MULTIFUNCTIONAL FURNITURE AND ITS IMPACT IN RESIDENTIAL BUILDINGS WITH LIMITED SPACE

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Abstract

One of the problems of today's life is the limited living spaces and the way furniture is used in them, and the reasons for this are changes at multiple levels, including family size, age groups and income levels. Therefore, an engineer who designs furniture must think about a design that is more flexible and useful, cheaper and more efficient.
Hence, the idea of smart furniture has come to meet human needs within architectural spaces with limited spaces without resorting to changing the size of the space or space.
Furniture design is an ideal solution to meet the changing needs of the inhabitants of these spaces and is compatible with their culture and customs. Modern technology for designing furniture and housing has created several solutions including what is known as the computer home, the digital home and the interactive home, making pieces of furniture more flexible and useful, as they take up less space than the limited free space and perform more than one function for the users of these spaces.
The idea of smart furniture that interacts with everything around it has emerged to meet the necessary and changing human needs in terms of function, use, space or spatial arrangement through the use of geometric shapes that are easy to shape and understand, far from extravagance and complexity in spaces and decorations, using materials and raw materials that help achieve the goals needed to solve the problem of limited space.

Keywords: *furniture/design/function/limited spaces .*

1 INTRODUCTION

Development, population growth and increasing demand for housing and housing care, have led to the emergence of several variables in the design of housing projects, some of which are compatible with meeting humanitarian needs, and in some there are shortcomings in meeting human needs in the long term, in accordance with the continuous change of daily and functional needs.

One of the forms of this lack of long-term satisfaction of needs has clearly emerged in the limited living spaces. With the development of age groups and changing life circumstances, several design ideas have emerged to solve these problems in order to make these limited spaces more flexible and useful with the presence of smart and interactive furniture.

Research Problem:- Failure to meet changing human needs within limited spaces using traditional furniture design ideas.

Research Significance: The emergence of the problem of insufficient satisfaction of changing human needs clearly requires pause, reflection and finding innovative and advanced solutions to the problems found in architectural design, such as limited space housing units, which nowadays represent the majority, due to high construction costs, land prices and increasing human growth.

Research Objective: To keep pace with the development of smart furniture design and the solutions it provides for the problems of limited space housing.

Research Hypothesis: By developing the use of flexible and multifunctional smart furniture design, changing human needs in limited accommodation can be satisfied

Research Methodology: Descriptive and analytical approach, which describes and analyses models of smart furniture units in order to arrive at smooth and easy design ideas that work to achieve benefits and functionality as needed.

1 - The concept of housing:

A home is a space in which human relationships prevail, ensures the cohesion and progress of the family and in which each individual builds himself and his being.

1.1 - Human needs in the home

The basic needs necessary for a human being to live a life that is different from all other creatures are divided into:

A - Physiological needs

It refers to the way in which physiological activities are carried out and distributed within the housing unit and refers to the following:

* The nature of the activity is related to the instinctive activities of the person and the time it is carried out, such as sleeping, eating, hygiene, etc.

* The way in which activities are distributed refers to the efficiency of coordinating activities and accommodation according to the wishes of the user.

B - Biological needs:

It means the availability of suitable climatic conditions for achieving physiological comfort, which requires the control of all climatic, audio and visual influences in order to create spaces that give a sense of comfort when engaging in different activities.

C - Psychological needs

They refer to a person's psychological makeup, such as feeling of security, confinement and privacy, the need for social communication and friendship formation, the sense of spaciousness and spaciousness of the place and overall reasons of aesthetic, sensory and psychological pleasure represented in the place of residence and surroundings.

D - social needs

They are related to the changes brought by the data of the contemporary cultural reality, considering the change in the style of a complex family to a simple family, which led to a difference in the characteristics and forms of functions in all elements of housing, regardless of their expressive patterns.

A person's comfort in any environment depends on how well social needs are satisfied and satisfied.

1.2 - Classification of living spaces

Living spaces can be classified into two basic types:

* **Traditional space**, which is a space that has been the focus of human life since the emergence of human societies, and its efficiency and significance are related to the culture and behavior of its user.

* **Smart vacuum**, a modern concept that has been achieved only in the light of modern information technologies. It increases in breadth and breadth with the growth of the information environment and is associated with the high level of technology and the productive and creative efficiency of society.

1.3 - Components of living space

Living space can be divided according to human needs within the apartment through Table No. (1).

