

Robotecture and Artificial Intelligence (AI) Technology and its Impact on the Creativity Process in Interior Spaces

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Abstract:

Throughout history, new technologies have emerged that have reshaped our built environment and that of society. In recent years, many interactive concepts have been invented. These concepts could adapt and interact with the surrounding environment and its derivatives, which include Light, sound, wind energy, heat or with people by changing their condition without the need for any human intervention, this is called architecture of robotics "Robotecture". Where the world witnessed an unprecedented revolution in the fields of digital technology development and its applications and adapting it to draw new languages and vocabulary for architectural formation and interior design, as these languages and these emerging vocabulary for formation varied and multiplied between the use of deconstructive shapes, basic geometric spatial shapes, organic shapes, or hybrid shapes of all kinds and other forms. Architectural trends, such as the trend towards new modernity, imaginary / virtual architecture, and last but not least, Robotecture, "kinetic smart architecture", which are trends that could not have been developed and pushed in their direction had it not been for progress in the fields of digital technologies and their applications in the field of architecture and interior design. Robotecture is a term used to describe the integration of robotic technology into the design and construction of buildings and other structures. This can include the use of robots for tasks such as construction, maintenance, and inspection, as well as the incorporation of robotics into the design and function of the building itself. The goal of robotecture is to increase efficiency, reduce costs, and improve the overall quality of the building. One of the most significant impacts has been in the realm of building automation. Using sensors, artificial intelligence, and machine learning algorithms, buildings can now monitor and adjust their internal environments in real-time. For example, a building's lighting and temperature can be automatically adjusted based on occupancy and usage patterns, optimizing energy usage, and improving user comfort. Robotecture and artificial intelligence (AI) are revolutionizing the field of interior design, and their impact on the creativity process is significant. Robotic and AI technologies allows interior designers to automate many of the repetitive and time-consuming tasks associated with the design process, freeing up time and energy for more creative work.

Keywords:

Technology - Digital technology- Robotecture - artificial intelligence- programming- automation- interactive digital design- smart material- Design creativity- Creative Designer- Creative Design Situation- Robotic smart materials- Design you edit- Digital design approaches

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Introduction:

The existence of creativity is always linked to social conditions and develops according to its laws. History confirms that artistic creative forms do not arise from individual awareness only but are also an expression of a view determined by society towards the world. Thus, creativity is subject to special ideologies based on social foundations, where creative thought is a vital, active field. Through it, the creator - designer - interacts with problems and seeks to develop them through his previous information and his own perceptions and the conditions surrounding the problem in question and the vocabulary it contains so that he reaches the formulation of several results that, after evaluating them, can reach a solution to the problem at hand. The design of robotecture and artificial intelligence has a significant impact on the internal spaces of various settings, including homes, workplaces, and public spaces. With the rapid development of digital technology, the integration of robotics and artificial intelligence into these spaces has become increasingly common.

One of the most significant impacts of robotics and artificial intelligence on internal spaces is the automation of various tasks. For example, in the workplace, robots and artificial intelligence can perform tasks that are repetitive or require precision with greater accuracy and efficiency than humans. This can free employees to focus on more complex tasks, improving productivity and job satisfaction. In homes, the integration of robotics and artificial intelligence can provide significant benefits. Smart home technologies, such as thermostats, lighting systems, and security systems, can be controlled remotely, making homes more energy-efficient and secure. Additionally, robots can assist with household tasks, such as cleaning or cooking, improving the quality of life for homeowners. In public spaces, robotics and artificial intelligence can provide a range of benefits. For example, self-driving cars can improve traffic flow, while robotic assistants can assist with tasks such as cleaning and maintenance in public buildings. Additionally, the integration of artificial intelligence into public services such as healthcare and emergency response

can improve their effectiveness and efficiency. The design of internal spaces to accommodate robotics and artificial intelligence requires careful consideration. For example, the integration of sensors, cameras, and other digital technologies may require specific wiring or other infrastructure to be installed. Additionally, the design of spaces should consider the size and mobility of robots, as well as any potential safety concerns. The field of robotics is coming of age. Robotics and artificial intelligence represent the next cutting-edge technology to transform the fields of architecture and design. The past decade's surge towards more computationally defined building systems and highly adaptable open-source design software has left the field ripe for the integration of robotics wither through large-scale building fabrication or through more intelligent/adaptive building systems.

The problem of the study lies in:

- 1- Limited availability of data: The use of robotecture and AI technology in interior design is still relatively new, this could make it difficult to draw meaningful conclusions about the impact of these technologies on the creativity process.
- 2- Interpretation of creativity: Creativity is a complex and multifaceted concept; this could make it difficult to draw clear conclusions about the impact of robotecture and AI design on the creativity process in interior design.

This study aims to:

Know the extent of the digital technological development of the internal spaces using robot technology and artificial intelligence, how they affect Design Creativity and the impact of robotecture and AI technology on interior design.

This results in the need to study:

- 1- Artificial intelligence AI technology and applications of robotic systems in interior architecture.
- 2- Impact of Robotecture and AI technology on creativity process
- 3- Smart solutions from the structural point of view in terms of choosing building materials, type of construction, and the design method for the internal spaces, as the architectural form transformed from static blocks to dynamic blocks, in addition to metaphors from ecological natural forms.
- 4- Artificial intelligence regarding automation systems, alarm devices, and remote-control devices in various parts of the building, as well as energy conservation inside the building.

The research includes studying the following axes:

- A. Design Creativity "Concept "
- B. Robotecture and its effect on internal design

Process.

- C. The impact of robotecture and AI design on design creativity for interior spaces.
- D. Digital robotecture design approaches.

A. Design Creativity "Concept":

Design theorists have contributed to the development of multiple definitions of design and the design process, among which there is an implicit convergence in defining its meaning despite the different disciplines and trends, as design in its general concept represents a process that combines a number of interactive activities that take place according to theoretical or applied systems based on specific laws and concepts governed by a logical and procedural methodology And qualitative in order to reach the optimal solution to a problem so that it is subject to the conditions of the current biosphere of the problem and achieve the future extension at the same time.

According to this, there are many specific definitions of design among the design theorists, according to the definition of Gerhard Schmitt (Schmitt Gerhand) (1988), the design is: a logical process for planning and solving a problem and then representing it graphically to record the ideas and stages of the different design.

While Coyne, Rosman, Redford, Balachandro, and Gero, Rosemann, Coyne, Gero and, Balachandnow, Redfond define: "Design is the essential purposeful activity through which a person achieves the desired goal, and it is also the process of creating, creating and creating systems, and predicting how to implement them and accomplish them to achieve goals." desired."

Archer Bruce (1969) defines design in terms of being: "Imagine or visualize the idea of preparing and preparing a specific description of the system used to design the artificial product or the process of assembling the manufactured designs in a form that achieves the desired goal."

As for creativity, scholars have differed in their definition of creativity. Some of them mean by creativity (the ability to create something new or innovative, while others argue that it is (the process or psychological processes by which the new thing of high value is created and invented), and a third group believes that creativity arises On the creative ability and the creative process that ultimately leads to the realization of the creative work in its true form, Smith said that creativity is "finding relationships between things that have never been said to have relationships between them." Lewin field defined the creative as "the flexible person with original ideas and the ability to On redefining or reorganizing things, who can reach the use of things in circulation in new ways and methods that give them meanings that differ from what is circulated or agreed upon among people, and Roshka Alexandro (1989) defines creativity as "the integrated unit of a group of subjective and

objective factors that It leads to the realization of a new, authentic and valuable production for the individual and the group.

While the design creativity process represents a complex creative activity related to the transformations that occur not only to the design, but to the designer as well, and the first goal of the designer is to try to reach the best and smoothest design solutions, so that the design creativity process is based on multiple considerations that are formed to be a special visual language composed of Elements [- implicit, visual, relational, creative process] are consistent with each other to form a sound relationship that combines the elements of form and space through structural organizational

foundations with the aim of finding spatial solutions that achieve an appropriate solution to the design problem. In it or symbolizing it, and despite the importance of the design expertise and capabilities of the designer, the creative design needs a great deal of flexibility, imagination, mental and physical freedom, and the ability of the designer to improve, symbolic thinking, and carry out repercussions, analysis, and visual synthesis, and above all a superior ability to sense the stimuli of reality and its components.

There are a set of factors related to design creativity that determine its nature and are linked to a mutual interactive relationship with the creative designer, which can be illustrated through a table.

