

The impact of smart furniture design on meeting the needs of a limited-space housing

Prof. Ali Mohamed Senosy Mohamed

Professor at Interior Design & Furniture Department – Faculty of Applied Arts – Helwan University

Prof. Noha Fakhry Abd El-Salam Ibrahim

Professor at Interior Design & Furniture Department – Higher Institute of Applied Arts – NCA

Dr. Muhammad Hassan Ramadan Hassan

Demonstrator at Interior Design & Furniture Department – Higher Institute of Applied Arts – NCA

Moh.hassan9228@yahoo.com

Abstract

Life in a limited-space dwelling is one of the most important problems facing residents due to the failure to meet their changing living needs. Which requires re-thinking in a functional way to provide the largest number of human needs without the need to change housing and move from one housing unit to a larger one. Thus, it is possible to overcome the problem of owning large and expensive spaces in order to satisfy the wishes of the user and meet his changing needs. Hence, the responsibility of the interior designer comes towards finding appropriate design solutions to solve this problem in a way that is consistent with the user culture in light of modern technology for furniture design.

Through the technological developments in the design of residential buildings using artificial intelligence technology (computer home, digital home, interactive home ... etc.). Consequently, the traditional concept of furniture units has changed from just inanimate objects that humans use to units that are able to sense, identify and interact with users to meet their needs and desires. It was therefore necessary to resort to the idea of intelligent furniture that integrates with everything that surrounds it and interacts with it in response to changing human needs within the void using intelligent systems that have saved time and effort to perform the required tasks in a given time.

It is worth mentioning that the change in the function of the furniture unit was not only a functional change but was followed by a change in shape to suit this advanced technology, the reductive trend became dominant in furniture design, where the designs with geometric shapes became easy to configure and realize, far from Jostling decorative elements, the clean lines are suitable for the computer technology used in the furniture unit, as well as with the executing materials of wood, glass and metal that have made an unprecedented breakthrough in the age of technology.

Keywords:

Smart System – Smart Furniture – Narrow House

Introduction

The last century has enjoyed many successive changes and witnessed the end of - especially the beginnings of the third millennium - serious attempts to build new residential communities with

small spaces that do not suit the needs and requirements of the residents of these residential communities and do not achieve complete comfort for users. This resulted in the failure to optimize the architectural spaces, which negatively affect living within them, and lead users to act in a random manner, which is to modify and switch within the housing unit.

Therefore, the future needs of the family must be taken into account to meet these requirements, and to provide the opportunity to expand or change in the various spaces of housing, such as changing the way they are used by adding new utility pillars or eliminating benefits that are no longer used, which is reflected in the way the contents of the space are used with ease and safety.

Recently, there have been a marked shift in computer use regarding the use of smart homes, resulting in the need for electronic equipment such as microprocessors, sensors, wires, etc. The main goal of using smart systems is to connect and increase the interaction between all electronic elements in the internal space, from computers to all climate and thermal systems. Security and others. The smart system is thus defined as a set of inputs that are prepared and processed in certain ways to reach specific outputs that achieve the objectives sets.

Search problem

The problem of the research lies in the difficulty of meeting all the changing human requirements and needs within the housing units of limited space, and does smart furniture make the most of these spaces and make the best use in accordance with the needs and desires of its residents?

The importance of research

The importance of research is due to the need to keep pace with the technological development of residential furniture design to find radical solutions to the architectural design problems of limited-space housing units.

Search goals

The research aims to:

- Studying human behavior within the dwelling and the role of housing in meeting humanitarian needs.
- Study the classification of smart furniture and the extent to which it affects solving the problems of a limited dwelling.

Assignments

- Intelligent furniture design can be accessed to solve an integrated residential space that ensures optimum utilization of all limited spaces.
- Using the latest methods and techniques that help solve limited voids using high quality technical materials.

Methodology

An analytical descriptive approach:

Describes and analyzes models of smart furniture units to reach conclusions and design ideas that work to achieve utilitarian needs as much as possible to develop the reality we live in today.