Types of voids	**Instinctive (fixed) needs**	**Changing needs**
Space intended for carrying out activities	Receiving guests Relaxation (life)- dining	TV and a corner for watching satellite, or using the Internet. Personal space
Space with special purposes	Kitchen (food preparation) Bathroom (for physiological needs)	
Space for fixed objects	Master bedroom Children's bedroom	
Space for movement	Hallways for movement-entrance	

Table No. (1) shows the components of living space according to the basic and changing needs of the person in the apartment.

1.4 - The relationship of furniture to the performance of activities within the living space:

The relationship between man and furniture units is a close relationship that in most places reaches an organic relationship through its proportions and average lengths during walking, sitting, sleeping and eating. On the other hand, a person's judgment about furniture and the distances between it and between them depends on his awareness of proportions. Proportions are what determine the relationships of things in relation to each other on the one hand, and their relationship to the person on the other hand, it is considered a unit of measurement in itself.

It is worth noting that in the early 1970s, designer Joe Colombo developed his primitive model for a small kitchen by designing a comprehensive unit characterized by dynamic features that are compatible with the lifestyle of the occupants, as in *image no. (1)* and the shape of the space can be transformed with the simple push of a button into suitable surfaces for eating, storing and doing work from different heights and places. The vacuum also supports the performance of multiple life functions while changing the nature of the vacuum form.

Image no. (1) shows a model of a comprehensive furniture unit by Joe Colombo

So, the main advantage of this unit is the ability to get more functions in a limited area.

In 2006, Hong Kong architect Gary Chaey designed a new model for the concept of small apartments and managed to create this apartment, which has an area of 32 m^2, has 24 m^2 of room space, and within the walls there is a kitchen, library, laundry and dressing room, a living room with a hammock, a fenced dining room and a bar for mixing drinks, as in *image no. (2)*

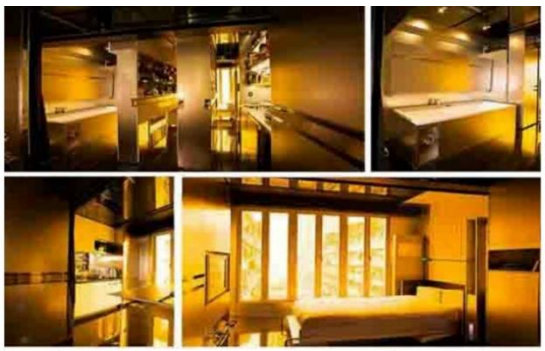

Image no. (2) shows a model of a residential unit by Hong Kong designer Gary Chaey, showing its different state according to the different positions of the movable wall units which allow for versatility of use in different situations .

Perhaps the widespread use of storage systems in contemporary interior design makes the system seem like an innovation for modern design, but the idea of showing or hiding internal components has been implemented in practice since the fifteenth century, when the implementation began with pieces of furniture that hang, bend, push and pull, gradually moving to architectural elements such as walls, ceilings and stairs to manipulate the volume

of the interior space, and with the development of technology, the storage system in the twenty-first century is often implemented in an aerodynamic way, arranged within existing architectural elements with an emphasis on concealment and reducing the possibility of the appearance of devices in order to preserve the view.

Therefore, we believe that this smart system opens up space for the exploitation of a larger number of furniture units, which eliminates the need for floor space and sacrificing the basic components of the space. Also, hiding traces of daily activities provides spatial space in our modern times, which witness population growth and are characterized by an accelerated pace of life.

2 THE CONCEPT OF AN INTELLIGENT SYSTEM

An intelligent system depends on the presence of a mainframe whose functions are similar to the human brain and is connected to an integrated network similar to the human nervous system called artificial neural networks. The branches of this network extend into space, and consist of a group of sensors and mechanical actuators. The actuators become an integral component of its system, which is responsible for acting and reacting in a predictable manner to any external variables in a way that ultimately resembles a pattern of vital functions. Ultimately, the human body is an ideal model or intelligent system at its best" possible images, present in the technical equipment that makes up interactive systems.

2.1 - Characteristics and properties of a smart system:-

A - Immediacy, responding to a stimulus in real time.

B - Ability to respond multiple times, as it responds to multiple environmental conditions at the same time.

C - Self-acting: where the system can act on its own.

D - The ability to direct the response occurs at the location that was exposed to the stimulus.

E - The ability to select a response is discrete and predictable.