Table "1" of factors related to design creativity

| Factors | Definition |
|----------------------------------|---|
| Creative Designer | The creative designer is the person who must be characterized by cognitive mental characteristics and emotional personal characteristics through his multiple skills and experiences. |
| Creative Design Situation | Repetition and multiplicity of creative design positions It contributes to calling the designer an individual who is creative, as creativity is linked to the situation that the designer interacts with and shows an unfamiliar solution. |
| Creative Process | A mental cognitive process in which the designer is an active organizer of experiences to respond to the new situation. |
| Creative Products | It is one of the aspects of human interaction with the environment. Creativity is measured in one of its aspects by the quantity and forms of production. Design creative production is a touchstone or measure of creativity. |

The relationship between the creative designer and these factors associated with the design creativity in the design process is an interactive relationship, where the creative design attitude leads to finding the inputs of the creative design process, through which steps the creative design production is reached, which is developed and created through continuous feedback processes to the design attitude. Creative, this relationship can be illustrated by the following diagram.



Diagram no.1 the relationship between the creative designer and these factors associated with design creativity in the design process.

B. Robotecture and its effect on interior design Process:

Intelligence is defined according to the British Encyclopedia as "the ability to adapt efficiently to

the environment, either by changing the surrounding environment or searching for a new environment that is more compatible."

The concept of Artificial Intelligence: AI is related to the intelligence associated with digital or electronic devices such as computers, cellular devices, or robots, and expresses the ability of these digital devices to perform tasks associated with intelligent beings.

It is also called the systems that enjoy the intellectual processes of man such as the ability to think, discover the meaning and learn from past experiences.

The mechanism of artificial intelligence: Artificial intelligence works in the digital environment through the availability of digital devices and specialized programs for the analysis and design of algorithms and machine learning. The future such as the automatic response and determine the appropriate interaction for the movement.

Artificial intelligence enters many electronic and digital fields and is present in different forms and began to be used in architecture and interior architecture so that it simulates the intelligence present in the human mind.

B. 1 Types of artificial intelligence used in robotic internal spaces:

- Interactive machines: It is the simplest level of the robot, as it is a machine designed to deal

with one type of data and respond to current situations only and is not able to create memories or make future decisions to improve its level or develop its intelligence.

- Limited memory: A machine can store a limited amount of information based on the data that the memory machine dealt with previously so that it can build knowledge through memory when it is associated with the pre-programmed data it has.
- Theory of Mind: It was used to manufacture a robot capable of using information to interact with situations in a human-like manner, which would teach the machine how to act in different and new situations and make decisions.
- Self-awareness: It is the goal for the existence of artificial intelligence, as it has awareness of the level of the human mind, as it understands and can predict and respond to requirements and variables.

Smart buildings have been divided as follows:

- a. Automation Buildings
- b. Responsive Buildings
- c. Effective Buildings

Robotecture is a type of interactive architecture that uses robot principles in design and manufacturing processes to create an architecture that can adapt spatially to the changing requirements of users and the surrounding environment and respond to their needs.

The robotecture took the control systems and methods of responding to the requirements of space as a basis in its principles, which made it different from the rest of the other architectural trends.

B.2. the principles of robotics:

Despite their different types, shapes, and fields of use, robots share three basic components that must be present in any type of them, namely:

- Mechanical construction: where all types of robots have a specific structure or structure designed to suit the task assigned to this robot.
- The electrical component: or more generally: the energy component that powers the robot and allows its control.
- Program: All robots must have some kind of programming that allows this robot to make a certain decision or perform a certain task.

B.3 Design process definition:

Design is an organized mental process by which we can deal with multiple types of information and integrate them into one set of ideas and end with a clear vision for those ideas. Usually, this vision appears in the form of drawings or a timetable. Design includes the method and the product at the same time.

The design process is defined as a system of work through which several activities interact and organize, with the aim of making decisions that seek to change the physical reality to reach previously known goals.

B.4 Design process and robotic architectural production:

There are several other factors affecting the design process and architectural production, the most important of which are:

a- Functional relationships:

Function is the most important element of architectural design. Human activity is a group of actions carried out by the individual within a specific place or space. In general, functional analytical studies are the first things that the designer begins with in the design.

b- The relationship of the building with the surrounding environment:

It relates to the surrounding environment conditions related to the site of the project, in which the areas of use are determined according to the size and type of building and the area of the site.

c- Physical requirements:

It refers to the internal climate of the building in terms of thermal conditions, natural and artificial lighting, and sound effects.

d- Technological requirements, informatics, digital communication, and artificial intelligence

Which is considered one of the most important systems introduced in buildings to keep pace with technological and robotic development.

B.5. The impact of robotecture on the design process

The process of designing smart buildings requires determining the needs of the occupants of the building at the present time and expected in the future very accurately and over a long period of time. The idea of what will happen next is the concern of computer system designers, and the designer must provide buildings capable of absorbing technical and technological development and employing it professionally.

For smart buildings to accommodate technological and service additions, they must be accounted for when planning and designing the building, and these services must be designed so that they can be replaced in the event of any defect. Parts of the building to provide high performance of the building's spaces so that they are not a source of stress for the users of the internal space and to provide the necessary level of compatibility between the factors affecting the internal space such as heat, light, color, and sound, and to achieve harmony between design and smart systems, the following criteria must be considered:

- The convenience factor that facilitates the functions and activities carried out by the occupants.
- The building's acceptance of the future and immediate changes in accordance with the technological development in the information revolution.
- Provide safety requirements through the introduction of electronic systems to warn of risks and control the functions of the internal environment of the building.
- Considering the environmental and functional characteristics of buildings and intellectual development in the design process.

All the above can be applied and made a tangible reality if intelligence is achieved in buildings in a utilitarian manner through a group of modern service systems consisting of automation systems and global information systems.

C. The impact of robotecture and AI design on design creativity for interior spaces.

Robotecture is a term that refers to the integration of robotics and technology into the design and construction of buildings and architecture. It involves using advanced materials, sensors, and other digital technologies to create intelligent and responsive buildings that can adapt to changing environmental conditions and user needs.

One example of robotecture is the use of smart building systems that can monitor and adjust lighting, heating, and ventilation based on occupancy levels and environmental conditions. These systems can help to reduce energy consumption and improve indoor air quality, making buildings more comfortable and sustainable.

Another example of robotecture is the use of robotic construction technologies, such as 3D printing and robotic assembly, to create complex and intricate building structures. These technologies can help to reduce construction time and costs while allowing for greater design flexibility and customization.

Robotecture also has the potential to improve building safety and security. For example, intelligent building systems can monitor for potential security threats and alert building occupants and authorities in real-time. Similarly, robotic technologies can be used to inspect and maintain buildings, identifying potential safety hazards before they become a problem.

However, the integration of robotics and technology into building design also raises ethical and societal questions, particularly around issues of privacy and control. As with any technological innovation, it is important to consider the potential benefits and risks of robotecture and ensure that it

is used responsibly and ethically to create a built environment that is safe, sustainable, and responsive to the needs of its occupants.

With the beginning and continuation of civilizations, each civilization had design requirements for the design of the interior space, and each of them had a specific concept for the interior spaces and the materials used to build it. With the different civilizations and cultures, this was greatly reflected in the design of the interior space. It is exposed to it as it includes most of the practices and activities practiced by man.

Building materials are considered one of the most important elements used in making the internal environment, and the material is mainly included in the composition of the external form of the architecture. With the appearance of the architectural blocks, the interior space is determined officially, whether it is popular, public, or private, quiet, or cheerful, outgoing or static. The person moves in a dynamic movement with the fourth dimension, which is time, to move from one space to another to approach the blocks and begin to interact visually and tactilely with flat or curved surfaces. Vertical, horizontal, or inclined, solid, transparent, or reflective, and although the design process begins with dealing with blocks and voids and moves on to surface details of texture and colors, the physical environment of architectural work begins with establishing surfaces with their textures and colors to form blocks and spaces.

From here, the material has a major role in developing and creating shifts that separate one era from another. The discovery of iron and concrete in the era of the industrial revolution has affected buildings through vast seas, high-rise towers, and facilitated the formation and laying of surfaces, and with this continuous development of materials through the ages and with progress. What chemistry and physics have done to the properties of materials has led to the emergence of the term intelligence on many products such as smart homes and paints that change color.

