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Smart House as An Input to the Application of Technological Development and Rationalization of Energy Consumption in Buildings and Achieve Sustainability

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KEYWORDS:
Smarthouse, technological development,energy consumption, sustainability

Abstract— **Architecture has been and remains the mirror that reflects the civilization of peoples throughout the ages, which is happening now in the field of global architecture is a shift in the general thought as a whole, as the modern era in which we live now is undoubtedly the era of technology and information revolution has reflected this image on buildings And imposed itself and the idea of smart systems and intelligent buildings emerged as an automatic response to architecture on the scientific and technological development.**

There is a major problem is through two aspects: The first aspect is to limit the concept of smart house to the majority of individuals to provide and facilitate techniques to achieve security and prosperity in the home, and increase the others in the provision of energy, The second aspect is the lack of consideration of the role that mating can play between the concepts related to these two directions (computer technology and energy reduction) in developing the concept of smart house and its role in the field of energy conservation and improving its thermal performance and thus increasing its total value.

Therefore, the importance of studying the smart house is that the development of this trend in the hoped-for way serves the same inhabitant by providing the appropriate lifestyle and the economy in the cost of its operation, which is reflected positively on the development of society, and serves the environment in which these houses are characterized by their characteristics of sustainability, On the third hand, its impact on the state has a positive effect on reducing the depletion of the general energy resources in the country and the possibility of directing the resulting savings in other development hubs .

A framework for research has been identified from three axes. The first is a study of the concept group related to architecture, smart house and sustainability, The second axis: study the role of smart house in the reduce of energy consumption and achieve sustainability and appropriateness and reflection on the development of society, the third axis: An analysis of a variety of different models of houses with general intelligence in the building, measurement of the smart aspects and the extent of their reflection on the characteristics of the house In order to arrive at specific results that can be evaluated and used in developing a set of criteria to assess the level of housing intelligence.

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I. INTRODUCTION

Housing is generally considered to be the most common type of building compared to the rest of the buildings. On the other hand, housing represents the predominant percentage of different types of use in any city. On the other hand, buildings are often used throughout the day, Which is used in specific times only, and taking into account that the smart housing is one of the promising trends that have not yet been explored all possible possibilities in its field, which can provide a living pattern appropriate and distinct aspects and aspects of multiple and at the same time economically The importance of this research is that the development of this trend in the hoped-for way serves the same inhabitant by providing the appropriate living style and economy in the cost of its operation, and serves the owner on the other hand to increase the added value of such housing, and on the third hand it serves the environment These houses are distinguished by the characteristics of sustainability, and their impact on the state, on the fourth hand, has a positive effect on reducing the depletion of public energy resources in the country and the possibility of directing the resulting savings in other development hubs.

The problem of this study is to overlook the impact of this revolution on the structure of the house and the way it is built and the way people live in it, while thinking about the means and factors that affect its design and search for its appropriateness and considering the techniques of smart housing as a kind of entertainment or what is outside the concrete reality, Housing is spreading with its significant benefits in the convenience of life within it as well as its ability to save on the cost of operation and maintenance, as well as future developments and cheap costs.

II. THE METHODOLOGY OF THE STUDY

To achieve the objectives of the study, the research uses two research methods: Theoretical and analytical ,Theoretical Methodology: first study of the concept group related to architecture, smart house and sustainability, second study the role of smart house in the reduce of energy consumption and achieve sustainability and appropriateness and reflection on the development of society Analysis Methodology: An analysis of a variety of different models of houses with general intelligence in the building, measurement of the smart aspects and the extent of their reflection on the characteristics of the house In order to achieve specific results that can be evaluated and used in developing a set of criteria to assess the level of housing intelligence.

The first axis: study of the concept group related to architecture, smart house and sustainability

1-The concept of smart housing:

- The smart building system emerged at the end of the 20th century as a direct result of scientific and technological development. These systems have many applications and have become important as new technologies. Many international conferences have called for the application of this technology in architecture.

Most of the specialized technical companies in this field did not give a specific definition of smart buildings [1] but agreed as an integrated system consisting of:

- Building Management
- Office Automation
- Telecommunications
- Space Management
- Maintenance Planning
- Business Support Systems
- Video Systems
- Audio Systems
- Security Systems
- Redundancy Systems

- In the International Conference on Smart Buildings in Toronto in May 1985, the Smart Building was defined as follows:

"The Smart Building is an Intelligent Building Combines Innovations, Technological, With Skillful Management, to Maximize Return on Investment "

That is a smart building is a building that combines creativity, technology and management skill to maximize project income.

The BOMA Building Builders and Managers Association has also defined the Smart Building as [2]:

"The building that contains technological applications so that these applications benefit from each other through the exchange of information"

Here, one must point to a very important point: that no building containing a sophisticated intelligent system is a smart building, but a smart building must have a set of sophisticated smart systems integrated with each other to allow the exchange of information between them.

