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Enhancing Personal Identity for Interactive Interiors via Biometrics: Inpatient Rooms in Hospitals as a Case Study

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KEYWORDS:
IEQ Indoor Environmental Quality, Space Identity, Human Biometrics, Kinetic Architecture, Interactive Architecture, Healthcare Buildings, Mental Health, Human Biofeedback

***Abstract*— Today, the effects of indoor environmental quality on the health and well-being of people is a very important topic and require a comprehensive approach in which the main environmental factors are simultaneously assessed and enhanced, With the aim of improving their health and psychological condition and targeting the disabled, the handicapped, and patients in medical and psychological treatment centers for the elderly. With the multiplicity and diversity of the category used for these examples, it has become difficult to determine the requirements of each individual user and provide optimal conditions to speed up the recovery process and improve the quality of physical and psychological health. Sometimes the user may not feel comfortable without knowing the reason, despite the availability of many requirements and facilities for him, Thus, the feeling of not belonging to the space is enhanced, due to the lack of designs and determinants with symbols and connotations that mimic the nature of the user, his requirements, beliefs, and his physical and moral conditions. Therefore, many interactive kinetic design stimuli contribute to giving an architectural imprint for each user, facilitating interaction with him and simulating his conditions, or even contribute to improving his psychological and physiological condition in order to achieve the highest productivity of the activity he exercises in the space. Certainly, this in turn enhances the user's belonging to his or her residing environment and creates a personal identity for the architectural design based on his biometrics. This research expands the perceptions of design thought to improve the emotional experience of the human being within the space, and This approach is a framework for transforming the built environment into a networked organism that is intelligent, empathetic, sensitive, and adaptable, But under the overall control of the user, And that is through biometrics that is used as inputs guiding the vocabulary of the dynamic interactive architecture of the interior design, For direct interaction at the appropriate speed to the current conditions of the patient in real-time.**

I. INTRODUCTION

TODAY, the main aim is to improve the quality of the physical and mental health of the user and the efficiency of his behavior by linking human perception and emotions to the building environment [1].

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Where it focuses on the ability of the intelligent physical adaptive spaces to respond to the user's physiological needs, and that is based on its biometrics, which is monitored through sensors and cameras to monitor the user's behavior. Contributing to this, technological progress in interactive architectural designs with the occupants of the building, in addition to modern techniques in the field of dynamic architecture and modern architecture techniques and smart materials that respond to the interactions of users in the internal environment of the building.

Therefore, this research seeks to develop smart design visualizations more interact with the user's physical and mental condition, so that it will become an interface to raise the efficiency of the patient's room or the target person and reduce the length of his stay and the speed of his hospitalization, given the availability of optimal environmental conditions within the space that directly affect him according to indoor environmental quality standards, where these interfaces can learn in real-time from the behavioral patterns of the inhabitant and reduce the chances of anxiety, tutu, depression and physical collapse of the state of the body. To achieve these goals, it is necessary to integrate interactive computing devices, dynamic self-tuning architecture vocabulary, interactive control systems, smart emotion detectors, human behavior, and physical current sensors of the patient's body. So, the goal is to blur the lines between the digital and biological fields, where physical electronic spaces can be created that can (feel), so that the controllers are the user's mind, feelings, physical state, and mood, then these mechanisms are combined with a dynamic, interactive, intelligent architectural system without the need for manual reset.

II. USER IDENTITY IMPACT ON INTERIOR DESIGNS:

Sometimes we feel uncomfortable while walking in some spaces, and this turbulent feeling is due to several factors in the interior design, which have many noticeable effects on the communication and emotional balance of the user. The user interacts positively with environments that fulfill his psychological and social needs, integrates his understanding with an understanding of space, and when he matures connects his various memories and experiences to the places in which they occurred, and forms the user's images of those spaces [1]. Interior designers develop plans for meaning-enhancing spaces for users who experience them, as this means transforming spaces into places, and these experiences can affect future experiences within the space[2]. Most of us are affected by the spaces in which we spend most of our time, such as work, home, school, etc., and this theory can be called attachment to place, or place and identity, or sense of place or dependence on place, so it can be considered attachment to place is the emotional link between users and their environments [1]. So place identity is the user's feeling of connection to a place when they are psychologically invested, and it essentially becomes part of their self-identity [3].

Any architectural space consists of material and moral components that contribute to defining the identity of the place and its relationship with its users, with their different needs, circumstances, requirements, cultures, genders, and ages, so it is important to describe the spaces through some elements and determinants in order to facilitate their classification architecturally and functionally according to the design settings required for each user while he was inside it. Therefore, the different design inputs among the users are one of the indicators of defining the identity of the space and consolidating the relationship between it and its user, with the aim of achieving the quality of life within the space.