Where the emergence of smart materials began when NASA in 1992 modernized and developed the methods of defending the United States of America by developing materials that allow new capabilities for weapons and soldiers, so it manufactured smart planes based on stealth during flight using the technology of changing the color of the plane and not discovering it during espionage, and it also developed clothes. The soldiers and the development of tissues are colored with the surrounding environment as they are connected to the ambulance centers by implanting sensitive devices inside the tissues to give a signal to identify the locations of the injured soldiers, and with the

development of these materials and techniques at the level of the structural characteristics of the material, a merger has been made between these materials and the interior design to produce an integration that resembles integration. Which results in the interaction of living organisms with nature and the surrounding environment and adapting to its changes. These changes are as follows:

- Changes in the climatic environment
- Changes in the light environment
- Changes in the vocal environment

These changes affect the human sense, and the physiological comfort. For example, the human eye is affected by light, and because of this effect, the eyelids close or remain open in a proportion that helps vision. The pupils also dilate or decrease according to the strength or weakness of the light to help avoid the effects of this lighting on the eye itself on the one hand. And on the vision on the other hand, as the human skin secretes sweat when exposed to high temperatures to moisturize the body temperature. Animals adapt to the environment through biological interaction with the environment. Some of them are active at night and see in the lowest levels of light or depend on emitting rays and receiving their waves to determine distances. Some of them depend on camouflage by simulating nature and its own ability to change its color like a chameleon. Accordingly, the idea of smart materials was established, to develop the material's sense of the environment and deal with it to serve the designer.

C.1 Definition of smart materials:

Although the term "smart materials" is frequently used, it does not have a specific meaning. The words "smart" and "intelligent" are used as descriptions of materials or systems that can be utilized and employed to serve the designer's desire.

Robotic smart materials: They are sensitive, adaptable, and evolving materials that can instantly change their physical properties (such as shape, bond ability, viscosity and even color) in response to natural or artificial stimuli such as a change in temperature, mechanical constraints, electric or magnetic fields.

These materials can possess what seems like a kind of memory stored in them, by which you can always return to a certain body after going through a state of deformation. This means that if these materials were subjected to strong influences that led to their deformation and change of shape and structure, they can return using heat to their original shape very precisely as if they had remembered it all along.

It just depends on a scientific concept called phase transition. From the name, the term means the

transition of a substance from one phase or state to another. It is easy to imagine the transformation of water from the liquid state to the gaseous state, for example, but there are phase transitions that occur on a much deeper level, transitions that occur within the crystal of the material itself. This ability to change is not limited to what we know as "elasticity".

In addition to the difference in the mechanics of the work of these materials and their properties from the mechanics of stress-strain curves, these smart materials are also distinguished by their ability to withstand 20 times the level of deformation that the flexible materials can bear without losing their ability to return to their original shape.

Among the types of smart materials used in interior architecture:

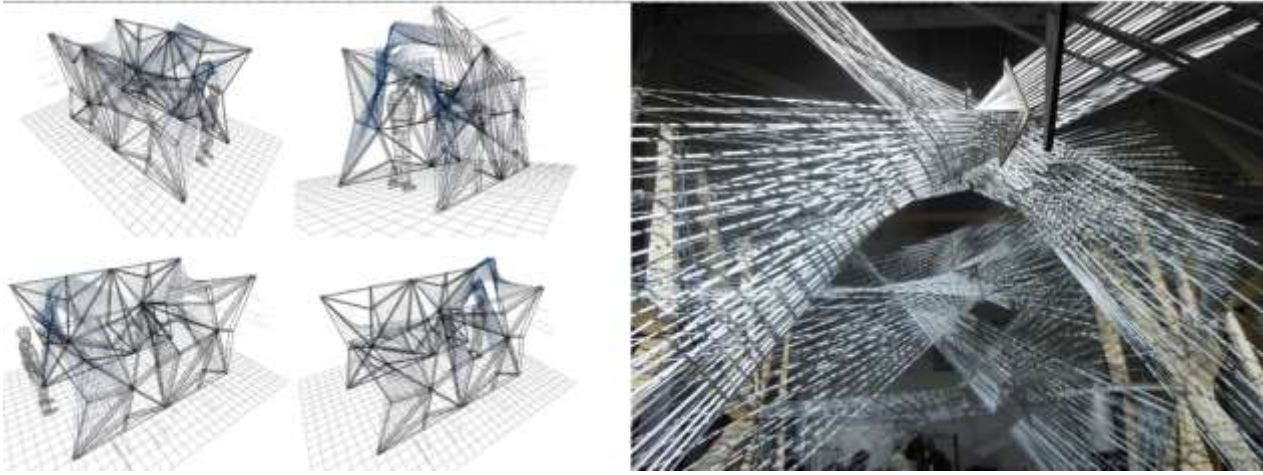
- **Smart materials that change color or flow:** they are used in pieces of furniture and wallpaper, and their color changes with an external effect of light or heat to give different shapes, or they are used in lighting units that change shape with heat.
- **Smart energy-converting materials:** the most famous of which is the solar cell used on the roofs of houses, which provides a lot of electrical energy.
- **Materials electrified by pressure:** such as the design of interactive tiles when walking on them used in exhibition halls.
- **Phosphorescent light-emitting materials:** such as using luminous tape to light up staircases in case of emergency or when there is a power outage.

C.2 The effect of Robotecture and AI technology on the shape of the internal space:

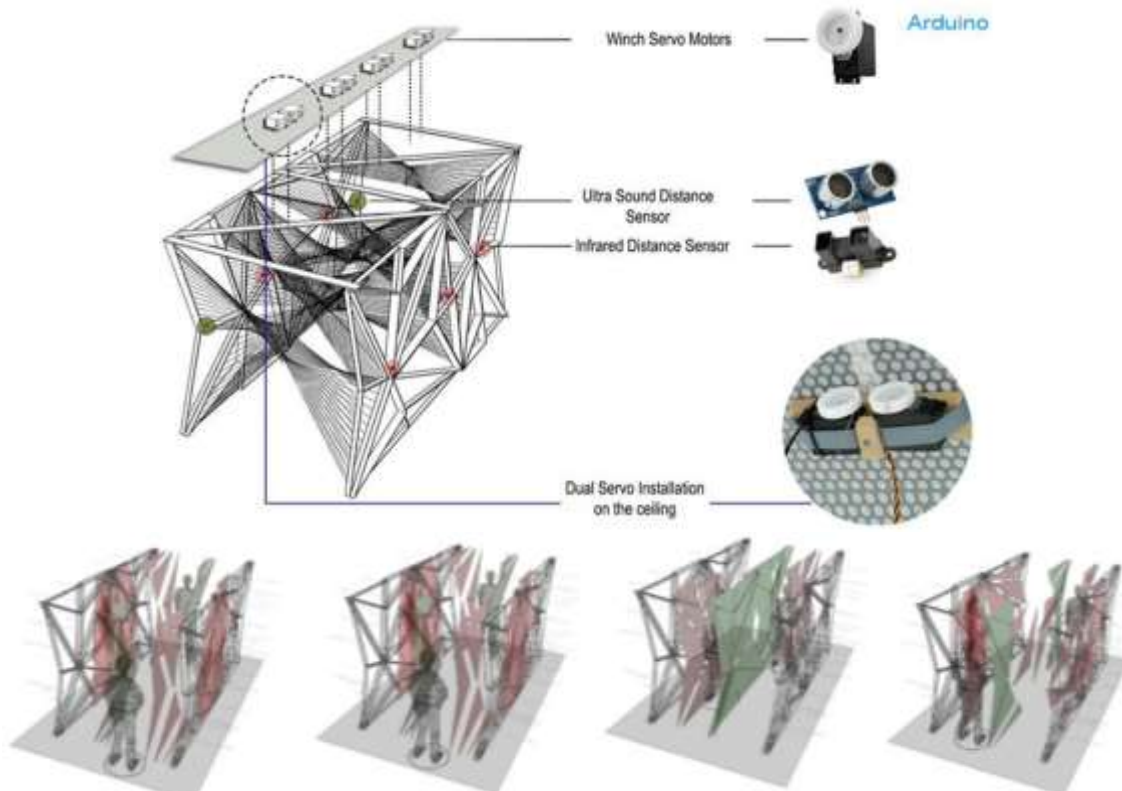
Contemporary building materials and construction methods have influenced the development of the shape of space determinants, and with the technological development and the entry of artificial intelligence technology and robot technology, new forms of internal spaces have emerged that are characterized by flexibility, difference, and diversity in the shape of the void space. The shape of the structural structure on the internal space in terms of its dealings with the surrounding environment, and the space became spatially adapted to the surrounding environment.

