

Research paper

# The internet of things in smart construction and interior decoration

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## Abstract

The use of digital methods in the construction industry has experienced significant growth in the 21st century. Cyber and physical environments are unprecedentedly integrated with the Internet of Things. The Internet of Things has wide applications in various industries, including the sectors where the Internet of Things can have significant effects, we can mention the construction industry, building operation and management which is the result of moving towards the goals of sustainable development, therefore, due to the significant advantages of the Internet of Things, the use of this technology in various industries, especially the construction industry, has been widely welcomed. Considering the positive role of Internet of Things technology in the future of the construction industry and the increasing desire of researchers to conduct research in this field, in this article we will examine the use of IOT in smart buildings. Now we want to discuss the application of Internet of Things in interior decoration.

## Introduction

The Internet of Things refers to many objects and devices around us that are connected to the Internet and can be controlled and managed by applications on smartphones and tablets.

The Internet of Things is changing the world beyond what we imagine. From driving on highways to the process of shopping and even energy distribution in houses in different cities.

The Internet of Things, abbreviated as IOT, is changing the way people work and live today.

IOT can be divided into three categories:

1. Sensor
2. Computer
3. Objects

Today, smart home technology based on the Internet of Things has become so widespread that its use has become a daily thing.

In this article, we will examine the facilities and needs of

a building using analytical and descriptive studies. And we provide you with everything you need to know about the Internet of Things.

In the following, we will learn about some examples of the Internet of Things and their use in everyday life.

### A. Lighting:

Philbis lighting color is one of the most effective tools that can change the entire atmosphere of your home. The Internet of Things has been developing lights with new technologies to make your life beautiful.

The main features of these types of lamps are: Voice control through voice requests such as "bedroom light" and "living room light" automatic operation of this system that turns off the lights when people leave the house and turns them on by touching the smart phones of the home owners.

And among other features of this automatic system is power color and remote control (setting the programmed light change is available to the members of the house).

### B. Window:

Smart windows, this type of new generation windows,

Doi:

which are produced by several companies in the field of building materials, have been introduced as an excellent product in interior decoration with new capabilities. A famous store has been built for customers who want to see the capabilities of these types of windows and test these types of lamps in the real environment and use them in person.

One of the capabilities of smart windows is that it is equipped with an automatic alarm using IOT technology. The main features of smart windows are as follow:

1. The window is forced to open or close through smart phone control with warning function as well as notifying smart phones when opening.
2. Amazing smart window with transparency control function for privacy and better control of daylight gives people inside the house the ability to control their privacy and air quality sensors in bedrooms and living rooms connected to windows with open and Closing the windows in addition to the filters in the rooms bring the air into the house with better quality.

#### C. Smart table:

The screen of these types of tables is a smart table with many applications with a 46-inch touch screen.

The technical specifications of this type of smart table (Smart Table) are as follows:

The 46-inch screen with 1280p resolution and 700p brightness is efficient enough to use in bright environments.

And it also has file transfer and import functions for data exchange as well as many other purposes such as training, advertising, exhibition and consulting.

#### D. Smart cities \_Central controller\_ Smart sensors

In general, a smart city consists of three main layers. The first layer is the technology-based layer, which includes a multitude of smart phones and devices and sensors connected to high-speed communication networks. The second layer consists of raw application software. Translation of raw data into warnings and symptoms is one of the tasks of this layer. The fourth international conference Electrical engineering, computer science and information technology.

It has the right tools, at this stage technology providers, programmers and developers enter the scene. The third layer is being used in cities, companies and by the general public. Applications will only succeed if they are widely

adopted and succeed in changing the behavior of their users, intelligent monitoring, automated transportation, intelligent energy management systems, water distribution, urban security and monitoring. The environment are all examples of Internet-based object applications for the development of smart cities. Internet-based Esha can solve the major problems that people living in cities have, such as pollution, traffic, and lack of energy resources, etc. Emptying the trash can send a telecommunications message to the municipalities, or by installing sensors and using web applications, citizens can easily find free parking spaces in the city.

#### E. Central controller smart home equipment and components

Every smart building is equipped with a central and automatic controller system that uses the building management system with the building automation system to perform its tasks

Including 2 applications of Al-Amr and Russian technologies in smart windows.

#### F. Smart refrigerators

In the late 1990s and early 2000s, the idea of connecting home appliances to the Internet under the name of the Internet of Things was popular among people, until in June 2000, LG Company was able to market the world's first smart phone called Internet Digital DIOS, but in it At the time, it was considered a failed product because consumers considered it an unnecessary product and expensive with a price of more than 300,000 dollars. The smart refrigerators in Fig. 1.