Thus, the concept of intelligent housing means: the dwelling in which special electronic systems are used in the operation of some parts and control of some systems that contain such as systems of lighting, air conditioning, ventilation, energy, etc. It can be said that the degree of intelligence of the house depends on the amount of what is achieved and the amount of what is used of the techniques and the amount of the possibilities contained in the scope, and the extent of the scope of the field works within the scope and deal with the other components of buildings, networks and facilities.

-Characteristics of smart housing:

Through the monitoring of multiple visions and definitions of intelligent housing, theoretical theories can be classified into three main features: automation, virtualization and sustainability, as well as the features of smart architecture. Smart housing is a smart building and therefore has the same characteristics and characteristics of smart buildings [3]. The total of the entries through which the values of intelligent architecture can be achieved and a smart architectural product (smart dwelling).

1) Automation:

Automatic control systems are one of the most important approaches to access a smart architectural product. Automation systems have been associated with the emergence and development of the computer[4], As many of the buildings were able to use the automation systems and advanced communication systems to reduce energy consumption and support the requirements of security and safety As a result of multiple writings in this area there were many requirements that the smart architecture to achieve the lowest possible human intervention through the optimal recruitment of available technologies, Communication Techniques Automatic control systems can be controlled using a central computer that supports the ability of the building to integrate its various systems.

2) Virtualization:

The last period of the twentieth century witnessed a remarkable development in the relationship between the computer industry and the means of communication and the transfer of information [5]. This paved the way for the beginning of the digital revolution and the enormous potential offered by this revolution enabled the transformation of all forms of information into a digital model such as texts, graphics and multimedia. Through networking, which opened the door to reformulate life activities in the direction of the possibility of performance through the international network of information or local networks, which earned the smart housing the second attribute of the virtual and the transition to virtual reality.

3) Sustainability:

With the rise of global environmental problems and the declaration of architectural practices as one of the parties responsible for some of these problems and with increasing attention to the need to preserve natural resources emerged concepts of conservation and sustainability, to be adopted by many theorists in an attempt to link these concepts and characteristics of smart housing (automation and virtual) These are to achieve some progress in the field of integration between the characteristics of smart housing and the concepts of conservation and sustainability according to local conditions and data [6]. Based on this proposal, a number of architects considered sustainability as one of the pillars of architectural intelligence of the dwelling, In order to integrate it with the components of intelligent housing and an important feature of it, therefore, sustainability has been considered a major pillar on which the architectural intelligence of the dwelling and the purpose of the intelligent housing to achieve.

III. The Second Axis: Study the Role of Smart House in the Reduce of Energy Consumption and Achieve Sustainability

Increasing the awareness of the problem of shortage in energy resources and increasing attention to developments in this field led to the development of trends aimed at achieving energy efficiency, improving the thermal performance of buildings and reducing the energy consumed in it. In an attempt to achieve a conscious mix between concepts of trends in improving the thermal performance of buildings and building techniques There are five main aspects that are considered to be the most important aspects of energy consumption: location, external cover, internal spaces, systems and devices used, as well as building users themselves, which also have a role in reducing energy consumption and improve thermal performance, (fig 1)

The following is a review of the most important aspects of energy consumption in the building [7] :

A. First: Smart aspects of the building site:

These include intelligent selection of the building's location and orientation in the plot, intelligent formation of building blocks, intelligent site coordination elements surrounding the building, intelligent insurance of its boundaries and entrances. It is noted that these elements, except the latter, are not related to specific energy saving techniques, but depend on the designer's ability and skill in applying green architecture to improve the thermal performance of the building

B. Second: the smart aspects of the building cover

Include the smart materials used in its construction, the intelligent and tight insulation of its fixed and mobile sectors, the intelligent selection of locations, spaces and materials of exterior openings, the intelligent shading of its parts and the smart colors of its exterior.

C. Third: Smart aspects of building spaces and equipment:

Intelligent selection of spaces to achieve ventilation and natural lighting, intelligent selection of spaces, sizes and components of blanks, intelligent selection and control of openings and areas of openings and controls, smart brushes and intelligent interior sectors, which generally result in thermal comfort and thus eliminate or reduce reliance on HVAC systems To the least possible, thereby reducing the energy consumed in this area dispense with the general air conditioning systems in the building or reduce reliance on them.

