the human mind for the building. They are systems that allow control and monitoring of all building activities:

1. Security and safety systems
   • Security systems: such as protection from theft, assault, and natural and non-natural threats.
   • Fire protection systems: such as automatic fire detection systems, fire-fighting sprinklers.

2. Environmental Control Systems
   • Energy Management Systems.
   • Heating, ventilation and air conditioning systems.
   • Sanitary engineering systems.

3. Electrical network management systems
   • Electrical network management system.
   • lighting systems.
   • Cable management systems.

4. Integrated Communication Systems
   • Voice communication systems.
   • Visual Communication Systems.
   • Data Transfer Systems.

❖ **Examples of smart home control**

1. Controlling the lighting and heating in the smart home: All lighting units can be controlled using the ignition switch or by remote control, and there are other lighting systems such as:

- By ringing the doorbell or telephone, and the light can be made to shine more brightly for those with limited vision.
- The motion detector can open and close the lighting when entering and leaving the room by detecting the movement.
- The rooms of the smart home have temperature monitoring devices that enable the heating and water heaters to be turned on and off.

2. Control the alarm, security, and enter the smart home

- **Fire alarm:** the lighting can be turned on to guide the way out or escape, and the alarm occurs when the temperature suddenly increases or there is smoke by means of an audible alarm or by calling the nearest fire station in the area
- **Security Alarm:** When thefts occur, a strong acoustic alarm is triggered, and the nearest police station is contacted to inform it of the theft, while closing all openings of the house, including doors and windows.
- **Entry door system:** in which the entry door is equipped with a system that, when a stranger violates it, triggers the security alarm, or the system opens the TV or transmits events by cameras to cell phones via the Internet
- **Identification systems:** by recognizing the voice print or facial features or by analyzing the user's movement and sensing the reaction of the earth to him.

❖ **Detection systems**

1. **Infrared detection:** These devices are not detected by projecting rays, but by detecting infrared rays emitted from the human body and used in external fences to detect intruders and have a range of up to 150 meters - or by cutting off the beam when entering
2. **Vibration detection:** It is used in rooms inside the house to identify and track objects, such as the "360-degree rotating scanning mechanism"
3. **Microwave Detection:** It is used to detect movement around the building by cutting the person passing around the building to the rays.

❖ **The difference between automation, response, and learning**

- o **Definition of automation:** "A machine that performs work automatically and continuously without human intervention, through programming this machine to carry out the work" - It is the use of computers and devices based on processors or controllers and software in various industrial, commercial and service sectors in order to ensure the smooth running of procedures and business Automation is accurate, sound and with the least possible error. Automation is the art of making procedures and machines run and work automatically.

- o **Definition of response:** "An activity carried out by a living organism as a response to a situation it encounters, a stimulus that alerts it, or a stimulus that provokes it. With regard to the building: the building's ability to meet the desires and requirements of its occupants and to changes in the building's internal and external environment, which is a reaction from the building. It occurs as a result of the need for it through the system.

- o **Ability to learn Discovery aids:** Discovery aids are a set of rules that increase the probability of solving a problem more accurately, it is the ability to learn from his experience, for example, in a meeting room the system can feel the increase in the number of people, it lowers the temperature from 24 degrees to 18 degrees to beat the heat of 20 people. If the person in charge of the system lowered the temperature to 15 degrees, then the system must realize that its calculations were somewhat inaccurate. If the number of people in the room reaches 30, the system must calculate the temperature of each person based on the latest experience. Therefore, the ability to learn is a very important and critical process in fire and maintenance systems.

- o **The difference between automation and response:** "Automation is a type of response, but it is limited or conditional, where the building responds and acts itself based on a pre-prepared database, but it does not have the ability to learn and make decisions based on what it has gone through from previous experiences and experiences, the building responds to light A car without another to open the door of the outer dwelling." The automated building has the ability to respond according to what its systems and equipment have been programmed to perform specific functions according to specific inputs and through a pre-prepared database, but it does not have the ability to respond intelligently to the internal and external environment and to the needs and requirements of its occupants. Because it does not have the ability to learn that characterizes smart or effective responsive buildings. [1]

❖ **Automation and its role in increasing efficiency and saving energy**

It is necessary to identify the main factors that increase the energy costs of an ordinary family and cause unnecessary energy consumption, namely:

- • Heating unused areas
- • The lights are left on unnecessarily.
- • High level heating and cooling systems.
- • Devices left unlocked.
- • Unable to use daylight as much as necessary.
Such automation of heating systems and electrical systems is controlled by a house:
- • Provides 10% to 30% of thermal energy savings
- • Automatic illumination of unnecessary lights
- • Reduce electrical energy consumption by up to 30% by automatically programming devices according to cheap tariffs.