1. Smart home

It is a technically equipped dwelling, in which it has acquired the ability to think, in order to change its behavior according to the needs of the inhabitant, and to adapt to external conditions',

i.e., it means the ability to program the house electronically with a range of possible possibilities that enable its various components to adapt acting according to the corresponding circumstances and variables are already known. ⁽⁴⁾

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

- a) The adaptability of these spaces to adapt to the variables around them and change the traditional concept of space (the possibility of versatility of a single space) with cost economy, so that the same space can be used for many different activities, and this is done through the possibility of tweaking and movement between Units that make up the space.
- b) Using integrated and flexible furniture units that can be developed according to the changing needs of users. ^(2, p. 25)

The intelligent system is based on the presence of a central computer that is similar in functions with the human brain and is connected to an integrated network similar to the human nervous system called the “**Artificial Neural Network**” and extends the branches of that network into the void.

This network consists of a group of “**Sensors**” and “**Actuators**” to become a complementary component of its system, which is responsible for acting and responding in an expected way towards any external variables in a way that ultimately corresponds to the pattern of vital functions, and the human body is the ideal model or the smart system is in the best possible form, and is found in the technical equipment that makes up the interactive systems. ^(10, p. 35)

1.1 Features and characteristics of the smart system ⁽¹²⁾

- a) **Instant:** Where you can respond to the catalyst in real time.
- b) **The ability to respond multiple:** it responds to more than one environmental situation at the same time.
- c) **Self-action:** where the system can act on its own.
- d) **Steering ability:** The response takes place in the place where the catalyst has been exposed.
- e) **Ability to choose:** The response is done separately and predictable.

1.2 Smart System Features: ^(7, p. 47)

- a) Energy savings with the use of renewable energy alternatives such as sun and wind (sustainability).
- b) Regulate temperatures to reach thermal comfort.
- c) Automatic window control to open and close at day and night sequence slit automatically.
- d) Achieving security through surveillance by cameras.
- e) Reduce the size of the spaces inside the dwelling due to the integration and shrinking size of some devices.
- f) The development of smart materials daily and the emergence of modern materials interacting with the human and its requirements (smart materials) such as the use of glass that achieves vision from certain angles and prevents it from other angles to contribute to solving the problem of loss of privacy.

1.3 Intelligent system defects: ⁽⁴⁾

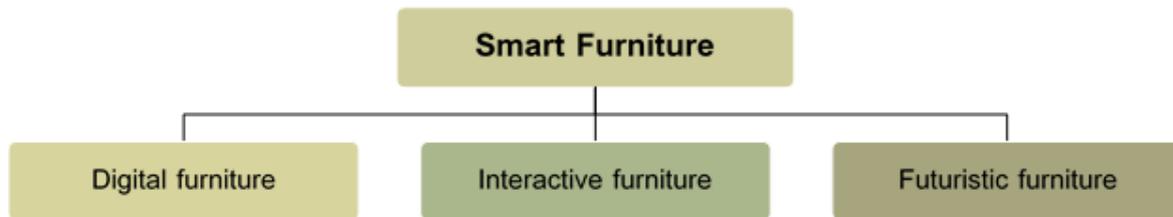
- a) The current high cost relative to the income of the average Egyptian person.
- b) The possibility of sudden breakdowns.
- c) The problem of living in an ocean of electromagnetic and laser waves harmful to humans.

d) The idea of integrating different systems calls for many meetings and studies between an integrated team specializing in various systems in addition to the cost of placing these systems in a single BAS system.

e) The cost of converting a traditional building into a smart building capable of accommodating advanced systems, is much higher than the cost of a building designed to be smart.

2. Smart furniture

It is a furniture that responds to the requirements of contemporary life affected by changing social and economic transformations, it works to find more innovative solutions to give a range of functions to the user within the void through the use of modern technological methods.



Shape (1) Showing The Classification Of Smart Furniture (Student Design)

2.1 Digital furniture

It is an undeveloped furniture characterized by intelligent electronic equipment that gave it another dimension in performance that was not expected to be reached, resulting in increased cognitive ability to meet the user's needs ⁽⁷⁾, such as the Smart Multipurpose Sofa Q4.