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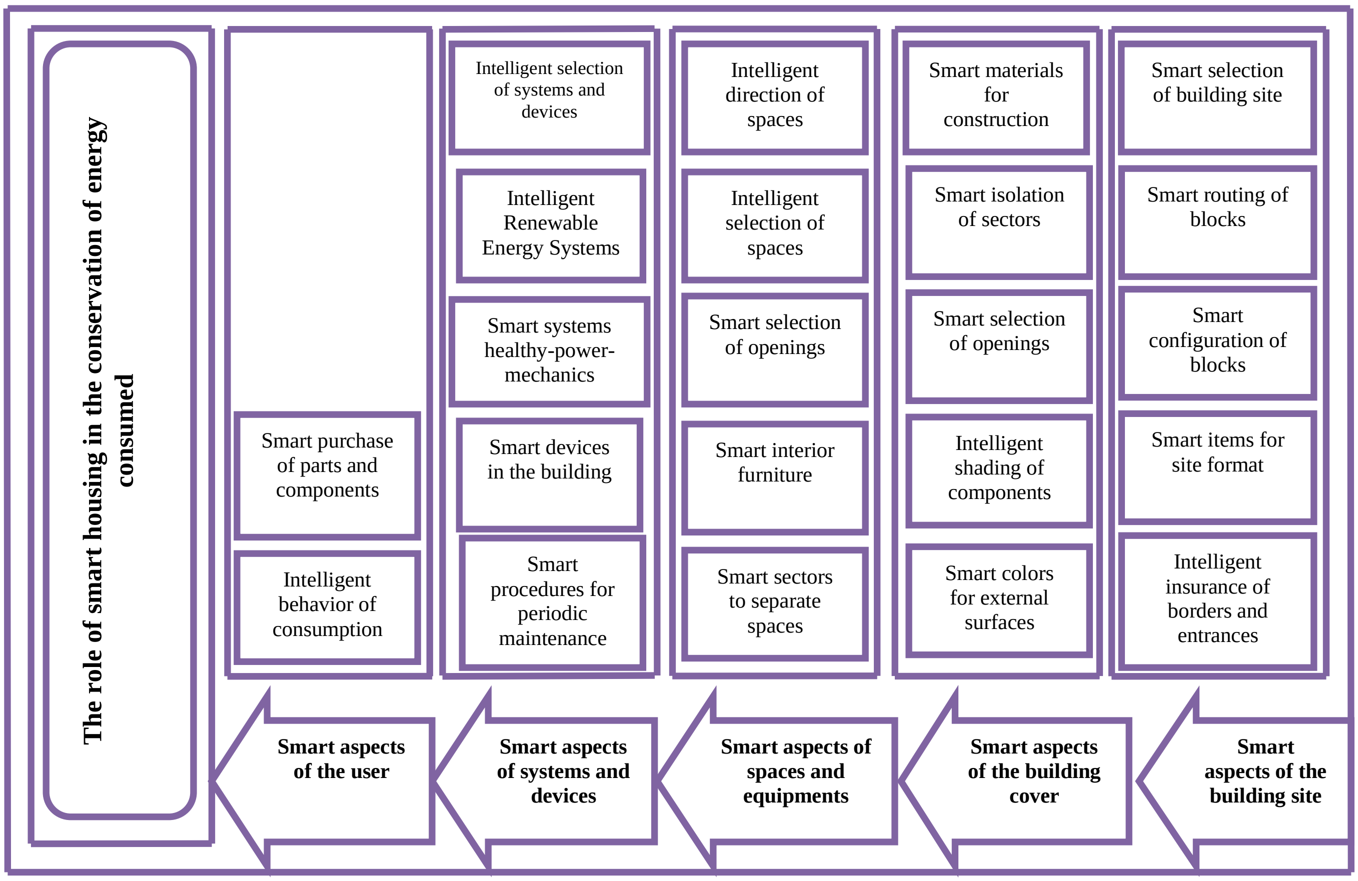

Figure (1): Explains the most important aspects affecting the provision of energy consumption in the smart building

D. Second: the smart aspects of the building cover

Include the smart materials used in its construction, the intelligent and tight insulation of its fixed and mobile sectors, the intelligent selection of locations, spaces and materials of exterior openings, the intelligent shading of its parts and the smart colors of its exterior.

E. Third: Smart aspects of building spaces and equipment:

Intelligent selection of spaces to achieve ventilation and natural lighting, intelligent selection of spaces, sizes and components of blanks, intelligent selection and control of openings and areas of openings and controls, smart brushes and intelligent interior sectors, which generally result in thermal comfort and thus eliminate or reduce reliance on HVAC systems to the least possible, thereby reducing the energy consumed in this area. Dispense with the general air conditioning systems in the building or reduce reliance on them.

F. Fourth: Smart aspects of building systems and devices

These include smart systems and devices supporting the performance of various home functions such as intelligent systems to provide renewable energy, adapting the interior spaces, saving water consumption, heating, smart devices for food preservation and preparation, washing and drying clothes and utensils, as well as smart procedures for the periodic maintenance of these systems and devices.

G. Fifth: Smart aspects of the user

It includes the habits and behavior of the use of energy resources in the building. It has also been referred to through the pilot project which aims to try to change these habits by informing the consumer of its cost. This approach can be developed by specifying a specific goal for the amount of energy consumed per building - daily or the energy consumed throughout the day with Tips on how to reduce this cost, weekly or monthly, according to the quality and level of the building and the use of smart meters through a central system - to send readings to the electricity companies through the Internet on the one hand and alert the owner in stages on the other hand when the consumption of the upper limit The user can thus change his or her habits and select prudent patterns in the consumption of different energy resources in the building.