(Fig 1) shows some of the characteristics that can enhance the feeling of comfort for the user within the architectural design of the space.

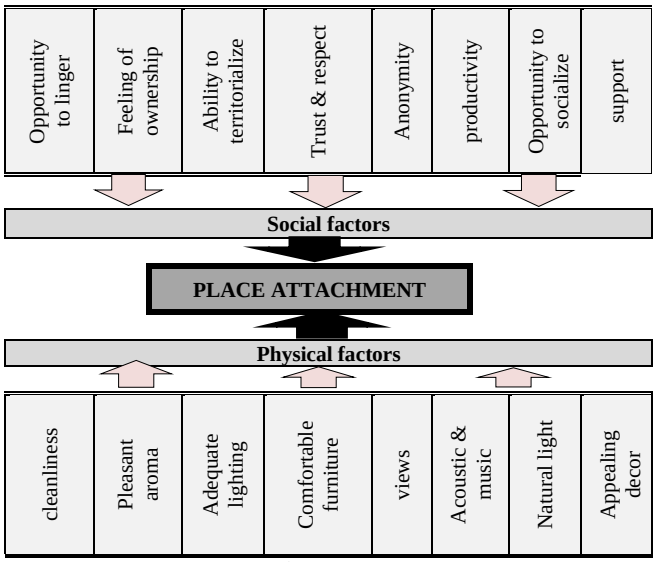


Fig. 1. Place Attachment Model for Social Factors and Physical Factors [4]

During the thinking process to develop plans for interior spaces, relying only on solving architectural problems, developing different designs for the space, and ignoring aspects related to the positive feeling of a person inside the space, which negatively affects the comfort and well-being of the user and weakens his belonging to him. This is due to several reasons, one of which is the presence of the user in these internal spaces mainly for 90% of his age, and it also includes most of his daily practices and activities[5]. Therefore, these internal spaces have a diverse impact on the user, sometimes a feeling of comfort and distress, despite the availability of many requirements and means of comfort for him, and the person may not be able to determine the causes of this feeling, and thus reinforces that feeling of not belonging to the void, This is due to the absence of designs and determinants with symbols and connotations that mimic the nature of the user, his requirements, beliefs, and his material and moral conditions. Therefore, it is important during the development of architectural designs for architectural space, to determine the nature of the user, his conditions, and requirements in order to achieve his positive comfort, and that is through several design vectors that contribute to giving a fingerprint to each person that is reflected on the desire residing in him, making it easy to interact with him and simulate his

conditions or even Contribute to improving his psychological and mental condition to achieve the highest productivity from the activity he practices [6].

III. POSITIVE DESIGN IN INTERIOR DESIGNS CONSIDERATIONS:

Interior design has a vital and important role in promoting positive communication between interior spaces and users, enabling them to meet their needs, perform their activities and maintain their safety, in addition to self-realization and belonging, and enriching these designs with features that reflect the ideas, beliefs, and identity of users [7]. In general, the reason for the different design processes from one society to another is due to the contradiction between cultures and customs as a result of the different lifestyles of peoples, and they are also affected by the needs of the internal environment and the external environment.

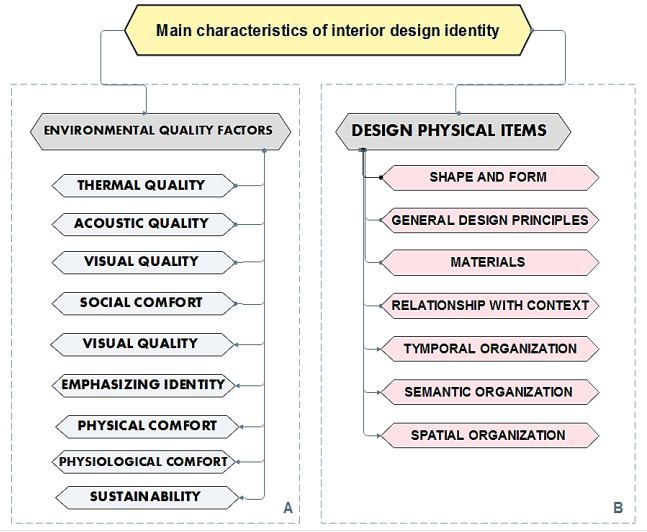


Fig. 2. Main characteristics of interior design identity A [7] , B ([8]

The methods used to achieve a positive atmosphere for users with the presence of natural, social, environmental, and functional conditions are represented in these design processes, so there are many characteristics and considerations that need to be achieved in the design of internal spaces that contribute to achieving the quality of the internal environment for users by directing the design to alternatives that suit their requirements, clarifying these characteristics and considerations as it shows in (fig 2).