A smart door is a tool that allows residents, depending on the internal features, to do tasks such as checking the internal contents of the pen, sending and receiving notes, and alerting if the door is open through their smart phone, such as other components of a smart home Internet connection is one of the requirements of this device. Currently, very few manufacturers such as LG, Samsung and GE prepare their own smart applications, but it is expected that the number of companies active in this field will increase with the spread of the acceptance of smart buildings. In fact, smart refrigerators have a user interface with a smooth display, internal cameras and options for personalization.

Panjal and Mishi smart freezers can communicate with other smart devices in the house such as speakers, smart TVs and even smart dishwashers or smart microwaves.

Considering that the features and services provided by each smart refrigerator are different based on its brand name and model. In the following, we will examine some of these features.

The ability to search for cooking instructions and collaborate in cooking by reading the recipe step by step Preparing shopping lists and updating information on the mobile phone connected to Pashmal. The ability to check the products available in Badjal remotely and separate the products based on the expiration date and warning the ability to create a personal profile separately for each family member and coordinate between them, the ability to display notes on the screen and upload images.

As its name suggests, the theme rotates the cars around an axis and moves them vertically by a rotating mechanism, the space occupied by this system is almost equivalent to two cars and it provides the possibility of parking 13 cars. In the country, Tik Parking Company has the ability to build rotary parking for regular cars and SUVs it has.

The ability to display the contents of the refrigerator without opening the door.

- The ability to display the kitchen environment in another place by connecting to a smart TV
- Warning in case of malfunction or need to replace parts such as filters
- Ability to provide hot and cold water with adjustable temperature by family members.
- The ability to close the refrigerator door automatically when both hands are full.



pixtastock.com - 40584047



Fig.1. Smart Refrigerator

### G. Smart parking

Considering the increasing need for cars in big cities and the need for suitable parking space, mechanized parking lots are considered a basic solution to solve this situation. These types of parking lots are suitable for use in residential, administrative, and Almoumi complexes and on the ground and underground floors, the height of which is about 4 meters and more. are used Gah Pari parking lot in the condition that there is enough access and narrow and medium capacity.

Due to its low purchase price compared to other types of mechanized parking lots, as well as various applications on the ground, underground, and above, they are the most appropriate choice. In places where the upper side of the parking lot is required, a number of this type of parking lot can be placed together. Among its advantages, the following can be mentioned.

The cheapness of the system compared to the parking lot for the high speed of production and simple operation. The smart parking system is revealed in Fig. 2.

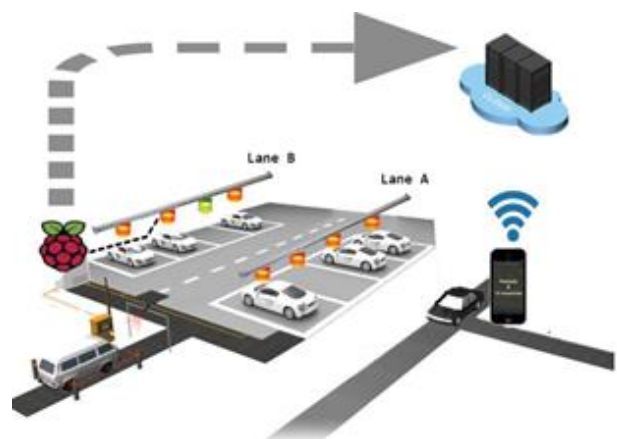


Fig.2. smart parking

#### H. Smart windows

This innovative and impressive technology allows consumers to block all or some of the lights with just the turn and push of a button. This level of light control can potentially save billions of dollars in heating, cooling and lighting costs. As research shows, approximately 3% of the energy used in the United States is consumed by the windows of residential units. Among the various existing technologies that can be used in the structure and program of smart windows, the following can be mentioned:

- De-heating
- Photochromic or photochromatic
- Liquid crystals
- Electrochromic

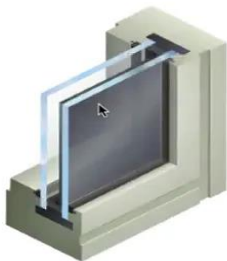
Cleaning windows is one of the problems of traditional houses, which requires spending a lot of energy and time. Smart windows can be a good option to solve this problem. Also, reducing and saving energy consumption

is one of the other advantages of this new tool. In the summer season, when a house is exposed to the sun's rays, the interior of the house heats up and more energy is needed to balance the air in the house. Using smart windows to block ultraviolet rays can not only prevent energy waste, but also protect paintings and furniture at home or work. These windows allow people to take advantage of natural light in order to reduce electricity consumption for lighting. It also creates the required heat of the environment. Today, many companies are trying to provide a unique technology that enables a window to quickly change from clear to opaque in any situation with the slightest change. For example, a company today uses light absorption technology by microscopic particles called SPD.