IV. The Third Axis: An Analysis of a Variety of Different Models of Houses with General Intelligence in the Building

The selected models of the applied study are analyzed through several key points to facilitate the comparison of the selected models to arrive at specific results that can be evaluated and used in developing a set of criteria to assess the level of intelligence of the dwelling. These points are [8]:

A. About the Smart Home:

The name of the smart house, the name of the work team implementing the house, the location of implementation, the date of establishment of the smart house, and know the profile of the design idea of the house.

B. Architectural Description of the Smart Housing:

In which the different parts of the dwelling are explained in general, such as the distribution of architectural spaces in it, the total area of the dwelling, the horizontal projections and vertical sections of the house ... etc.

C. -The Features of Intelligence in Each Feature of the Smart Housing:

In which the features of the intelligence of different intelligent housing are determined by determining the availability of intelligence features for each of the characteristics of the smart home (Automation, Virtualization, Sustainability).

1) The first model: Heliotrop house

a) About the house:

TABLE (1)
SMART HOUSE: GREEN + WIRED

	**Heliotrop**	**Housing Name**
	Freiburg-Merzhausen Germany	*Site*
	Architect Engineer: Rolf Disch Structural Engineer: Andreas Wirth	*Staff*
	It was completed in 1994	*Implementation period*
This residence was named after the heliotropes because the architect Rolf Disch inspired his idea of the heliotrope flower that moves with the movement of the sun throughout the day. This building is attached to a small administrative office.		*Brief*

b) -Architectural description of Heliotrop housing:

The architectural idea of the house is to create a wood structure based on a central center axis, able to rotate around itself, (Fig2, Fig3) and is able to move with the sun throughout the day to take advantage of as much solar energy as possible (Fig5, Fig6). The house is designed by architect Rolf Disch and designed to be a private house. The building consists of two main parts, the first of which consists of the car garage, (Fig6, Fig7) the reception rooms and the engineer's office. The second part is built on the rotating axis of the building [9]. Ascending to the three roles, and above the ground floor entrance to another home allows direct access to the upper floors from the outside.

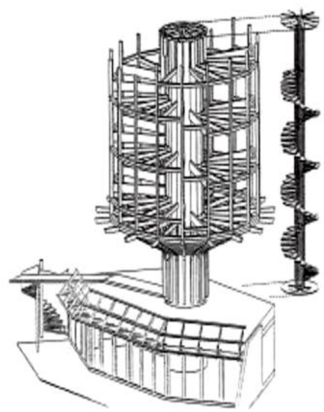

Fig (2): The wooden structure mediates a rotatable axis around itself

Fig (3):The wooden structure house at the time of execution

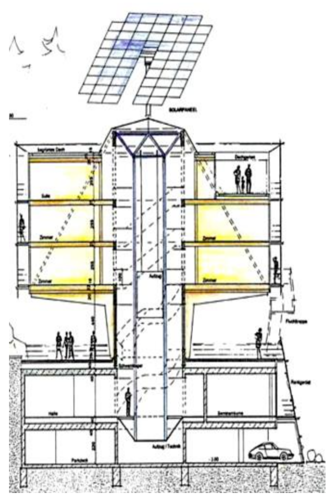

Figure (4): A sector that illustrates the design idea of the house

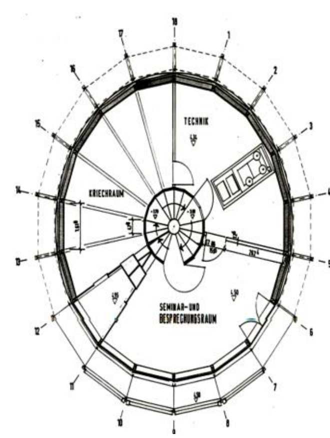

Fig. (5): The horizontal projection of the first stage

Figure (6): An external entrance that allows direct access to the upper floors

Figure (7): The main entrance of the dwelling in the ground floor

C) *the features of intelligence in every feature of the smart housing*

Automation

1- Self-acting

(Figure 8): Surface wind speed measuring device

vailability of building management system BMS:
All parts of the outer shell of the heliotrop residence relate to the BMS building management system.
As for the overall building movement, the computer responsible for the management and operation of the building is programmed to rotate the residential part around its axis every ten minutes according to a calculation that determines the movement of the sun throughout the day, according to the need of the house to the sun.
There are thermal sensors and wind speed measuring device in the surface of the dwelling, (fig8) and connected to the BMS to determine the external temperature and to know the extent of the need of the building to direct sunlight to feed the house, the data is sent to the BMS.

Ability to learn:
Hiliotrop residence has not reached the level of intelligence that allows it to change the state of the outer casing based on predicting future weather conditions or by using the data obtained by changing its state according to similar experiments in the past.

Ability to change:
The dwelling has the ability to change the characteristics of the external atmosphere according to climatic seasons throughout the year, and one day depending on the temperature of the atmosphere
In the summer, the house turns away from the sun, through the rotation of the house around its axis to the north-east and open the windows at night, which can keep the room temperature 25 degrees Celsius [10]

2-Remote control in building systems and technical equipments

Intelligent Control System:
There are two home control systems, the manual system and the wireless system, where there are manual operation keys in the rooms of the house, in addition to the presence of internal sensors for the rooms helps the computer in determining the input of the room in terms of heat and air.