IV. IDENTITY IMPACT ON PSYCHOLOGICAL HEALTH:

When social, personal, and cultural identities are reflected in the places in which a person lives, works, or spends a great deal of time, it affects his perceptions of them. It is appropriate that these places remind us of the main feature of each of our identities, as the interaction between space and person is always complex [9] , Whereas the person defines the space and vice versa, and the person gives the space meaning and vice versa. When we begin to absolve ourselves in the places we inhabit, then a sense of psychological identity grows around the structure of the void [10]. As for the sense of psychological identity and its interactions with interior architecture designs, it occurs in all areas of a larger scope, such as religion, nation, culture, city, gender, social class, and social roles, as well as in smaller areas such As family, neighborhood, homes, and rooms, in general, it can be said that every ethnic group or civilization presents architectural identities defined according to its traditions and cultures at different times [9].

Therefore, it is necessary to realize that does not depend entirely on the form and composition of physical space only but is linked to the feelings and meanings, and there are many factors that form the identities of nations and the expression of selves, such as ways of raising children and the structure of the family and relatives.

V. THE POSITIVE DESIGN CONFIRMS THE IDENTITY AND ITS EFFECT ON HUMAN BEHAVIOR

Interior design can affect user behavior positively or negatively, so the interior designer can direct users to specific behaviors, through the skills and abilities that he possesses and by using his own tools, including the elements of interior design, and then identifying the user's behavior to confirm his personal inclinations and his various positions to confirm identity. Therefore, interior designers must create appropriate environments for the formation of positive behavior, through the exchange of good feelings with others, achieving good levels of psychological needs, such as privacy and safety, and enhancing human interaction. There is also a relationship between physical spaces and human activities, and any change in any of them will affect the other [7]. From here we discover that positive interior design is concerned with understanding the mentality of each user individually, because he will be able to form a way to respond to the required changes in the design, so it is necessary to understand the way the user sees the new interior design, to be able to reach the design point that is affected by the change of behavior. I think that directing the human aspects of users through influences, whether kinetic or sound, in order to provoke their feelings, is one of the best ways to modify negative behavior, and it is preferable if smart technologies and tracking sensors are integrated into this system, this will contribute to more accuracy in drawing the required scenarios and stimuli Positive feelings, based on vital data observed for each individual user.

A. Relative Identity Determinants in Healthcare Interiors:

There is no dispute that the design identity of architectural spaces must be achieved according to the different natures of their users in any internal space that accommodates humans because the achievement of relative identity is a basic requirement under which all human needs fall according to Maslow's hierarchy, but there are many applications that take the requirement to achieve identity as a priority Major design, these applications include all treatment environments, disability

centers, elderly care centers, mental health rehabilitation centers and specialized treatment housing. This is due to several reasons, the most important of which are: the variation of the target groups, the danger of overlapping the content of the database within it among users, requiring high accuracy in monitoring each user's information, its noticeable impact on the status of users for these particular spaces, the importance of modifying or including any new data within its database, and finally strengthening Social distancing and reducing contact recently after the outbreak of the COVID-19 pandemic. The data of the users of these spaces are entered into a specific database, using contemporary smart technologies that contribute to the flexibility of design and the possibility of creating different scenarios for the architectural void, and the enhancement of architectural vocabulary with the possibility of interacting with the inputs of each user individually according to his requirements, needs and circumstances, in addition to the smart interactive sensors that Track the user at such a level as in followed (fig 3) [11].

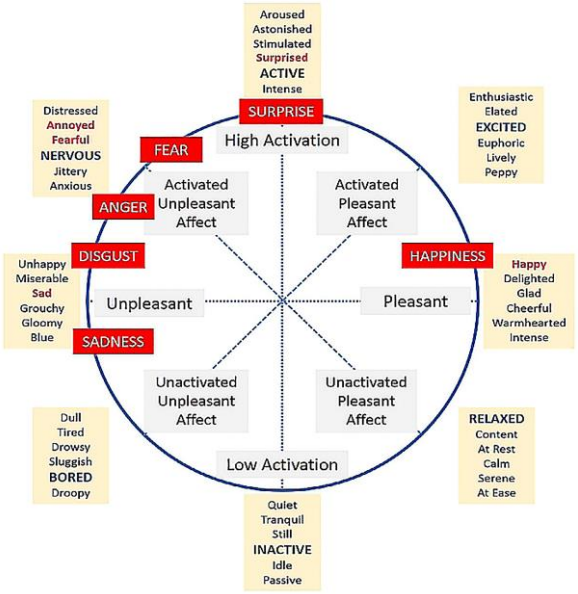


Fig. 3. Circumplex model for emotion detection in smart health environments.[11]