2.2 - Characteristics of the Smart System:

1 - Saving energy by using renewable energy alternatives such as sun and wind (sustainability).

2 - Regulating the temperature to achieve thermal comfort.

3 - Automatically controlling the opening and closing of windows during the day and night, so that the curtains automatically fall.

4 - Achieving security through video surveillance.

5 - Reducing the size of the space inside the apartment due to the connection and reduction of the size of some devices.

6 - Smart materials are developing every day and modern materials that interact with people and their requirements appear.

Smart materials, such as the use of glass that achieves visibility from certain angles and prevents it from other angles, contribute to solving the problem of loss of privacy.

2.3 - Disadvantages of the smart system:-

A - The cost is currently high compared to the average income

B - The possibility of a circuit breaker failure.

C - The problem of living in an environment of electromagnetic and radio waves that are harmful to humans.

D - The idea of integration between different systems requires many meetings and studies
between an integrated working team specialized in different systems, in addition to the cost of putting these systems into one system is BAS.

F - The cost of converting a traditional building into a smart building capable of housing advanced systems, which is much higher than the cost of the building.

3 SMART HOME

It is a dwelling equipped with a technical method that has the ability to think, in order to changed its behaviour according to the needs of the occupants and adapted to external conditions, i.e. the ability to program the house electronically with a set of housing options that allow its various components to adapt and act according to the appropriate conditions and pre-known variables.

The philosophy of interior design of contemporary spaces depends on several points that can be summarized as follows:

* The ability of these spaces to adapt to the variables around them and change the traditional concept of spatial arrangement (multiple use of one space) at an economical cost, so that the same space can be used for many different activities, and this is achieved through the possibility of changes and movement between the units that make up the space.

* By using woven and flexible furniture that can be developed according to the changing needs of the user.

Interior spaces are no longer divided into specific spaces using traditional materials as was the practice in the past, but rather strive to achieve the highest degree of flexibility and adaptation to future and technological changes by using smart furniture of various shapes and designs.

4 SMART FURNITURE

It is a woman who primarily responds to modern life demands that are affected by changing social and economic transformations. She works to find more innovative solutions to provide a set of functions to the user within the space using modern technological methods.

CNC programmed intelligent furniture is divided into:

A- Digital Furniture
B- Interactive Furniture
C- Future Furniture

4.1 - Digital Furniture:

It is a new device characterized by the presence of smart electronic equipment. Its origin is another dimension of performance that was not expected to be achieved, which led to an increase in its cognitive and perceptual capabilities to meet the needs of the user. Computer applications have also allowed the rediscovery of the function which performs, such as the multi-purpose smart sofa Q4

Multi-purpose Smart Clutter Q4

It is a sofa that contains wires that are compatible with smart home electronics, and consists of four square-shaped seats, identical in surface area, so that they can be arranged as desired to obtain multiple functions. This means that the sofa can be assembled for a traditional seating arrangement, or it can become like a chaise longue or a unit for work or play.

Smart sofa equipment 04:

* One of the office chairs is backless and has a power cord, which allows it to be connected to a mains power source.
* The buttons on the base of the printer are actually magnetized holes that allow the connection of various types of devices.
* The armrests are hollow inside so that music players can be placed and controlled from the side of the armrests.
* It contains a projector and a lighting unit placed on the attached table.

Image no. (3) shows the Q4 sofa used as a double bed, suitable for sleeping and leisure activities at the same time.
Image no. (4) shows some of the equipment included in Q4

4.2 - Interactive furniture:

This robot communicates with people to become an integral part of technological society and is able to provide practical solutions with the ability to respond to interconnected variables. Interactive furniture is divided into fixed interactive furniture and mobile interactive furniture.

4.2.1 - Fixed Reactive Bed (Somnos):

It is now the most advanced bed in the world. It uses high technology and beautiful design to combine comfort, entertainment and interaction with the modernity of the present era. This bed has attracted the interest of many people, such as the "Yotel" hotel chain in the United Kingdom, as shown in *Image no. (5).*

The bed is equipped with the following accessories:

* Advanced motorized curtain unit that can connect to the Internet via Wi-Fi
* HD video projector, a movable cinema screen that can be pulled out to play video and digital content.
* An under-mattress audio system connected to 4 speakers and a subwoofer, and a programmable LED lighting system under the bed, in addition to a reading lamp, with the ability to control the intensity of the lighting.
* RFID smart card reader, to identify the owner's identity to retrieve his data, in addition to the ability to work, favourite music and the ability to wake people up for meetings and notify them of changes.
* The ability to adjust the position of the mattress and adjust its angles to suit different positions for sitting, sleeping, relaxing, etc.