Q4 Smart Couch Fittings:

- One of the sofa seats without a back and connecting to the main source of energy.
- The buttons on the sofa are a magnetic hole that allow the connection of different types of devices.
- Armrests are hollow from the inside where music players can be positioned and can be controlled.
- It has a projector and a lighting unit mounted on the attached table. ^(8, p. 242)



Figure (1) shows the Q4 uses as a bed for couples and seat as the same time



Figure (2) shows Q4 Smart Couch Fittings

2.2 Interactive furniture

This furniture interacts with humans, it is able to provide practical solutions that are responsive to environmental variables, and interactive furniture is divided into: 'Fixed interactive furniture - mobile interactive furniture'.

a. Fixed Interactive Bed (Somenus) ⁽¹⁴⁾

It is the most advanced bed in the world, it uses high technology and exquisite design to combine comfort, entertainment and interaction with the modern times of the present era, Figure (3).

Somenus Fittings:

- A sophisticated unit of moving automatic curtains.
- Internet access through Wi-Fi.
- HD video projector, animated movie display that can be pulled down, and DVD playback.
- An audio system connected to 4 speakers and an amplifier, an LED programmed lighting system under the bed, a reading light, with controlling the intensity of the lighting. ⁽⁵⁾
- RFID smart card reader, to identify the holder to download his data, as well as the ability to play his favorite music, and the ability to wake people to their meetings. ⁽¹³⁾
- The ability to adjust the position of the mattress and adjust its angles to suit the different conditions of sitting, sleeping, relaxing and others. ^(8, p. 191)



Figure (3) shows The Somnus-Neu Interactive Bed

b. Interactive mobile bed

It is a smart bed that can turn into a roof in the absence of use, based on a hydraulic system that makes the bed move up and down with poise until it is installed in the desired position, Figure (4).

It is equipped with interactive lighting units that recognize sleeping times and different lighting levels depending on the nature of the activity required in the void, ^(6, p. 143)



Figure (4) shows bed during use and when it is turned into ceiling

2.3 Futuristic furniture

Furniture uses the latest digital technology to improve the quality of the user's functional performance by introducing new standards for the concept of activity, making the user feel more comfortable with better well-being than before.

a. Future bedroom

Beta Living ⁽¹⁵⁾ has conceptualized the futuristic bedroom, which includes interactive mirror glass, smart windows, a cabinet that displays its contents through its interactive mirror and a high-tech bed with multiple sensors for user comfort, Figure (5).



Figure (5) shows future bedroom contents

The future bedroom consists of:

- **An interactive bed** with multiple sensors to adjust the optimal body temperature and raise an emergency alarm. ⁽¹²⁾
- **Light smart cushions** with special technology that make them light up when the user wakes up.
- **An interactive mirror** that displays the contents of the wardrobe, the clothes can be measured using a special gesture technology, and the mirror will choose the appropriate clothing based on weather changes. ^(1, p. 123)
- **Smart Windows:** These are TV displays through which you can know the weather and browse social media accounts.

3. Impact of smart furniture on the design of a limited housing

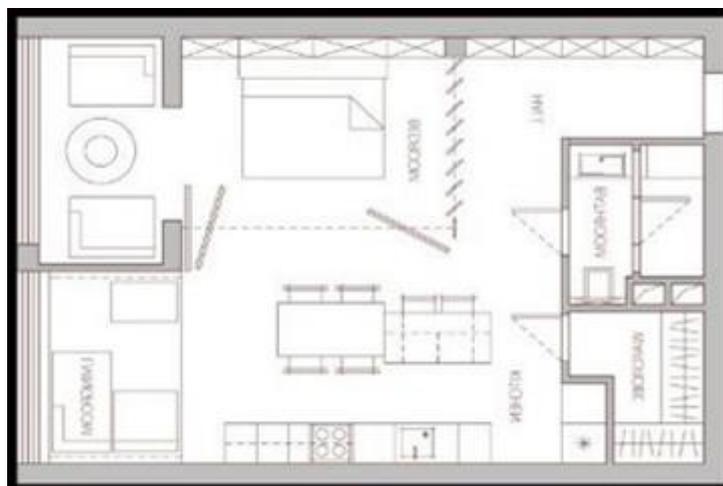
a) **Area:** 50 m².

b) **Space type:** Multifunctional space.

c) **Description:**

A residential unit with multi-functional furniture to practice more than one different activity at different times or at the same time, Shape (2).