Through this integrated structure, it is possible to create a smart interactive environment that contributes to the treatment of the patient and contributes to the speed of his recovery by improving his psychological and physical conditions, through the formation of the void and its interaction with the conditions of the user in real-time, and thus every user becomes an identity designed for the space it inhabits.

VI. INTERIOR DESIGN IDENTITY DETERMINANTS THROUGH BIOMETRICS

We can summarize the determinants of this design identity in five determinants monitored by trackers, vital sensors, and surveillance cameras integrated into the design (table 1).

TABLE 1.
THE FIVE MAIN HUMAN BIOMETRICS THAT EFFECT ON DESIGN IDENTITY (THE AUTHORS)

No	FACTORS	INCLUDE
1	physical expressions & body movement	facial expression, body motion, touch, Movement routine
2	Facial reactions & Gesture [12]	Gaze, Vocal information, verbal communication, mental states
3	Biofeedback &physiological state	Heart rate, Pulse, Blood pressure, Breathing levels, Temperature, Perspiration, CBC test
4	Human behavior	Movement routine, Gaze Vocal information, Body language, semantic speech
5	Mental & psychological response [12]	Heart rate, Pulse, Blood pressure, Breathing levels, perspiration, Muscle actions, Skin conductivity, Temperature

The main purpose of any internal space inhabited by people for long periods of time, for the purpose of residence, temporary housing, treatment, work, or other activities, is the ability to obtain the highest efficiency of the goals of establishing this place, and this will be achieved through the ability to control the Interior conditions and design vocabulary for this design. It is worth mentioning that one of the features of the positive design that achieves belonging to the users within it is the design that simulates the identity and requirements of the user (table 2), and seeks to provide all his demands that achieve comfort and quality of life.

TABLE 2.
PATIENT REQUIREMENTS AND PERSONAL INPUTS TO DESIGN RELATIVE IDENTIFIED INTERIORS (THE AUTHORS)

No	Requirement	INCLUDE	
1	Biometrics	monitoring	**facial expression** - facial electromyography - eye tracking
			physical state [13] - electroencephalogram EEG - electrocardiography ECG - skin conductance response SCR
2	tracking	Body reactions	
		Routine behavior	
3	internal	psychological response	
		emotional response	
		cognitive response	
4	user personal data	ID	Gender – age – job – culture – religion – ethnicity - socioeconomic
		Infection phase	**Ex: Cancer types** [14] **:**(Bladder, Breast, Colorectal, Kidney, Lung, Lymphoma, Melanoma, Oral and Or pharyngeal, Pancreatic, Prostate, Thyroid, Uterine)
5	Built environment	Human sense	Sight – hearing – touch – smell – taste
		Architecture design	Lighting – colors – form – geometrics – enclosures – layout – view – sound – temperature – humidity – material – texture

The identity of the building occupants is challenged by achieving the internal environment quality elements such as air quality, heat, acoustics, and positive views. As for the architectural design of the space, there must be many design alternatives for each user and his circumstances, and the interactive, dynamic, smart, and responsive design features contribute to this, through which all elements of the architectural design of the space can be controlled, including floors, walls, ceilings, openings, materials, and others.

Through the design guidelines of the aforementioned confirming identity, a void is formed that resembles the owner who inhabits it, and thus positively affects the psychological and physical health of the therapeutic environments and contributes to the speed of recovery. These routers are linked to a set of monitoring and tracking systems and smart sensors, and then analyze the data that was monitored through them, which includes physiological and psychological data, gestures, behavior, movement, and facial expression interactions, as it is translated in real-time, and sent to the motor control systems as commands for interactive movement in Design vocabulary, as it responds directly to the conditions of the person being treated, seeks to achieve the optimal therapeutic environment for him, and improve the environmental conditions surrounding him (fig 4).