It uses its own smart windows to change the window from light to dark and vice versa within a few seconds. Fig. 1 shows how this technology works. The smart parking system is revealed in Fig.3.

## View platform

**Coating**  
Electrochromic coated insulated glass unit



**Network**

Glass connected to wired, secure cloud-enabled network



**Controls**

Automated or manual, smart and connected

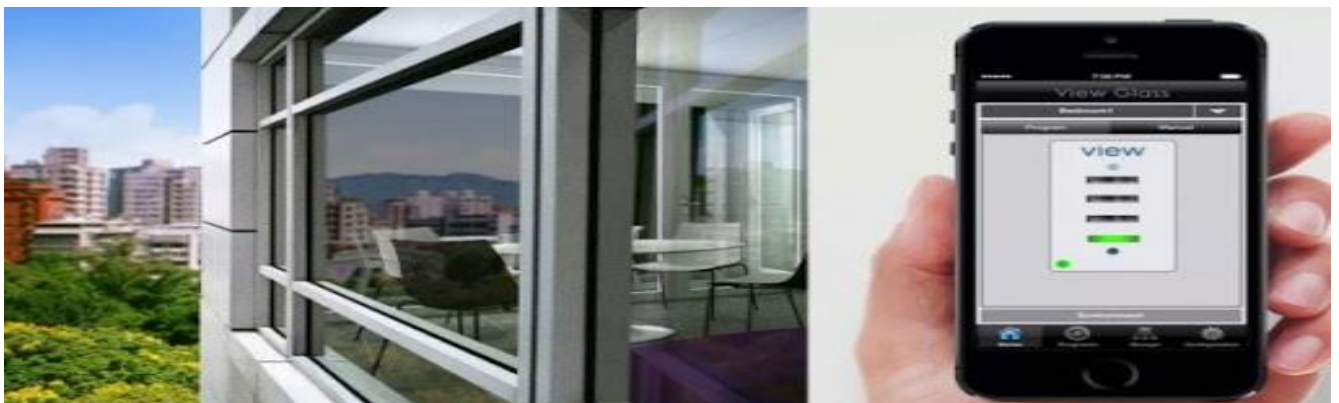


Fig.3. Smart windows

### I. Smart window functionality

Today, windows are changing in a way that has not been seen in the last 50 years, with this trend, traditional curtains and windows will soon be abolished, SPD technology will certainly be one of the reasons for this revolution, but other competing technologies Like LCDs liquid crystals, they will not be ineffective. Liquid crystal fatwa is currently being used in products such as portable computers, calculators, digital watches and microwave ovens.

In these displays, electricity is used to change the shape of the liquid crystal so that light can pass through it, thus forming shapes and numbers on the screen, another technology that is of interest in the smart window industry today. Electrochromic windows: E. In this technology, by adding Valmaz, the surface of the glass becomes dark or the voltage of the glass becomes transparent.

Concepts based on electrochromic technology, such as suspended particle technology, can be adjusted to display different levels of visibility, such as liquid crystal technology, and are not a zero and hundred vision technology. Electrochromic technology actually describes materials that can change color when an electric current is passed through them. In principle, electricity in this type of material creates a chemical reaction. This reaction, like any other chemical reaction, changes the properties of the material and changes the way the material reflects

and absorbs light. Figure 2 shows the application of electro chromite technology in smart windows.

### J. Lighting system

Smart lighting system is a modern technology designed for energy efficiency. In this system, we seek to increase the efficiency and automatic control of lighting systems so that the necessary settings can be made based on the environmental conditions. Research has shown that 19% of the energy consumed in the world is used for lighting, and 6% of the greenhouse gases produced in the world are due to energy consumption for lighting. Smart lighting is a method by which people can remotely control cooling devices, heating devices, lighting, etc. Also, the concept of smart lighting includes the use of natural sunlight to reduce the use of man-made lighting. Smart lights eliminate unintelligent modifications like timers, are much easier to control, and allow people to adjust them and provide better performance. After installation, the smart lighting devices are synchronized with the resident's smartphone to be able to provide a specific schedule for their operation. They can also be automatically configured to work with other smart devices such as cameras and security systems. These systems can be adjusted both for use in the interior spaces of the building such as corridors, living rooms and bedrooms and in open spaces such as entrance doors, garages and courtyards with any level of access and no professional technician is needed to set them up. The Lighting system in Fig.4.