Examples of discovering dynamic interactive design patterns:

Design an interactive dynamic structure. Measuring 2.5 meters high, 1.2 meters wide and 4.5 meters long, the structure consists of wooden frames and flexible strings with sensors and actuators for movement. The pattern of woven elastic ropes is designed to influence the viewer's visual perception and respond to their movements.



Shape no."1" Demonstrating illustrations of the kinetic interactive structure shape designed by AA Athens School 2014 "Kinetic Haze"



Shape no. "2" An illustration of the form of interaction with people in the structure

C.2.1 Method of assembling robotic interior spaces

As a result of the development of smart materials used in architecture and interior design, which are integrated together to build an electronic mind of materials, which are integrated with control systems that consist of the following:

- Sensors Detectors Transducers
- Control systems.
- Electrical Mechanical Micro-Systems (MEMS)
- Sensor Networks.
- Output models / Input models.

These elements were used by the NOX group and the UN Studio group, in a position that relies on automatic movement, such as the movable wall that

senses the movement of visitors, which was designed by the DECO Architects group, based on human body sensors through heat. The wall moves and changes in shape based on "the visitor's action and reaction," as well as towards the people inside the interior space.

C.2.2 Intelligent robotecture:

It is a composition of building elements exposed to external weather to perform a set of functions to respond to environmental changes to maintain the comfort of users with the lowest energy consumption. In this cover, the interface elements are adaptable through their ability to self-adjust to modify and change their shape and form.

The smart covers represent part of the robotic building systems that are connected to other parts of the building outside the Zone Enveloping area,

such as (sensors and actuators) connected by command wires, all of which are controlled through the central building management system (BMS), which represents the brain of the building.
 Double Cover: The double façade in the outer envelope of the building consists of two parts

separated by a vacuum corridor of air ranging from 15:90 cm, either divided or undivided. Sun shading tools are often used between the two parts of the cover.

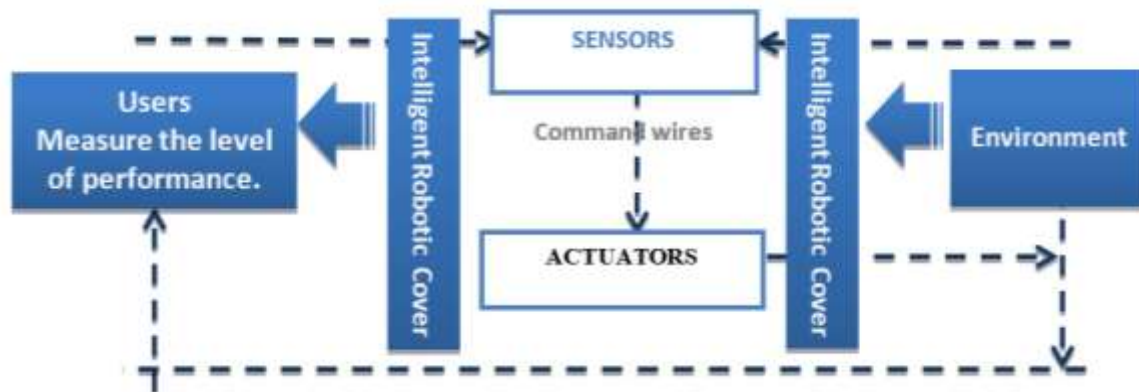


Diagram no."2" A simplified image shows how the smart robotic shell works and adapts to the surrounding environment.

C.2.3 Functions of the smart robotic cover:

The main objective of the robotic envelope is to provide comfort and safety for the users of the internal space. Comfort can be divided into three basic elements:

- **Thermal comfort:** It is achieved by controlling the thermal permeability of the facade through several methods, including controlling the shading of the facade and thermal resistance by using the double ventilated facades, in addition to the possibility of air permeability to the interior space by using windows that can be opened, closed, and operated through a smart automatic system. The Arts Center Singapore building is an example of the use of a smart robotic shell.
- **Auditory comfort:** Considering the architectural envelope as the most important element for isolating the internal spaces from the noise of the external environment, therefore, one of the functional requirements of the smart interface is noise reduction, as it controls the flow of air from the surrounding environment to the internal space, thus acting as air valves. through automatic control.
- **Visual comfort:** What is meant by the individual's ability to perform his activity comfortably inside the interior space, depending on visual comfort, and it depends on several factors, including the direction and intensity of the light source. And since the level of lighting required within the spaces is either determined by artificial lighting or natural lighting, and it is preferable to rely on natural lighting to save energy inside buildings, and since the idea of applying reliance on natural lighting has several

problems, including glare from direct rays and excess heat gain, for this solar curtains became the controller. By using the computer and shading control tools, it has an important role in achieving visual comfort, and this type of control and interface management leads to a reduction in cooling loads by about 20%, as well as a reduction in electrical lighting loads.

C.3 The effect of Robotecture and AI technology on designing furniture of the internal space:

Furniture is an integral element of the interior architecture design and is inherent to it, and its design depends on the function of the space in which it will be placed, and given that the robotic space is a dynamic, mobile space that interacts to respond to the changing needs of the user, and the space becomes vital and accommodates the increase in the activities that are practiced inside it. Therefore, robotic space must be used, and the limited closed spaces eliminated and transformed. To an open space and be in constant contact with the surrounding environment, and to accommodate the design of furniture for robotic open spaces, the trend was to use multi-use furniture that can be disassembled, installed, pressed, folded, and automatic response, and for this it depends on hinges, mechanical mechanisms, and the use of collapsible walls and movement to separate the different spaces, and it became dynamic and also evolutionary.

Active and adaptive robotic furniture:

It is living furniture that can be transformed from one form to another and from one function to another to suit the robotic space in its various forms, whether in its normal state or in the case of changing space or air conditioning and responding to environmental and human variables, and for this

the furniture design becomes more flexible and capable of folding, stretching and movement.

For this, robotic furniture depends on the following:

- **Artificial intelligence:** it needs electronic equipment, as it relies in designing furniture on integrating sensors and a data processor in its parts that are linked within central networks made of smart materials. The most important characteristic of these materials is the ability to take variable reactions to meet the needs of their functionality.
- **Interactive systems:** to interact with the internal effects of the robotic space, as it is considered an integral part of the design of the robotic space and gives a reaction as a

response to the user according to an attached digital programming system consisting of "sensors - sensors". The types of systems differ according to the type of response that each type shows.

- **Robotic systems:** to add the possibility of change so that it grows with the growth of the space in it and to meet the needs of a larger number of people and becomes subject to development with the change in the shape of the robotic space.
 - Nature simulation
 - Flexibility
 - Repetition
 - The movement



Shape no 3 Venice Home Design illustrates the concept of adjustable furniture.

Designyouedit: Venezia Home Design presents a new concept of design and furniture. Products are "adjustable": they can be modified and customized in terms of form and function with simple steps and a touch of creativity. They are multifunctional, flexible and can be transformed or adapted for different uses and locations: home, office, all types of public areas and even outdoors. You are the essence and your ability to interact with these things and your imagination to reconfigure spaces. Design you edit is a design that changes according to your needs and follows you over time.