- Master room is integrated with the living space and attached to a terrace.
- Dressing room to change and store clothes.
- Kitchen is integrated with Dinning space.
- Bathroom.



Shape (2) shows the Plan of an apartment

d) Concept:

- 1) Glass partition equipped with modern techniques containing sensors and mechanical triggers to separate spaces, where sleeping space 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 to perform two different activities at different times. ⁽¹⁶⁾
- 2) Using digital technology in the wall library shelves in the living space to get the latest news with the “RSS” feature.



Figure (6) shows Glass movable partitions which changes its transparency according to the user's needs



Figure (7) shows Bed has been transformed into a living space and the wall is used as a library for storing books

- 3) Using chromo electric glass technology, which changes its transparency according to the user's needs within the space, as in the form of (6).
- 4) Using smoke detection cells and early warning units to achieve security and safety.
- 5) Using the back wall of the seating area as a library for storing books with direct lighting units for the user's optical comfort, figure (7).
- 6) Providing a mid-kitchen unit to increase storage capacity, as well as using its surface for fast food for couples.
- 7) Providing a dining table attached to the kitchen unit for four persons.
- 8) Using the space for performing more activities at the same time, Figure (8).
 - Using sliding glass partitions to separate activities (sleep and food) in the same space.
 - Using revolving wooden partitions to separate sleeping space or living area from the entrance area.
 - Design a hidden dressing zone by using doors painted in the same color as the walls.

- Increasing wall storage units by utilization, the wall of the entrance area behind the main door of the residential unit.



Figure (8) shows the integration of food space with the kitchen in one space using deletable and addable volumes

Results

- 1) Small spaces can be acquired that meet life requirements and provide all kinds of well-being to the user through smart home technology.
- 2) The components of the dwelling are determined by the activities carried out within the residence to ensure the user's comfort, privacy and security.
- 3) Study all basic and changing human needs to reach good design solutions that achieve efficient utilization performance.
- 4) Technology has greatly influenced architectural intellect and has changed the concept of internal space, which has become adaptable to many activities.
- 5) Smart buildings are more expensive than traditional buildings, but this extra cost also increases the project's expected return due to the building's high value.
- 6) Using smart home technology saves energy by using advanced control systems that allow the user to manage costs during the day.
- 7) Intelligent design aims to monitor the actions and desires of users so that they can form automated reactions to achieve those desires easily and, saving time and effort.
- 8) Smart furniture contains special electronic equipment from mechanical sensors and triggers that deliver innovative uses that were previously unknown, giving creative aesthetic value to these elements.
- 9) The use of built-in multi-functional furniture is one of the most important elements that helps users meet their future needs and satisfy their desires on a permanent basis.

Recommendations

- 1) The need to use digital technology and artificial intelligence in interior design and furniture for limited-space housing, which solves all the problems that the residents of these houses may face.
- 2) Attention to the study of all the limited areas as it is one of the biggest problems facing Egyptian society at the moment.

- 3) The economic aspect of smart technology and the need to reach scientific solutions should be studied to reduce the cost of its establishment in a short time.
- 4) The furniture designer should be familiar with modern technology as it is an important design tool that helps solve many of the design and operational problems that both the designer and the user may face.
- 5) The importance of spreading culture and technological awareness in our Egyptian society to learn how to use it and develop it through scientific research and experiments to become an environmentally compatible technology and carry our Egyptian identity.
- 6) The need to reduce the acquisition of large-scale housing, which is a burden on the user on the one hand and the state on the other, as these expensive spaces drain opportunities for land use, thereby increasing the chances of competition between buyers, thereby increasing the price of those lands.

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