Ability to provide user requirements:
For example, it may be desirable to rotate the dining room to face the vineyard during a gala dinner, or the building may need to be turned away from the sun when the residents are outside the dwelling and are used. Manually switch the computer to identify the spaces used, and keep the room temperature low.

Virtualization

Intelligent Communication System

Due to the relative height of the building, which was constructed in 1994, the Hiliotrop residence did not have the possibility of intelligent remote control, because the internet service was not spread at that time. Therefore, there is no communication system in the building from the outside.

Sustainability

1-Orientation Towards Serving Environmental Purposes and Achieving Community Objectives:

Figure (9): The external glass surfaces allow sunlight to pass into the dwelling with the movement of the building throughout the day

Self-regulation of solar energy:
Hiliotrop residence is one of the most important dwellings that embody the concept of sustainability and benefit from the self-system of solar energy in smart housing. The dwelling contains glass surfaces with the full outer surface area, (fig 9) which allows the direct sunlight to reach the interior spaces of the dwelling throughout the day. Rotate the house around itself and direct it toward the sun according to need (fig10, fig11).
The direct solar gain can be controlled by controlling the orientation of the building based on the state of the external climate [11].
All rooms are equipped with windows to take advantage of natural lighting and direct external view throughout the day through two types of glass, one covering the northern half of the dwelling with open glass, and the other covering the southern half of the dwelling, which consists of three layers of glass with cavities filled with material Krypton .

Figure (11): The rotation gear connected to the BMS system

Figure (10): The base of the rotary housing

Sustainability

Figure (12): Solar cells in the surface

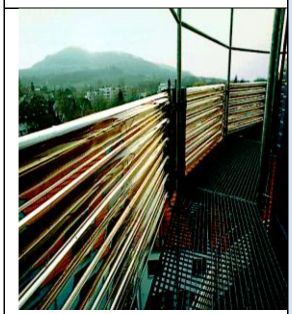

Figure (13): Water heating pipes surround the building as part of the circular terrace

Figure (14): Heat transfer pipes located in the middle of the inner ladder of the dwelling

Non - Solar Solar System:

Photographic acquisition

There is a matrix of solar cells on the surface, (fig. 12) of the dwelling, which converts the direct sunlight into electrical energy, which is placed on a rotating stand and the movement with the sun in the horizontal and vertical directions. This trace is done by the presence of a solar sensor in the middle of the matrix connected to the BMS of the dwelling. It is programmed to track the movement of the sun throughout the day, which works independently of the movement of the dwelling, allowing to take advantage of as much direct radiation as possible regardless of the direction of the house towards the sun.

Solar cells produce about five times the electricity needed to feed the house,(fig13) and any excess electricity is sold to state electricity companies at the same price as they were purchased.

Due to the large amount of energy required for the movement of the dwelling as a whole and its rotation around itself, the electricity that exceeds the needs of the internal dwelling is consumed in this movement.

Thermal acquisition

Assemblies of vacuum pipes installed on the perimeter of the circular railing of the surrounding terrace were installed to provide the necessary hot water for the dwelling throughout the year.

Solar hot water is stored in tanks on the lower floor by conveying it in pipes located in the middle of the inner ladder located in the middle of the dwelling(fig14).

2-Emphasis on the future dimension of architecture

Figure (15): Ventilation and heating in the roof of the spaces of the dwelling

Other Renewable Energies

In this dwelling, the underground heat energy was used to maintain the temperature of the water that was heated by passing through the empty tubes surrounding the house razors.

The heat of the ground was used to heat the internal spaces of the dwelling in the winter(fig15). The air passes through ventilation pipes through the ground tanks to the ventilation holes in the spaces of the dwelling.

2) The second model: Smart House: Green+Wire

a)- About the house:

TABLE (2)
SMART HOUSE: GREEN + WIRED

	**Smart House: Green + Wired**	**Housing Name**
	Museum of Science and Industry MSI Chicago city Illinois United States of America	*Site*
	Architect Engineer: Michelle Kaufmann	*Staff*
	May 2008 to January 2009	*Implementation period*
The Smart House: Green+Wired won the competition for the best environmental housing in the city of Chicago for the year 2009, as it was distinguished by the least consumption and waste of energy by measuring the amount of heat and electricity consumed inside and outside the house.		*Brief*

b)-*Architectural description of Smart House: Green+Wired:*

Michelle Kaufmann has built a model for a residence whose idea is to combine green architecture with smart technology. This model was put in front of the Museum of Science and Industry in Chicago, America, to become a shrine to encourage visitors to bring the idea of sustainability closer to modern technology(fig17).

The design concept of the house is based on intelligent design, the division of architectural elements and the good distribution of interior spaces, allowing for the good use of living spaces. Users feel widened without the need for a wide area of land.