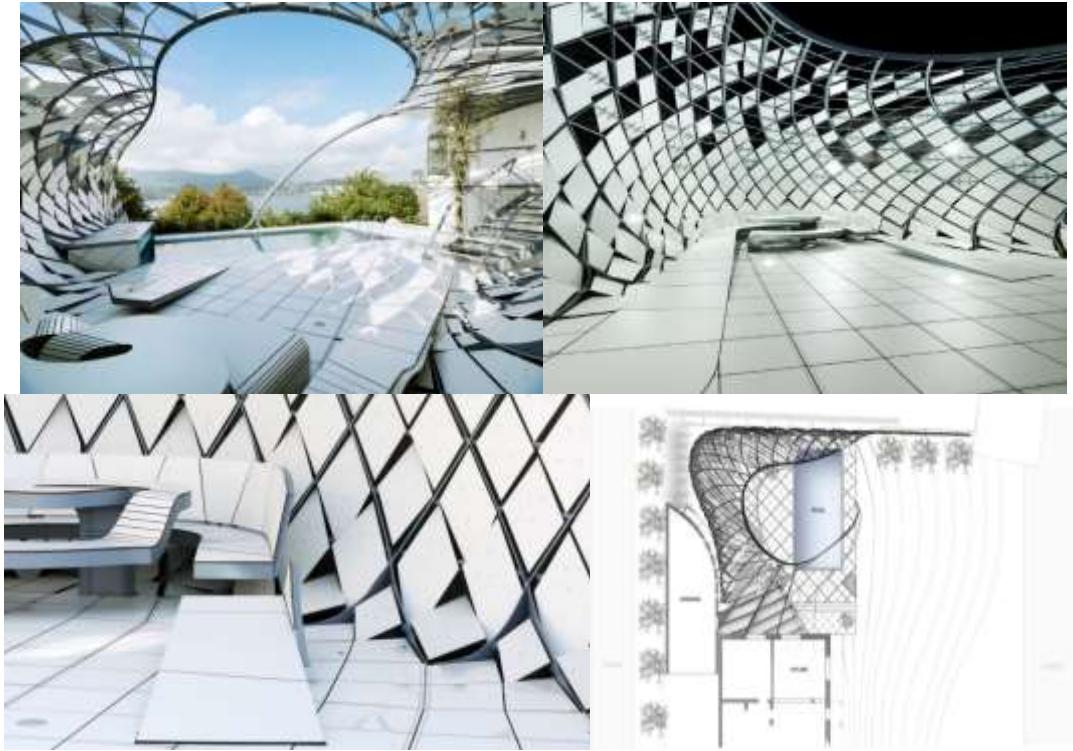
Vienna-based architecture firm Heri & Sally designed a cocoon-like steel structure around a swimming pool in the garden of a private builder in Austria. With composite panels and interior constructions dependent on their function, the parametric spatial element describes the possibilities of a usable and experiential surface.

The fence itself becomes - proceeding from a diagonal structural arrangement - and thus the possibility of space. It does not define the space, but creates it and makes it experiential, and functionality as a demarcation slips into the background and is only a by-product. The aim of

the cocoon-like opening element is to create different spatial qualities and experiment with space. Partially covered, towed, and protected, then open and finally in the middle or at the end in the pool water where you can swim out of it. The curves convey a sense of spaciousness that makes the space appear larger than it is - and creates the perfect resonant attitude inside the home. Various integrated constructions such as stairs, benches, lounging areas or tables with backrest and pool cover are in geometric relationship with the original construction; They come out only to become part of the structure again.

Starting from a diagonal structural arrangement - thus the possibility of space. It does not define the space, but creates it and makes it experienceable, and functionality slips. The embedded panels follow a dynamic trajectory from the perpendicular edge to the space described, to evolve in the central parts in relation to the steel structure from the inside out or to melt more and more along the vertical.

In this case, the structure is an accumulation of possibilities in a described space and only creates the edges of a vast land in between.



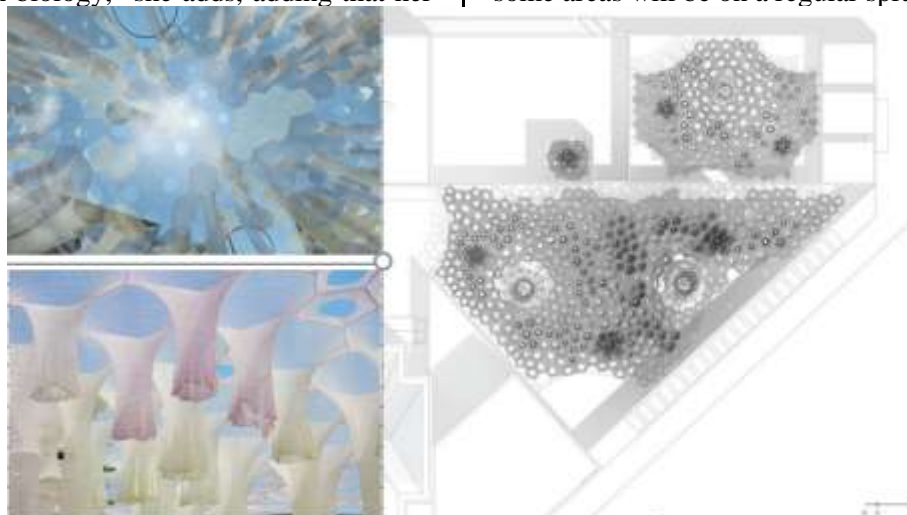
Shape no. 4 The horizontal plan and illustrations show a moving design of a steel structure resembling a cocoon in Austria.

Architectural designer Jenny Sabin Studio, Location: Long Island City, NY, USA, Year: 2017 in New York has created a shelter installation that uses machine-woven solar fabrics that absorb and emit light with the intention of being a "socially and environmentally responsive structure" that reacts to heat and sunlight, as well as the bodies of visitors who enter the site. Using the latest textile-based technologies, including solar-powered yarn and photoluminescent yarn, Sabine digitally designs installation shapes and objects. It's wrapped and woven into a giant robotic arm, which is an additive type of technology used in digital fabrication and 3D printing. For the seating, about 100 recycled and deconstructed bobbins are woven with the same photoluminescent yarns...coming from cell biology, cellular networks and how models work in biology," she adds, adding that her

use of highly responsive and technical materials began with a project for Nike in 2012.

The installation includes tall tapestry tubes hanging from a canopy stalactite pattern, forming part of the site's multisensory environment. During the day, visitors can rest from the summer heat under the canopy, letting in dappled sunlight while occasionally spraying visitors with a mist system built into the openings of those hanging tubes. Misting is activated by sensors that respond to motion.

Three 30-foot (9 m) high towers help stabilize the stretching canopy, holding the large water bags that feed the network of pipes that connect to the misting system." With up to 3,000 festival visitors expected, the master control allows misting to be paused if a large crowd enters. to the site, while some areas will be on a regular spraying cycle.



Shape no. 5 (a)



Shape no. 5 (b)

Shape no. 5 Horizontal projection and pictograms illustrate lumen's structure, an open, responsive system of lightweight, digitally knitted, machine-woven, high-performance, constructive, adaptive, feminine form that provides luminous interior elements, informal networks, social textures, and flexible, transformative, and playful fiber clusters

D. Digital robotecture design approaches

Undoubtedly, the extent of the great impact left by the ease of information dissemination, as well as the methods of digital handling of data, its organization, the speed of producing results, and the complex processors of information systems, which computers excel in solving, which greatly affected the quality of engineering shapes produced by man from machine to architecture. In the past, the engineer was limited to expressing his fertile scientific imagination due to the limited tools for expressing his ideas, which were limited to the studio, paper, and pen. The shapes that we live in our environment, which were made by man, have become more developed in many respects, dominated by the organic nature of the new geometric shape with rounded edges and the complex overlap between the shapes in a way that more meets the expected function of it, in addition to the other aspects of comfort that the new engineering product gives affected by that broad horizon provided by the computer. In dealing with shapes, reconstructing them, and employing them accurately to suit human needs aesthetically, functionally, and structurally.

The great technological intellectual shift had clear repercussions on the design methodology and the mechanisms of producing the architectural form.

D.1 Man-Machine System.

It is the system in which the functions of the human operator (whether it is an individual or a group of

operators) are combined with the machine as a single entity that interacts with the external environment according to a set of data and rules. The human system consists of hand tools and other auxiliary tools with which a human operator controls the process. The capacity of the system ranges from a person carrying a hammer to a person with great power. In other words, it is the system in which the human operator uses his physical energy as a source of energy.

Human machine systems engineering differs from other general and well-known fields such as human-computer interaction and social engineering because it focuses on complex and dynamic control systems that are often partially automated (such as the flight of an aircraft). It also studies human problem solving in natural environments or in highly simulated environments.

The architecture envisioned by default exhibits qualities that are new to architecture. First, interactive architecture displays behavior. Its behavior governs the way the robotic architecture adapts to the individual needs of its users, how it resolves conflicts between them, how it deals with conflicts and opportunities coming from other related spaces, and how it responds to external factors in its environment.

The behavior of a robotic system can be improved through learning. Learning is an essential quality of an interactive system, otherwise it is only capable

of providing automation. Predefined responses are constrained to predefined behavior scenarios.

Through continuous spatial adaptations driven by behavior and learning from experience, the robotic system also evolves over time. This development may have a form of physical change akin to growth. It can also lead to the development of other spatial traits ranging from material properties to spatial organization. Successful development of a robotic system means an increase in multi-objective performance.