Fig.4. Lighting system



### K. Smart fire alarm system

It is an intelligent system to prevent unfortunate events in the event of a fire accident, which can be designed according to the conditions and needs of consumers. Among the general functions of this system, it is possible to mention sending a warning message or SMS to the

number stored in the memory, closing the main gas valve, directing the elevators to the exit door automatically, announcing the exit routes and opening all the exit doors. The Smart fire alarm system in Fig.5.

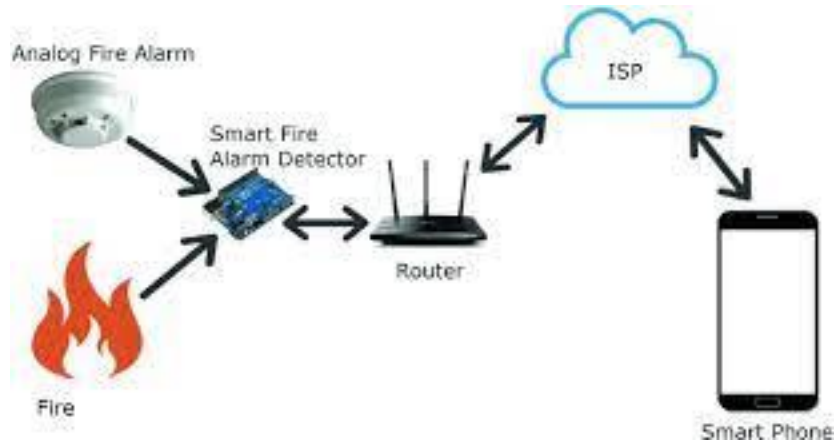


Fig.5. Smart fire alarm system

### L. Smart locks

Although today's traditional lock and key systems have improved over time, since the invention of the first lock more than a thousand years ago, the basic mechanism and the way this tool works have not changed. A piece of hard metal that, using a key, turns the pins inside the lock into the right position and causes the act of closing the door to be done in it. Problems such as keys wear out due to use, being expensive in terms of replacement, finding simple ways to open locks without a key and the possibility of copying a key led this system to the digital age. As it is clear, in a society, it is a difficult task to replace a system that has worked correctly and logically for a millennium and is accepted by everyone, but the many benefits of electric entry/exit systems made them accepted. The Smart fire alarm system in Fig.6.



Fig.6. Smart locks

### M. Intelligent parking puzzle\_Tower smart parking

No need for a special operator and high security of intelligent parking in the tower parking is one of the most widely used professional metal parquets with a fully automatic parking set. These systems transfer an area of about 7 x 7 meters, which is usually a place to park three cars next to each other. It has the ability to provide up to 40 parking spaces. The Smart fire alarm system in Fig.7.



Fig.7. Intelligent parking puzzle\_Tower smart parking

It has a structure like an elevator, on both sides of which there are places in the shape of age for car parking. In fact, there is a car elevator with a smart robot in its center.

The cars that have requested parking are placed on the pallet of the elevator robot, the elevator moves them vertically and directs them to the desired floor. When the car reaches the desired floor, it will be directed to one of the built-in textures. According to the existing pallets available for the construction of the parking lot, they can move to the left and right side of the elevator with its

front and back or a combination of both. Fig. 3 shows the transverse tower parking lot and the longitudinal tower parking lot.

*N. Smart underground parking*

Mechanized underground multi-storey parking is a type of mechanized parking that uses an optimal layout to accommodate maximum cars in the underground. This system is automatically controlled by computer for loading and unloading operations. There are many sensors for safety in operation and all cars are placed in the underground space, so there is complete security against theft. The operation of loading and unloading cars is very easy and fast. Using the parking card issued for the car, users can park very quickly. The average waiting time for loading in this system is about 25 seconds. The cost of building an underground mechanized parking lot, depending on the geographic location of the parking lot, includes several parts: construction cost, equipment cost, and installation cost. According to the equipment used in the construction of the underground mechanized parking lot and also the installation and operation costs of this parking lot, the price of the underground mechanized parking lot can vary. The Smart fire alarm system in Fig.8.