Image no. (5) shows the "INTERACTIVE BED SOMNUS-NEU"

4.2.2 - The mobile interactive bed

It is a smart bed that is used at night when necessary, and can be converted into a ceiling when not in use, as the bed is raised to the top, relying on a hydraulic system that moves the bed up and down in balance until it is fixed in the desired position, as in *Image no. (6).*

It is also equipped with interactive lighting units that recognize sleep time and different levels of lighting depending on the environment, the required activity in the space, which gives flexibility in using the space in multiple functions to achieve optimal space exploitation.

Image no. (6) shows the mobile bed during use and when not in use

4.3 - Furniture of the Future :

It uses the latest digital technologies to improve the quality of the functional performance of the user by introducing new standards in the concept of activity, making the user feel more comfortable and luxurious than before.

4.3.1 - Bedroom of the Future

Bina Living has designed a bedroom of the future that includes an interactive mirror, smart windows, a wardrobe that displays its contents through an interactive mirror, and a high-tech bed equipped with numerous sensors to achieve user comfort, as shown in *Image no. (7).*

Image no. (7) shows the components of the bedroom of the future, including an interactive bed, smart pillows, and an interactive mirror,

The bedroom of the future consists of:

* an interactive mirror equipped with multiple sensors to set the optimal body temperature and raise an alarm in case of emergency, and lightweight smart pillows equipped with special technology that makes them glow when the user wakes up.

An interactive woman displays the contents of the wardrobe, and clothes can be selected using special technology by selecting based on weather changes.

* Smart windows, which are also television screens through which one can know the time and browse the Internet and social media accounts.

4.3.2 - Robotic furniture "Rumions"

In an idea that aims to transform pieces of furniture into others as needed or move them to make room for people as they pass through the room. Spherical self-configuring robots can disassemble and reassemble by themselves

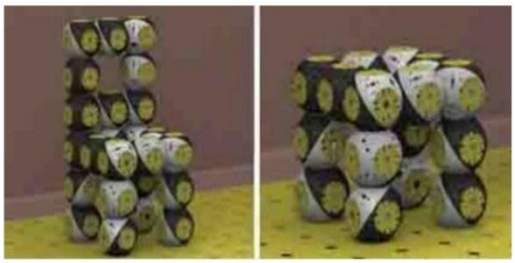

Image no. (8) shows a group of spherical robots assembled to form different pieces of furniture.

The design consists of two cube-shaped units. The cubes are held together, contain a battery and three motors for movement in addition to the wireless communication function, as shown in *Image no. (8).*
In addition to containing cameras to track the user, and a voice recognition tool so that the person can give instructions, the movement of the furniture becomes more flexible with less human intervention. The importance of the design lies in the fact that if the type of furniture is not used for a certain period of time, it can then be disassembled and assembled in a specific place to save space inside the room.

5 THE IMPACT OF USING SMART FURNITURE ON THE DESIGN OF A LIMITED SPACE HOUSING UNIT

1- Area: 250m
2- Multifunctional vacuum cleaner type.
3- Description of the residential unit of your property: Multifunctional for more than one activity, different at different times or at the same time

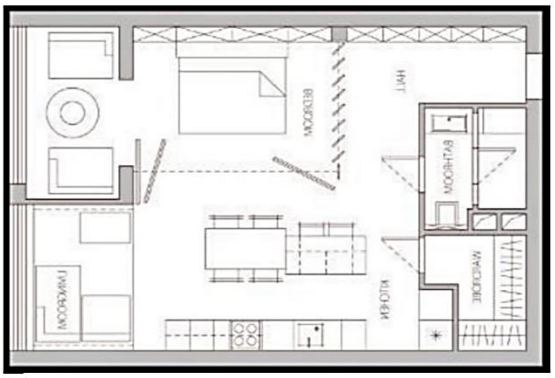

Image no. (9) Schematic diagram showing the horizontal layout of the housing unit
** The main sleeping area is combined with a vacuum*
** Attached vacuum for changing and storing clothes*
** Kitchen vacuum is combined with a food vacuum*
** Bathroom vacuum*

5.1 - Design idea:

A - The use of glass partitions equipped with modern technologies that contain sensors and mechanical actuators to separate the spaces, behind which the sleeping area is hidden during the day, so that the remaining space becomes a seat for sitting, and at night the bed is used as a place to sleep. Performing two different activities at different times.