In the process of behavior control and development of a successful robotic system the solution is encouraged, and successful ones are removed from the system. New solutions may also be introduced gradually to improve various aspects of system operation. In this way each system evolves over time. Interchange with other systems is possible, ensuring the global evolution of robotics, possibly branching into more distinct "species" in the future.

D.1.1 Intelligent Forecasting Methodology: Intuition and Vision

Intelligent prediction is a set of non-specific operations used by intelligent people to reach the presentation of various issues in the future, and smart predictions can also be issued by individuals who are not very intelligent, but they have proven excellence in certain fields.

One of the important features of a specialist in the future is his ability to imagine the future away from the past, as those who are unable to do so can only estimate inductively about trends, which does not provide the vision necessary for long-term planning.

Science fiction is the best source of intelligent prediction since, unlike future research, it does not link its decisions and perceptions to current reality. As for the axiom, it represents the bridge between knowledge and general knowledge, and it represents the only good source of information in the event of predicting the behavior of a confused system. As for vision, it is the ability to see what others cannot see, and it is an integrated picture of the preferred future that an institution or entity wants to create. Positive visions are characterized by the fact that they clarify the optimal system that an entity wants to establish. It is not a plan, as the plan specifies how to reach a specific goal, but the vision is to define that goal. It is also linked to strategies and actions so that it is not just wishes, and there must be participation from the owners of the entity in setting those. Strategies, which help in determining the areas to be worked on and the use of resources in achieving priorities.

Description of the methodology.

The question is how to reach those smart individuals and not how to prepare smart prediction

as intelligence is something acquired by instinct and then these individuals can be reached through:

- Literary research in all fields and in all sources, especially in the field of science fiction.
- Obtaining from each of the experts who have intelligence their recommendations for other individuals at the same scientific and intellectual level, and so on. It is also possible to obtain these recommendations from specialized institutions in the field of interest.
- Observations in conferences or various gatherings are not only useful in knowing the most intelligent predictor, but also how others accept and interact with him.

D.1.2 Architectural form generation logic mechanism

The architectural design methodology focused on what is called the design logic of the interdependence of shapes, so that studies appeared focusing on the importance of informing the architect of the visual diversity that he transformed in his environment to create the appropriate form.

The generative approach to the formation of architectural forms is one of the design trends that has received increasing attention in the last two decades. This approach is characterized by its ability to give a spectrum of formal solutions that exceeds the number and diversity of the human designer's ability to produce. The use of a generative methodology enables the development of rules Shape production, which enables the designer to control the formal aesthetic standards so that certain formal rules (proportion, proportion, or relationships) are respected, regardless of the difference in the final appearance of the product.

One of the most important directions of the generative approach is what is known as the (grammars shape) approach. The shape rules approach is based on the adoption of a set of laws that are applied in a manner of successive steps to generate a set of designs or a design language.

The rules of form are at the same time descriptive and generative, because the laws of the rules of form generate designs, just as these laws are themselves a description of the forms of the generated designs.

The rules of form are spatial rules and not textual or symbolic rules, and therefore they do not need any kind of translation or interpretation of symbols, but rather depend on laws governing the main formal elements: point, line, plane, volume...etc. The rules of form support emanation, and its laws use formal transformational operations such as addition, deletion, subtraction, and spatial transformations: displacement, rotation, and reflection. Also, one of the most important features of the rules of form is

that it is non-deterministic (and that it produces new designs by including design determinants in the laws). The working methodology for generative form grammar includes the following steps:

- Define shapes.
- Determine the shape of relationships.
- Determine the rules.
- Building Shape Grammars
- Design

D.2 Virtual reality mechanism

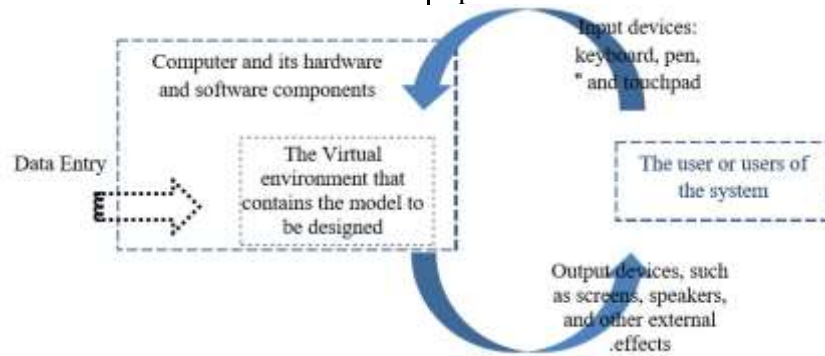


Diagram no. 3 shows the components of the virtual reality system.

D.2.1 Virtual reality: It is a term used in the eighties of the twentieth century in the Oxford dictionary, and it means the use of the computer with its physical elements, software, and other auxiliary tools in authoring participation with reality, and it has become a means of communication between various industrial designers, architects, city planners, academics, and various interested in technology in order to represent the environment and simulate it with vision and three-dimensional interaction.

And the impact of technological development and the digital and robotic revolution on the design methodology of architecture exceeded it to reach all aspects and requirements of implementation, construction, etc. with the help of computers and digital technology.

D.2.2 Use of hologram technology in presentations:

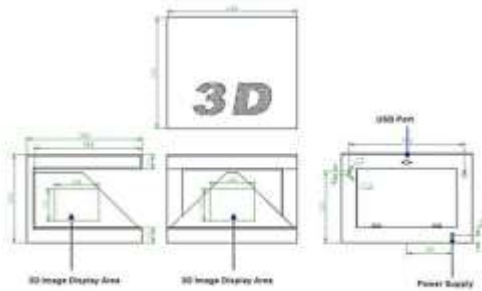
This science in the production of three-dimensional images may appear to be a kind of art or science fiction, but the hologram as a technology has many applications, and it is constantly increasing, so hologram scientists use it to study objects in three dimensions, and the computer's holographic memory is considered the memory of the future, and scientists believe that Humans store information in the brain in three dimensions, and this science can be used in the future in all applications in different aspects of life.

The display may be in the form of a transparent screen on which three-dimensional objects are projected, such as the display of the sunken antiquities in the Milan Museum.



Shape No. 6 A It shows how the hologram is displayed inside the glass box, where the display is inside a tetrahedral glass pyramid. group of holographic display screens in the Milan Museum, where a group of sunken antiquities are displayed on the Libyan coast, which are in the order: (1) the statue of the Greek goddess Hera. (2) the head of the Roman Emperor Caligula. (3) a group of column shapes for the Apollo Museum .

Or to use the glass box method, where the display is inside a glass pyramid and a holographic projector is placed above it, where the image falls on the four



sides, forming a holographic image in the center of the glass pyramid.



Shape no. 7 It shows how the hologram is displayed inside the glass box, where the display is inside a tetrahedral glass pyramid.

Among the most famous of these shows is the holographic display of the head of Queen Nefertiti, which is displayed in the Berlin Museum, and the golden mask of King Tutankhamun, which is

displayed in the Egyptian Museum, to complete the holographic display in the Berlin Museum of Modern Artifacts of Tell el-Amarna in 2012. The Light of Amarna Neues Museum Berlin 5 Dec.



D.3 Biotechnology Mechanism in Design

Biotechnology developed in 1996 with the entry and development of making digital virtual reality for the design environment and building the so-called "Experimental Workshop", which is a model for contemporary architectural education aimed at encouraging the preservation of advanced practices of technology, which led to overcoming the concepts of what is called green architecture or architecture. Environmental, to establish and build an integrated, organic model for design based entirely on advanced technologies and information, so that a complete representation of the life cycle of design, production and use of the design product can be achieved.

The most prominent development for linking technology and environmental solutions is the computer-assisted dynamic modeling techniques that were used to study and test the effect of wind and other environmental variables and systems on the building before its implementation, as it played the largest role in designing modern forms that come out of the scope of the cylindrical shape and shape The traditional spherical to a more complex shape that performs an environmental goal and withstands with high flexibility in front of various types of horizontal forces on the building such as winds and others.

In connection with this, a new type of laboratory was developed to meet the requirements of

technological and digital robotic construction, which is called the "Cybernetic Factory".

D.4 The shape mechanism follows the designer's vision of "designing non-standard shapes".