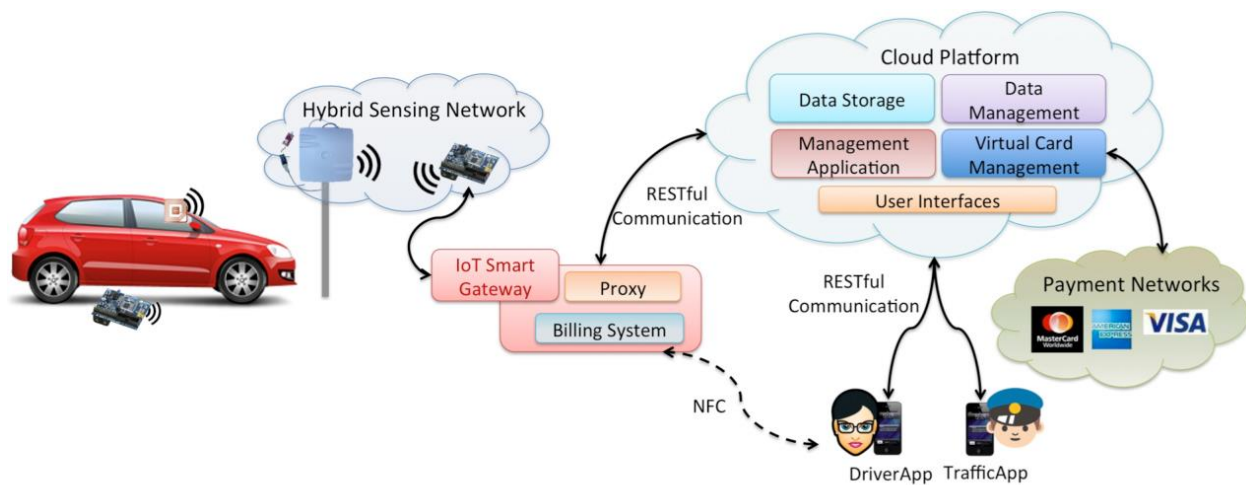


Figure 1. Overall Smart Parking System Architecture

Fig.8. Smart underground parking

*O. Smart vacuum cleaner*

A vacuum cleaner is one of the tools that has been able to help residents in the last century and make house cleaning much faster. An electromechanical device that is used to suck small waste and dust. This tool has an electric motor that creates a partial vacuum by creating a fan mode and causes the outside air to be sucked into the evacuation space. Companies active in this field in the new generation are seeking to make this tool more

practical by using smart robot vacuum cleaners. These robots are developed in the form of a disk equipped with cleaning technology that is controlled by microcontrollers. In this device, cleaning is done automatically. This tool is a user-independent vacuum cleaner that is programmed to clean. Some of its types are equipped with security cameras, telecommunication and communication systems. The first portable vacuum cleaner that used a vacuum was designed by Walter

Griffiths in 1905. This device consisted of a spiral suction device and a flexible hose pipe. Then in 1906, a person named James B. Gerby invented another vacuum device. He invented the Domestic Cyclone, which used water instead of a filter to separate dust, but the first portable vacuum cleaner that had a motor was invented by James Murray Spangler Big, a janitor from Ohio in 1907. This device has a rotating brush, an electric fan, a box and one of his wife's pillows used to collect dust because he had no money to start producing his idea. In 1908, he sold his patent to William Henry Hoover, then Hoover by placing it in a steel box and redesigning the vacuum cleaner hose connections, he later added disposal bags and filters and was able to launch the first vacuum cleaner in 1926. At first, the vacuum cleaner was a luxury utility tool, but after the Second World War, the middle classes were also able to get it, and it gradually entered many families. Today there are many types of vacuum cleaners. Some of them use filters, while others collect dust through cyclic separation, and some are even able to collect liquids. Then, with the advancement of various technologies, this tool underwent changes until the first robotic vacuum cleaner was made in 1996 by Electrolux, a professional manufacturer of household appliances in Sweden, called Trilohite. It was good and practical, but it had problems in dealing with objects. Because it stopped at a short distance from objects and left many small areas uncleaned, its production was stopped. Then, a British technology company called Dyson introduced its first robot vacuum cleaner in 2001, named DC06, but because it was too expensive, it never went into mass production. A year later, an American high-tech company called IRobot released a robot named Roomba that was able to detect dirty spots on a surface, change direction when it hits an obstacle, and detect steep surfaces to avoid falling. Prevent yourself in places such as stairs. Roomba robots were very popular and more than 20 models of them have entered the market to date. Like all tools, these robots also have their positive and negative aspects. Compared to Neti vacuum cleaners, they make less noise, save time due to the ability to perform their responsibility automatically and do not depend on the user. The Smart vacuum cleaner system in Fig.9.