The logic of providing convenience is that unnecessary and time-consuming tasks are performed automatically by this automation, and operations are performed that the user would not perform under normal conditions. The scenario option is one of the best solutions in controlling the operation of home systems, as the devices work on many orders in a sequential manner, including:

- • Close all blinds.
- • Adjusting the intensity of lighting.
- • Automatic adjustment of the room temperature to the desired temperature.
- • Opening and closing of automatic doors with motion detectors, etc.

❖ **Technical examples of smart home**

Smart home products that can be produced in the home environment have become widespread with the entry of information technology into every area of our lives. These devices include:

- • **Smart TVs:** You can open the desired music or videos and access them online through smart applications. Some smart TVs have the ability to recognize voices or gestures, which allows the TV to be managed with voice or with some movement and gestures.

- • **Smart lighting systems:** In addition to features such as remote access and power off, it is possible to turn off the lights if someone in the room has different sensors, or when there is no one, and the intensity of the light can be adjusted automatically according to the light the day.

- • **Smart thermostat:** You can set or monitor the temperature of your home remotely, which is by adjusting and setting your heat program to produce the desired temperature at the required times. The smart thermostat can learn according to the owner's habits and can be programmed by itself.

- • **Smart Lock Systems:** Smart door systems recognize homeowners and automatically unlock the door when they are near the house.

- • **Smart security cameras:** enable the homeowner to monitor his home and surroundings using these cameras while away from home or while on vacation.[2]

❖ **Advantage and disadvantage of smart home**

Smart home automation can provide a sense of ease, comfort and enjoyment. Having a smart home hub means that your devices from different manufacturers are connected and can interact with each other via a single home automation platform. You can make your smart devices work outside of Wi-Fi, Bluetooth, or networks like Zigbee or Z-Wave. And there are rewards and challenges for smart home automation, especially when hubs like the SmartThings or Wink Hub 2 compete with smart speakers that also include hubs, like Amazon's Echo Show 10. But without deciding, you might find yourself spending a lot of money when you don't need.

➢ **Advantage**

o There are still some good reasons to own your smart home, and one of the biggest advantages is to centralize your smart home automation; That is, unite all your smart devices, Wi-Fi, Zigbee or Z-Wave and Bluetooth into one easy-to-manage app. Individual smart devices may also have their own settings that the smart center can easily integrate into your home's automated system. Using a smart speaker alone may enable commands, although the variety of compatible devices may be more limited compared to a smart hub. A smart hub can run automatically, sticking to the schedule you set for it, as well as voice assistant actions. Many smart hubs can also allow you to access the devices built into their system through an application; Giving you remote control when you're out of the house and your voice isn't there. Even if you're not someone who often feels comfortable with technology, it's easy to use smart home hubs; Because it puts everything in one place. Smart speakers with Wi-Fi or Zigbee can limit your device options, especially for smaller product categories like light bulbs. Wi-Fi-enabled smart home devices are simpler to use with a smart speaker in hand, and smart speakers extend their range of capabilities, but smart hubs still offer the widest range of customizable options if you want to work on creating actions and connecting hardware.[4]

➢ **Disadvantage**

Although there are advantages to a smart home that can tie everything together, it is not a perfect solution. Among the possible disadvantages:

o There are very few globally accepted industrial standards that are suitable for smart home systems, and poor standards can cause standardization, as well as the use of proprietary technology to solve various problems for owners who want to automate their homes. Without these industry standards, a person may invest in a complete system, but may be unable to communicate efficiently with all devices. Among the most popular communication protocols for the products are (X10), (Ethernet), (RS-485), Lowland, (Bluetooth LE, (ZigBee), (Z-Wave), and other proprietary protocols that are incompatible with each other.

o The possibility of being exposed to hacking and penetration. A Microsoft research in a 2011 study found that the reason is the difficulty of interconnection between devices, and sometimes the high cost of ownership. Most likely, the customer will trust a single vendor to purchase an integrated system with all its devices, often with proprietary equipment, although it has been found that open source software can be used to hack proprietary equipment. Most smart devices depend on the Internet connection, and if it is interrupted, the interface of the smart system will be disrupted. And sometimes also, communication via wireless signals, which is the most economical way for the elements to communicate, may be subject to interference with different signals directed from another person, causing them to not work properly (5)

Conclusion

In the end, we can say that the smart building is a dynamic, responsive building that provides its users with comfort and performance at a lower cost. It is also the most important factor for the transition to a more sustainable energy and infrastructure sector, as well as improving productivity while rationalizing energy consumption, lowering carbon emissions, operating costs, and reducing environmental impacts. On the other hand, we must mention that increasing connectivity and enhancing information exchange in smart buildings is faced by limitations represented in the importance of confidentiality and protection of building users' data, and the need for a strong and secure system to reduce the risks of network growth and electronic threats, and the complexity of smart systems may become a challenge for facility managers, the challenge Today it is no longer about data but about how it is used.

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