Non-standard architecture is non-standard architecture. An extension of the contemporary design ideas of Frank Gehry's digital revolution in the free form of architecture and complex geometry that cannot be produced or imagined in its forms without the integrated support of digital technology to assist in the design of these forms. Therefore, the BMW exhibition building in Frankfurt, Germany, is designed by architect Bernhard Franken and his partners. A contemporary extension of these ideas that require comprehensive support during design and implementation by computer digital technologies.

In the mid-twentieth century, architectural theories flooded modern architecture, which clearly adopted the motto of form follows function. Opposite calls emerged, such as Frederick Kessler's ideas, which build the motto of form not following function, but rather form follows the architect's vision, and vision follows reality.

But what led to the failure of such calls at the time was the difficulty of implementing them at the levels of executive drawing and the realistic representation of free, non-standard forms until the digital revolution came to give the architect the ability to reflect his imaginary vision into reality.

At the end of the twentieth century, the appropriate environment was provided for the application of these ideas with the emergence of modern computer technology, which helped the designer a lot in building digital models of the architectural form,

which greatly facilitated the process of developing, changing, dynamic and non-standard modern architectural form, in addition to that overcoming the operational difficulties of this complex geometry of new forms with the help of Computer aided digital implementation techniques.

This is what led Franken to design the BMW exhibition using a dynamic, free and non-standard form, thanks to digital technologies that helped him a lot in designing the shape, as well as the executing company helped in its implementation, as the architect Franken's team used computer tools to generate the architectural form, meaning that there was no prior thinking for the architectural form of the building, as the design came in an image Parametric started from the recommendations of the client "represented by BMW" about delivering a media message informing about the launch of the marketing of the seventh category of its cars, and then Franken's team translated this message into a design program that suits the site chosen for the project, and to convert these ideas into an architectural form, use the design program A three-dimensional that can be introduced to movement from the Maya company, "maya animation", where a matrix consisting of three dimensions was introduced that represents the realistic forces of driving the car, and a study of the project site was started first in terms of the possibility of developing a dynamic shape that suits it, then studying the modeling processes using the Maya program to carry out deformation operations to reach a The appropriate architectural form for the design idea and location.

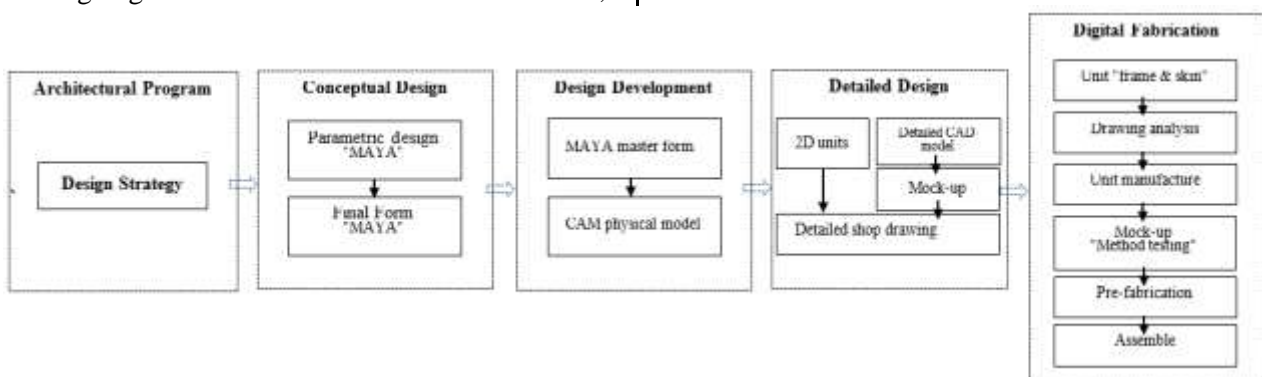


Diagram no. 4 shows the Design and construction process of BMW Exhibition.

The design team did not specify the type of outer shell covering the building, nor even the structural structure of its construction. Rather, it proposed and designed the shape (or shape) of the building first, and then suggested (later) covering the building with a light, flexible, changeable shell of

pretensioned membrane, as well as using the framework structural structure that contains elements Linear and curved, and the reason for proposing such structural and architectural solutions for the shape was to ensure the speed of implementation in a short period of time, in

addition to taking into account the preservation of the fluidity and dynamism of the shape, after many studies and discussions between the architectural and structural staff of the design team.

D.5 Mechanism procedural design of complex systems

It is a mechanism that looks at the design process as practical steps that require a comprehensive briefing on the various information and data that pertain to the environment, the shape, the influence and the influence of the general environment in which it is located, so that the building is similar to a living organism that interacts with its environment as a single complex entity despite the fact that it contains cells, nerves and devices that help it to perform its tasks to the fullest. In his interaction with his surroundings and the performance of his job.

This view of the building as a complex whole system consisting of complex parts in turn creates that total system derived from the general view of nature and how to build complex systems in it that enjoy a high organization without chaos, that the different computer software systems at the level of computer programs and at the level of communication between systems is easy to understand. The possibility of building a large computer interactive environment that can collect information from members of the design team of various specializations to try to manufacture informational cells that represent the small parts that can be installed and self-interacted to form an informational entity for virtual buildings that represent a complex system of interactions that meet the aesthetic, functional, economic and construction goals to be achieved in the building and in which it is translated. After physical physical forms using robotic manufacturing techniques or architectural forms, they will be similar to living organisms that respond to their environment and interact with it.

D.6 Digital programming mechanism

They are mechanisms that rely on direct text writing that uses hidden commands and capabilities in digital software. The computing process appeared in the fifties of the last century:

In 1950 through a program proposed by Professor "Hanaat" the program PRONTO as an initial form of the AutoCAD program. In 1960, Professor Christoph Alexander designed Object-Orientated Programming

Parametric appeared in 1962 at the hands of the Italian architect Luigi Moretti. In 1965 a quantum leap began when Ivan Seferlent developed the Sketchpad program and used the pen in a design process for the first time, where he draws a line

defining from the beginning of the point to its end (Zero).

The AutoCAD program appeared in 1968 in its current form at IMT University through a research team, and the developments of the program helped urban planning in 1970.

1975 Generator program appeared by Cedric Price.

- In 1980, artificial intelligence appeared, and computers began to be used personally.
- During the period between 1980 and 1990, (CAD. Cam -3d Printing) appeared, used by Frank Gehry, and developed that system.
- In 1982, the Graph iSOFT company was founded, and it started working on the ArchiCAD model, and at the end of the same year, AutoCAD appeared through Michael Raydal, and then it was bought by Autodesk.
- In 1985, Building Information Modeling (BIM) technology appeared in its current form. Then ArchiCAD programs appeared using CAD and BIM, the Pro/Engineer program from the establishment of Parametric Technology.
- In 1995, 3D Max appeared.
- In 1997, (Industry Foundation Classes IFC 1.0) appeared for specialists in the field of BIM.
- In 2000, the first model of Grasshopper, GRASSHOPPER, and in the same year, Revit appeared by Charlotte Software, Chartered Software, and IFC2.0 appeared in the same year, and two years later, Autodesk bought Revit.
- In 2005, Smart Building appeared in a company specialized in BIM.
- In 2008, BIM witnessed wide acceptance by governments, and it began to be used as a mandatory program on some projects.
- In 2011, China widely used Building Information Modeling technology in its projects.
- In 2013, IFC 4.0 appeared.
- In 2016 in Britain, BIM became mandatory to use it in projects from a specific budget of 5 million and above, and the appearance of BIM Arabia magazine and company in Al Watan Arab in 2015.

These mechanisms require the designer to have knowledge and skill in programming, and the digital form is built or created using direct digital programming mechanisms, which are based on one of the following two main methods:

D.6.1 Algorithmic method:

Using this method, it allows designers to discover meaningful bodies within more complex Geometrical patterns. The environments in which this method operates are distinguished by being

mathematically constructed, where the methods that the engineering subject can form are determined when modeling it, and then a digital simulation of natural processes is made through this method.

Examples of well-known algorithmic methods are the relationship of golden pieces, the logarithmic spiral generator, where it is possible to see the shapes and organizations in nature as a final result of internal growth laws - such as the spiral - mixed with external forces acting on them such as the sun, wind and water. In this method, such models are simulated digitally through Writing its algorithms as interviews to the laws of regularity of natural shapes to find a design code called the genetic code.