Fig.9. Smart vacuum cleaner

Some types need to be recharged after work, while others can find their own location where charging is done on its own. The Evolution of Smart Homes in Iran Today, various organizations and companies in Iran offer smart home services. Among the services of these companies are smart lighting, IST system, air conditioning, smart irrigation, electric curtain, SMS communication system, smart voice control, and remote control of the building through a smart phone. The installation and implementation of each of these systems has its own cost. Therefore, the more services are selected, the higher the cost of the project will be. Each company has its own method for determining the cost of smartening a building, but most of them announce their price according to the size of the house. It doesn't matter if the house is under construction. Made with and several years old. In each of these stages, the possibility of smartening or the security of their building, they use all kinds of smart systems, which can have a great impact on the price of the house, but in general, due to the high costs, the lack of proper infrastructure, and the possibility of hacking in these systems, they are still not welcome in the interior of the country has not reached the desired level. The first smart building in Iran was built in 1369, located in the north of Tehran, with an area of 1,250 square meters in the north of Tehran. This five-story building includes a library, an amphitheater hall, a health house, a prayer hall, and



administrative and educational areas, which hosts a large number of citizens during the day. It is considered to be its traditional type. In a broader way, home automation companies in Iran started their work in the early years of the 80s and were able to provide smart solutions for the Iranian market based on the international KNX standard. KNX system is a global standard for intelligent control of buildings, since 2006, many home automation companies in the world have produced their smart appliances and products based on this standard. Of course, in the beginning, this technology was unknown to many people and it was not well received, and the leading companies of this technology made a lot of efforts to introduce this system so that they could gradually find a special place in Iran. In this way, the best architects of Iran, with the cooperation of these companies, gradually used smart building technology in the construction of their advanced construction projects.

The process of using smart home in our country, like other technologies, was first implemented in a limited way in certain parts of provinces and big cities such as Tehran, Mazandaran, Gilan, Tabriz, Mashhad, Shiraz, Ahvaz and Isfahan, but with the growth of technology and industries such as Smartphones and the progress of the construction industry in the fields of video iPhones, parking jacks, etc., which are part of the executive requirements of a building, and smartness is also expanding everywhere in the cities of our beloved country. Fernak Raymon Smart House, Ermina Smart House, Lux Tarin Smart House, Tamin Parsian Smart House and Metallic Smart House are among the companies that have been able to complete several projects in various fields of smart building. Today, in our country, technology has been strongly integrated with people's lives, and people are mainly inclined towards intelligent systems. Offenders are working on tourism like the Internet of Things more than before because they can bring many possibilities to mankind through it, and this will be great for the future. The possibility of connection and mutual communication with home automation provides the possibility of better life management. The high level of automation makes control easier and safer for any property from anywhere, and for these reasons, this technology is expanding in our country as an efficient and economical option for future life.

With its development and evolution for smart homes and buildings, it is gradually becoming more affordable for consumers and its popularity is increasing day by day.

Therefore, with the increase in demand, many smart building companies are quickly established all over the country. The participation of Iranian engineers in smart technologies in Iran has led to the development and progress of the country.

### Conclusion:

Currently, everything that uses electricity at home can be controlled on the home network. It is possible to imagine the smart houses of the future in which smart devices will check the weather conditions in real time and will provide a schedule for watering the garden. Since the use of gasoline and diesel fuels will be banned in most countries in 2040, charging stations for electric cars will be built on all roads. Smart appliances will be able to monitor their performance to identify if a part is breaking down and automatically send a message to someone to repair it. And... As the price of sensors and Internet connections continues to fall, it becomes affordable to add more devices to the Internet of Things. Most companies dealing with the Internet of Things are currently in the experimental stage, as the technology required for their projects, including sensor technology, 5G Internet, and machine learning-based analysis tools, are still in the early stage

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### Author Contributions

R. Alian , S. Nabavian , GH. Iji , D. Derakhshandeh , B. Akhtarifar collected the data, carried out the data analysis and interpreted the results and wrote the manuscript.

### Conflict of Interest

The author declares that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy have been completely observed by the authors.