The house was constructed using recycled materials and manufactured (e.g., wood sawdust, electrical wiring, vinyl, etc.) as a practical model of intelligent architecture that is concerned with the environmental aspect in selecting the building materials used (fig18, fig19). The structure of the house was constructed and then assembled and installed on site.

Smart House consists of two floors, the ground floor contains the main entrance, the living room (fig20, fig21), the dining room, the salon, the kitchen, the garage, the machine room and the side entrance.

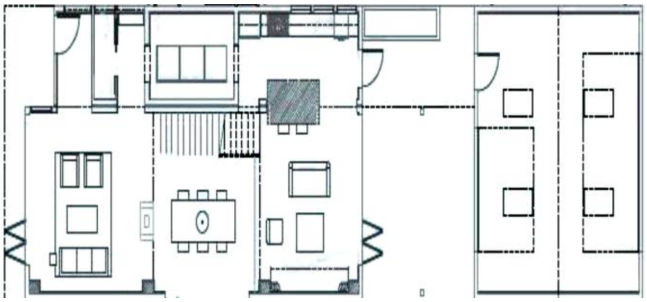

Figure (17): The plan of the ground floor

Figure (19): The external garage

Figure (18): The main entrance

Figure (20): The main bathroom

Figure (21): The main bedroom

1- Self-acting

(Figure 22): BMS Building Management System

(Figure 23): The main control screen in all elements of the building

vailability of building management system BMS

All parts of the Smart House: Green + Wired are connected to the BMS building management system(fig22).

The BMS management system controls all elements and features of the dwelling. It is connected to thermal sensors distributed throughout the dwelling to automatically control the internal temperature to reach the best thermal comfort without interference from the occupants in the dwelling(fig23).

The BMS is also connected to the heating and cooling system in the dwelling where it reaches the appropriate temperature in summer and winter only in the spaces used.

Automation

Ability to learn:

Hiliotrop residence has not reached the level of intelligence that allows it to change the state of the outer casing based on predicting future weather conditions or by using the data obtained by changing its state according to similar experiments in the past.

Ability to change:

The ability of the smart house to change is limited to the control of window blinds in different spaces, so that they can be opened and closed by programmed at certain times.

For external conflicts, they are opened and closed manually, because they are not connected to the BMS building management system or any electronic system

2-Remote control in building systems and technical equipments

Intelligent Control System:

The house has intelligent control in all its functions. Intelligent controls are spread throughout the house. There are control screens in the living room TV and bedroom control, and the temperature of the living spaces inside the house can be controlled.

Ability to provide user requirements:

The dwelling has the ability to meet the needs of its users, where the user has the ability to manage the sun breakers manually, and may need residents in the house to install solar cells and stop movement with the movement of the sun in the absence of the presence in the dwelling for long periods, because the need to obtain high electrical energy are not In need of and rest movement motors responsible for the rotation of solar cells around the building.

Intelligent Communication System

The house has the ability to control all its functions through the connection of the BMS system to the Internet, which allows the connection of the house to the mobile phone, which facilitates the control of the functions from inside and outside the dwelling.

The intelligent communication system can control the temperature of the living spaces from the outside, and inform the BMS that the occupants are approaching the house to operate the air conditioning and heating system and prepare the dwelling based on external data at that time.

The elements of the dwelling can also be controlled wirelessly by mobile phone or IPod (fig24).

Figure (24): IPod device connected to all elements of the dwelling

Smart controls are also available in all parts of the house. There are control screens in the living room TV, a bedroom control, or even a bathroom mirror equipped with internet connection, (fig. 25) which displays the outside weather every morning and the traffic situation in the streets.

Figure (25): The mirror in the main bathroom is connected to the Internet

Virtualization

1-Orientation towards serving environmental purposes and achieving community objectives:

Sustainability

Figure (26): Spread of glass surfaces in upper floors

Self-regulation of solar energy:
The dwelling contains large outdoor glass surfaces that allow direct sunlight to reach the interior of the dwelling, which provides natural heating in the winter, as well as providing natural lighting for the dwelling throughout the day.
The amount of lighting entering the dwelling can be controlled by the ability to control the external solar flares in front of the large surface areas of the windows in the ground floor(fig28), reducing the solar radiation entering the spaces of the dwelling in the summer. In the upper floors, the solar radiation is controlled by controlling the internal curtains. (fig. 26), There are also celestial openings above the garage to take advantage of the sun in the lighting and heating(fig27).

Figure (27): The upper openings above the garage

Figure (28): Glass surfaces in the ground floor

Sustainability

Figure (29): Use of photoelectric surfaces In the house to generate clean electricity

Non - Solar Solar System:
Photographic acquisition:
Thin-film mural solar cells are used in surface cladding to generate electricity from the sun's rays and to meet the energy needs of the dwelling. Solar cells are connected to the BMS system to determine the difference in energy generated by the solar cells and the internal consumption of the users, so that the use of government electricity coming from abroad in the case of the amount of energy stored from solar cells. (fig. 29).
Thermal acquisition
Assemblies of vacuum pipes installed on the perimeter of the circular railing of the surrounding terrace were installed to provide the necessary hot water for the dwelling throughout the year.
Solar hot water is stored in tanks on the lower floor by conveying it in pipes located in the middle of the inner ladder located in the middle of the dwelling.