Robotic architecture will benefit from engineering programming with complex algorithms that allow engineers to visualize the building, reshape it, and improve it to suit their needs and achieve the intended goal. This tool allows the engineer to benefit from artificial intelligence, work freely, and create designs with unlimited creativity.

Grasshopper program: It is an addition to the Rhinoceros program, dedicated to modeling algorithm-based parametric programming and creates visual algorithms and software, so that the user does not need prior knowledge of computer programming languages, and allows designers to make various generative designs. Algorithms are designed and made using Components) where they are linked in the drawing space of the program in different ways until we have multiple shapes.

D.6.2 parametric style

This method uses parametric equations to bring about a change in the architectural form. Parametric is concerned with the possibility of formulating a set of variables in functions based on mathematics. This leads to the generation of a field of possibilities, which is particularly useful in the systematic control of complex curved surfaces. A family of parametric variations can emerge from the characteristics of one initial form. However, they vary in their dimensions or shapes, as they are two cases of the same design, but they have been placed within the framework of certain determinants, but the exact dimensions and precise identification of the initial forms of these elements vary from an initial form to two others. Such mechanisms are exploited in the initial stages in the fields of architecture and interior design. Their outputs are shown visually. Parametric programs depend on modification. The primary three-dimensional elements, such as the cube and the pyramid, include in their construction flat shapes

that serve as limits to the size of the mass, and they greatly interfere in defining the body and in giving it characteristics and effectiveness affecting perception. From here, the change in the sizes of shapes and their areas is an effective means of innovation. The installation of flat shapes and their area whenever we get a greater number of formal and plastic relations, which will be the basis for a new thought.

The goal of parametric design is not to produce a beautiful shape, but rather for a different and advanced structural design.

Specialized tools in parametric design are:

1- Grasshopper For Graph iSOFT & Dynamo for Revit

Parametric design: It is linked to the rules of controlling the geometrical relations within the morphology of the shape.

2- BIM:

It is the digital representation of the physical and functional characteristics of the building, whether at the level of construction, roofing, or architectural facades.

3- Parametric modeling:

It is the creation of a digital model based on a series of programmed rules or algorithms known as information. We can define relationships and their nature and leave complex calculations to the computer after knowing what we want and what their inputs are.

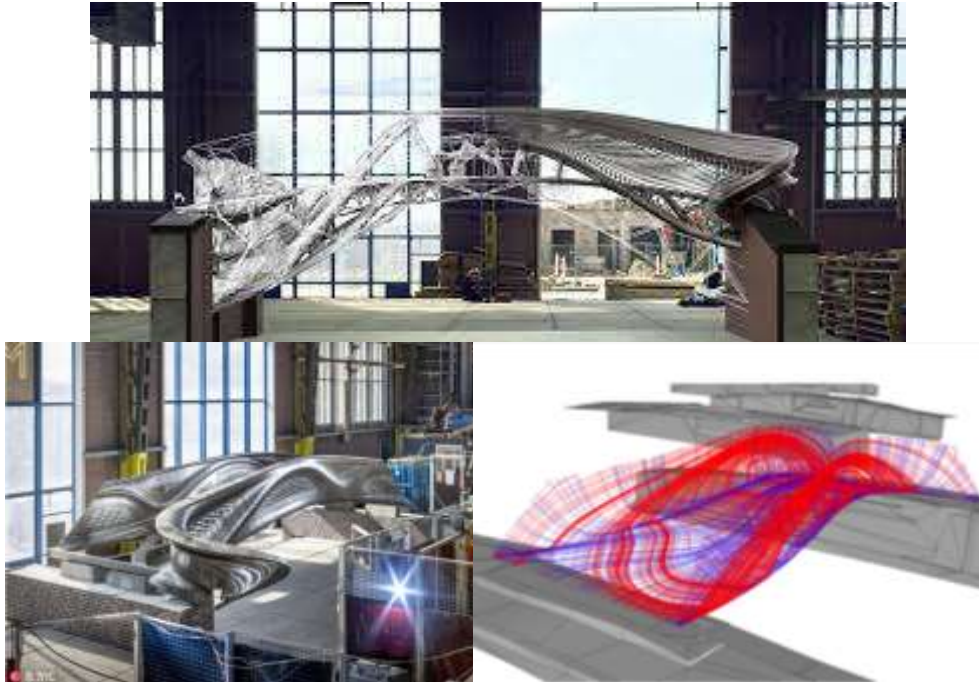
In terms of the integrated building, the parametric design depends on inputs, relationships, algorithms, and formulas, and is matched by the BIM, as it depends on the various engineering sciences related to the structure of the building at the level of the facade and elements of the building, which is mastered by the parametric design methodology based on a point, line, and surface qualified for implementation in any of the design fields.

Parametric modeling software:

- Associative modeling.
- Procedural modeling.
- Data flow modeling.
- Component modeling.

Modeling is based on four axes:

- No Iteration) SketchUp
- Multi Operation Iteration (Grasshopper) Iterations and multiple selections that can be measured and modified for reference.
- Single Operation Iteration (ArchiCAD, Revit) Single iterative modification with no other options.
- Dad Levels) Digital Architecture Design Level) Personal division.

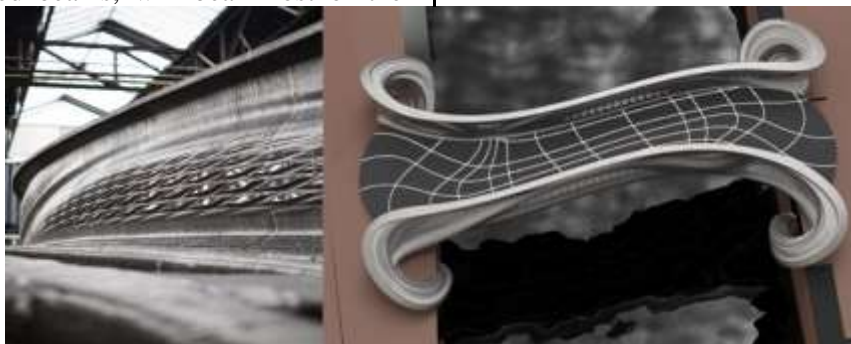


The bridge was made of a special type of stainless steel with a length of up to 12 meters, and it is considered the largest 3D-printed metal structure in the world, and it was implemented in cooperation with the American software company Autodesk.

MX3D has developed a six-axis robot that can do free-form 3D printing on a large scale. While traditional 3D printing takes place inside a printing device, this new type of technology can print in mid-air without traditional restrictions.

The balustrades on both sides of the bridge, which are bio-box-shaped beams, will bear most of the

load. Furthermore, since it was not clear how the material welded piece by piece would respond to tensile stress, the design makes it so that the compressive forces would act on the bridge in the first place.



Shape no. 8 Manufacture of the first solid bridge in the world using 3D-printing technology, with a length of 12 meters, and it will be installed early next year across the “Oudezijds Achterburgwal” channel, in the De Wallen area, the largest and most famous area in Amsterdam, and it will be intended for pedestrians and cyclists.

Conclusion:

In conclusion, the design of robotics and artificial intelligence has a significant impact on the internal spaces of various settings. With the rapid development of digital technology, the integration of these technologies into internal spaces is becoming increasingly common, providing a range of benefits in terms of productivity, efficiency, and quality of life. The design of these spaces should consider the needs of robots and artificial intelligence, as well as the safety and convenience of human occupants.

1- Robotecture and AI technology have the potential to revolutionize the interior design

industry by streamlining the creative process and increasing efficiency.

- 2- With the help of AI, designers can create highly detailed 3D models and renderings in a fraction of the time it would take using traditional methods. Additionally, AI can help designers to optimize designs for functionality, sustainability, and cost-effectiveness.
- 3- However, there are also potential drawbacks to relying too heavily on AI technology in the creative process. It may lead to a loss of individuality and creativity if designers become too reliant on pre-designed templates or algorithms to guide their design decisions.

Moreover, the human touch is crucial in interior design, and it cannot be replaced by technology entirely.

- 4- the integration of robotecture and AI technology in the interior design industry has the potential to create a more efficient and effective design process while also providing new opportunities for creativity and innovation. It is essential to strike a balance between using technology to enhance the creative process and preserving the unique creativity and personal touch that make interior design a highly valued art form.
- 5- AI can help designers to generate and explore a wide range of design options quickly, allowing them to test and refine their ideas more efficiently. AI algorithms can also assist designers in optimizing designs for factors such as functionality, sustainability, and cost-effectiveness.

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