B - Using digital technology on the shelves of the wall library in the living space to find out the latest news using the "RSS" function.

C - Using chromocarpy glass technology, which changes its degree of transparency directly when exposed to an electric field according to needs. The user is inside the space, as in Figure No. (10).

D - Using a smoke detection cell and an early warning unit to achieve security.

E- Possibility of using a vacuum for night sleep:

* Availability of a double bed unit with two side units attached for storage purposes Availability of a dressing room connected to the bedroom, which contains a wardrobe hidden inside it.

F - the possibility of using the living space during the day through two spaces available next to it. Two separate chairs that can be combined into a library in the shape of the letter L .

* The rear cover of the seating area was used to create a wall-mounted library for storing books, equipped with direct lighting units to achieve optical comfort for the user, as in *Image no. (10).*

Image no. (10) shows glass partitions that change the degree of transparency as needed. The sleeping space is transformed into a living space and the library's independence to store books.

G - Providing a central kitchen unit to increase storage capacity, in addition to the possibility of using its surface for eating and a quick meal sufficient for two people.

H - Providing an additional movable surface (dining table) attached to the central kitchen unit, sufficient for four people to fit the dimensions of the ergonomic food space.

I - Using the space to perform more than one activity at the same time, as in *Image no. (11).*

Image no. (11) shows the merging of the dining room and kitchen into one space using storage units that can be removed and added.

* Using a sliding glass partition to separate sleeping and eating activities in the same space.

* Using a rotating wooden partition to separate the sleeping or living area from the entrance area.

* Hide the space intended for clothes by using doors in the colour of the walls

* The possibility of increasing wall storage units by taking advantage of the wall of the entrance area behind the main door of the residential unit.

Research Results :

1 - The concept of thinking based on acquiring large and spacious areas in order to meet the needs and follow the desires of the user has changed, as the areas of the space can be saved by acquiring small areas that meet the needs of life and provide all kinds of luxuries for the user through smart home technology.

2 - The components of the dwelling are renewed through spaces that require practicing sufficient amount of activities

inside the apartment to ensure that the user achieves comfort and provides privacy and security.

3 - The necessity of studying all basic and changing human needs in order to arrive at realistic design results and radical solutions that allow us to have access to the most suitable housing for the occupants.

4 - Technology and the digital revolution have greatly influenced architectural thought, leading to a change in the concept of interior space from fixed to mobile elements that can adapt to many activities that are carried out in the space.

5 - Smart buildings are generally considered to have a higher cost than traditional buildings, but this increased cost also gives an increase in the return of what is expected from the project due to the high value of the facility.

6 - The use of smart home technology is not only a luxury, but it brings comfort and safety to users, and conserves energy using advanced management systems that allow the user to manage consumption costs during the day.

7 - The greater the user's contact with technological systems, the greater his desire to own this technology and try to apply it in his residential environment due to the numerous advantages it offers and which help to satisfy his maximum needs.

8 - Intelligent design aims to follow the user's actions and desires in order to be able to form automatic responses to achieve those desires. Easy and practical, which saves time and effort.

9 - The smart unit contains special electronic equipment, including sensors and mechanical actuators, which achieve innovative uses that were not previously known, which adds creative aesthetic value to these elements.

10- The use of multifunctional built-in furniture is one of the most important elements that helps users meet their future needs and satisfy their desires permanently and continuously.

Research recommendations:

1 - The necessity of turning to the use of digital technology and artificial intelligence in the interior design and furniture of homes with limited space, thus solving all the problems that the residents of these homes may face.

2 - Interest in studying everything related to limited spaces, because they are one of the biggest problems facing society today.

3 - The economic aspect of smart technology must be studied and it is necessary to come up with scientific solutions that reduce the costs of its implementation.

4 - The instrument designer must be familiar with modern technology because it is considered an important design tool. It helps solve many design and implementation problems that both the designer and the user may face.

5 - The importance of spreading culture and technological awareness in our society to learn how is to be used and developed through scientific research and experiments

for a technology that is compatible with the environment and carries our identity.

6 - It is necessary to limit the acquisition of housing with large areas, which represent a burden for the user on the one hand and for the state on the other.

Expensive areas exhaust the possibilities of land exploitation, which leads to increased opportunities for competition among buyers, and therefore an increase in the price of these lands.

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