2-Emphasis on the future dimension of architecture

Figure (30): Wind fans producing electricity

Other Renewable Energies

Wind power is generated by wind fans in the garden of the dwelling to increase electricity, (fig. 30) output to meet the needs of the dwelling.

Wind power fans are not part of the house but rather a separate part that operates independently of the dwelling.

Figure (31): Use of green surfaces Tired of rainwater

Rain water is collected and collected so that it is filtered for use after it is safe to drink. The water used in the dwelling, such as gray water from the bathroom sink, basins and washing machine, passes through a series of biological filters available outside the dwelling, use in planting the garden surface of the dwelling or garden outside the dwelling(fig31), or re-pumped into the toilet, is not suitable for drinking.

V. Design Criteria Guide for Assessing Housing Intelligence:

After extracting the most important points that describe the design criteria for assessing the intelligence level of the dwelling, these points were put in a practical guide that contributes to facilitating the design process of the architect when designing a smart dwelling, Table (3), or when assessing the intelligence level of this dwelling, as follows:

TABLE (3)
A GUIDE TO ASSESSING THE INTELLIGENCE LEVEL OF THE DWELLING

Design criteria for smart housing	
BMS Housing Management System	1-The existence of the building management system BMS, which controls the elements of the building
	2-BMS controls the natural and industrial lighting inside the dwelling
	3- Control BMS in the heat (heating and cooling) natural
	4-Control BMS in renewable energy sources
	5-Control the BMS in all elements of the dwelling
Ability to learn	6-capacity of the dwelling on self-knowledge using heat sensors and meteorological data
	7-the ability of the house to predict the external weather situation based on future expectations, and self-decision
Ability to change	8-the ability of the house to change its status and form based on a prior order from the user
	9-the ability of the house to change its shape and status automatically
Intelligent Control System	10-Availability of a wireless control system from inside the dwelling on the elements of the outer cover
Ability to provide user requirements	11-the ability of the house to accept new orders to the user is illogical, based on his desire to do so
Intelligent Communication System	12-Connect the BMS system to the Internet to obtain expected climate data throughout the day
	13-Connect the BMS system to the Internet and allow control of the elements of the dwelling using a mobile phone or the Internet from anywhere outside the home
Self-regulation of solar energy	14-Availability of one of the solar systems in the house
	15-Control the amount of energy exchanged between the inside and outside by controlling the external cover elements of the dwelling
	16-Integrating the self-system with one of the elements of the outer envelope
Non - Solar Solar System	17-Availability of one of the non-solar systems in the house
	18-follow the system of self-movement of the sun
	19-Integrating the non-self-system with one of the elements of the dwelling
Other Renewable Energies	20- benefit from one of the sources of renewable energy and other integration with one of the elements of the house
The degree of overall intelligence assessment of the dwelling percentage	

VI. RESULTS

1. The most important measurement points that determine the design criteria for evaluating the intelligence of the dwelling were:
   - The existence of the building management system BMS, which controls the elements of the building.
   - BMS controls the natural and industrial lighting inside the dwelling.
   - Control BMS in the heat (heating and cooling) natural.
   - Control BMS in renewable energy sources.
   - Control BMS in all elements of the house
   - Ability of the dwelling to self-knowledge using heat sensors and meteorological data.
   - The ability of the house to predict the external weather situation based on future expectations, and make the decision self.
   - The ability of the house to change its status and form based on a prior order from the user.
   - The ability of the house to change its shape and status automatically.
   - A wireless control system is available from inside the dwelling on the external cover elements.
   - The ability of the house to accept new orders to the user is illogical based on his desire to do so
   - Connect the BMS system to the Internet to obtain expected climate data throughout the day.
   - Connect the BMS system to the Internet and allow control of the elements of the dwelling using a mobile phone or the Internet from anywhere outside the home.
   - Availability of one of the solar systems in the house.
   - Control the amount of energy exchanged between the inside and outside by controlling the external cover elements of the dwelling.
   - Integrating the self-system with one of the elements of the outer envelope.
   - Availability of one of the non-solar systems in the house.
   - follow the system of self-movement of the sun.
   - Integrating the non-self-system with one of the elements of the dwelling.
   - Benefit from one of the sources of renewable energy and other integration with one of the elements of the house.
2. In the design of smart housing with high intelligence must be applied both automation and virtual housing in the framework of sustainability and environmental friendliness, followed by the application of the proposed design criteria

VII. RECOMMENDATIONS

This research is recommended:

1. The issue of housing adequacy should not be seen as the possibility of housing at the lowest possible cost and only, but it extends to life activities within the dwelling, as well as its compatibility with the environment, its ability to meet the needs of its continuing users within the limits of their material potential and desires, Consumption and maintenance.
2. Emphasize that the smart housing if it is today a kind of luxury, it is today a requirement for the necessary benefits of many and appropriate for all age groups (elderly - sick - disabled).
3. Directing scientific research towards comprehensive studies of the real experiences of smart homes and the extent of their impact on the different aspects (economic, social, psychological and environmental) of the family life.
4. Re-imagining the academic projects and their general political orientations for the purposes of architecture and architecture in architecture in architecture, given the huge number of opportunities it presents, as well as its ability to architecture and urbanism, including liberating the process.
5. It is necessary to carry out a series of specialized studies in the fields that support the realization of the concepts of smart architecture, such as the fields of building sciences, computer science and their architectural applications.
6. The need to expand the base of participation and the expansion of the team in charge of architectural work to include specialists in technical equipment, connections, automation systems, program and site designers, to work alongside the traditional practitioners of the profession: such as the architect, construction, plumbing, electrical and other specialists, under the supervision and direction of the architect, given the complexity of architectural practice in The light of these smart architecture and the requirements of its multiplicity.

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Title Arabic:

" المسكن الذكي كمدخل لتطبيق التطور التكنولوجي وترشيد استهلاك الطاقة في المباني وتحقيق الاستدامة"

Arabic Abstract:

كانت العمارة ولا تزال هي المرآة التي تعكس حضارة الشعوب على مر العصور، وهو ما يحدث الآن في مجال العمارة العالمية فهو تحول في الفكر العام ككل، حيث أن العصر الذي نعيش فيه الآن هو بلا شك العصر الحديث وعصر التكنولوجيا وثورة المعلومات ولقد انعكست هذه الصورة على الأبنية وفرضت نفسها وظهرت فكرة الأنظمة الذكية والمباني الذكية كاستجابة تلقائية من العمارة للتطور العلمي والتكنولوجي.

ويعتبر المسكن عموما وعلى عكس الانطباع السائد من نوعيات المباني المعقدة مقارنة بباقي أنماط المباني الأخرى ، فمن جهة تمثل المساكن النسبة الغالبة من أنماط الاستخدامات المختلفة فى أى مدينة ، كما أنها من جهة أخرى من نوعيات المباني التى غالبا ما تكون مستخدمة على مدار اليوم بخلاف الانماط الأخرى التى تستخدم في أوقات محددة فقط ، وإذا أخذنا فى الاعتبار أن المسكن الذكى يمثل أحد الاتجاهات الواعدة التى لم يتم بعد إستكشاف كافة الإمكانيات الممكنة فى مجالها والتى يمكن أن تعمل على توفير نمط معيشي مناسب ومتميز من جوانب ونواحي متعددة وتحقق فى الوقت نفسه الاقتصاد فى تكلفة التشغيل ، فإن أهمية هذا البحث تكمن فى أن تطوير هذا الاتجاه بالصورة المأمولة يخدم الساكن نفسه بتوفير النمط المعيشي المناسب والاقتصاد فى تكلفة تشغيله ، كما يخدم المالك من جهة أخرى بزيادة القيمة المضافة لمثل هذه المساكن ، ومن جهة ثالثة فانه يخدم البيئة التى تقام فيها هذه المساكن بتميزها بخصائص الاستدامة ، كما يمتد تأثيره على الدولة من جهة رابعة بالتأثير الإيجابي على تقليل استنزاف الموارد العامة للطاقة بالدولة ، وإمكانية توجيه الوفر الناتج فى محاور تنموية أخرى.

وتتمثل إشكالية هذه الدراسة في إغفال تأثير تلك الثورة على بنية المسكن وطريقة بنائه وطريقة حياة الناس فيه، أثناء التفكير في الوسائل والعوامل التي تؤثر على تصميمه والبحث عن الملائمة فيه واعتبار تقنيات المساكن الذكية نوعاً من الترفيه أو مما يقع خارج نطاق الواقع الملموس، رغم أن هذه المساكن آخذه في الانتشار مع ما حققته من فوائد كبيرة في ملائمة الحياة داخلها بجانب قدرتها على التوفير في تكلفة التشغيل والصيانة، بجانب ما ينتظرها من تطورات مستقبلية ورخص في التكلفة.

تم تحديد إطار عمل للبحث من ثلاثة محاور. الأول دراسة لمجموعة المفاهيم المتعلقة بالعمارة والمنزل الذكي والاستدامة، والمحور الثاني: دراسة دور المنزل الذكي في تقليل استهلاك الطاقة وتحقيق الاستدامة والملاءمة والتفكير في تنمية المجتمع، المحور الثالث.: تحليل مجموعة متنوعة من نماذج المنازل المختلفة بذكاء عام في المبنى وقياس الجوانب الذكية ومدى انعكاسها على خصائص المنزل للوصول إلى نتائج محددة يمكن تقييمها واستخدامها في تطوير مجموعة من المعايير لتقييم مستوى ذكاء الإسكان.