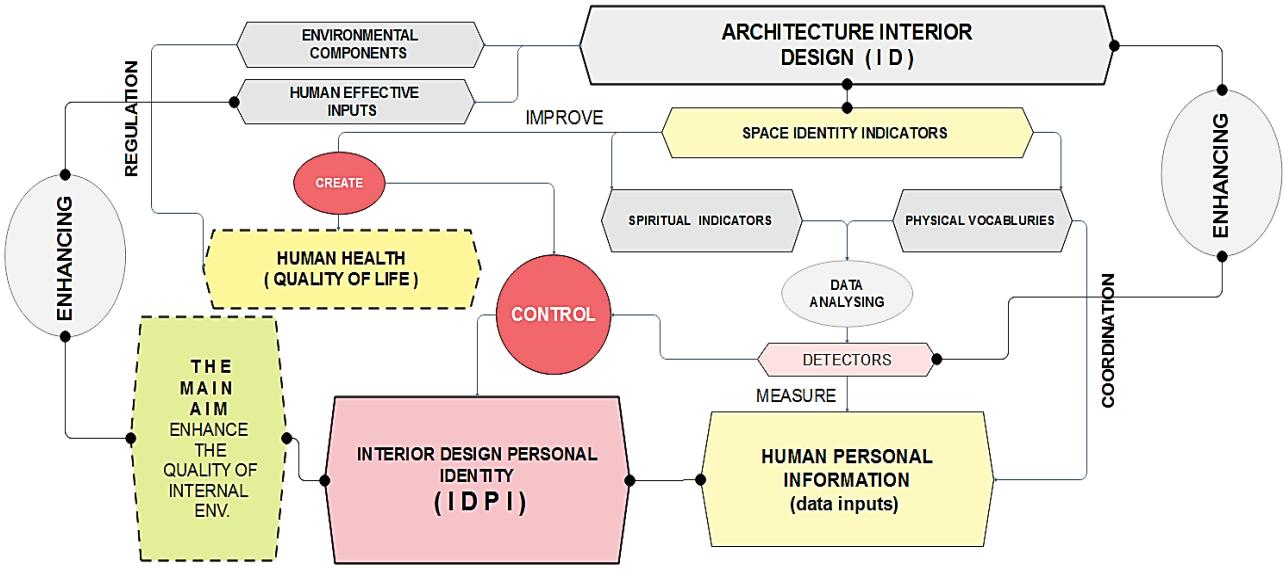


Fig. 4. the relationship of architectural vocabulary and characteristics with biometrics for the user to create an identity for interior design.(the authors)

VII. Interactive Application Analysis

The choice of future interactive applications depends on the extent of their diversity in terms of the types of technology and mechanisms used in order to achieve flexibility in the design, where the set of relative indicators that are monitored as a catalyst for the interactive design interaction, these indicators may be represented in human biometrics, biofeedback characteristics, or The patient's gestures, monitoring the routine of his daily activities and actions. We will try to analyze a set of examples that apply the principle of interaction and being affected by the user's identity and personal data, as well as sensing all his vital data and biofeedback in real-time, translating facial gestures and analyzing his movement and daily activity and its implications that threaten his health or raise its efficiency, and how these technologies can be dropped and used in Applications in treatment centers or even in the built environment for the average user in the future, so the space becomes responsible for enhancing the quality of the user's health condition and the safety of his physiological and psychological condition. These techniques and interactive designs are applied to the architectural vocabulary of hospital rooms and medical care centers.

A. The Reconfigurable System:

This application is a wall system with an interactive, fast response and is subject to change in shape and reconfiguration, based on the variables of the surrounding environment, in order to improve the physical and social environments for users [15]. This system aims to create multiple human spaces with different uses and able to meet the changing needs of users, and this was achieved through: first, manufacturing, designing, and programming a wall system that has the ability to be reconfigured, and secondly by doing tests for the developed system, where many scenarios were examined and that with the aim of developing dialogue between people, buildings and the environment. After looking at the different aspects of the

structural design and its relationship to the user, the model was developed by developing a set of prototypes as design alternatives, most of which were converged during the reconfigurable design stage (fig 5). Three possible scenarios were proposed to reconfigure the system, which includes: firstly (the incubation scenario), through which the wall is reconfigured so as to create a positive space that attracts users in a concave shape, secondly (the expulsion scenario), through which the wall turns into The convex shape so that it creates a negative and repulsive space, and a third (the demarcation scenario) where the shape of the wall is straight, and thus these three scenarios have an important role in developing the system and enhancing its relationship with users. The system collects data in a responsive interaction mode from the surrounding environment by using built-in sensors. The data is analyzed and reported to the structure to determine the appropriate configuration of the wall.

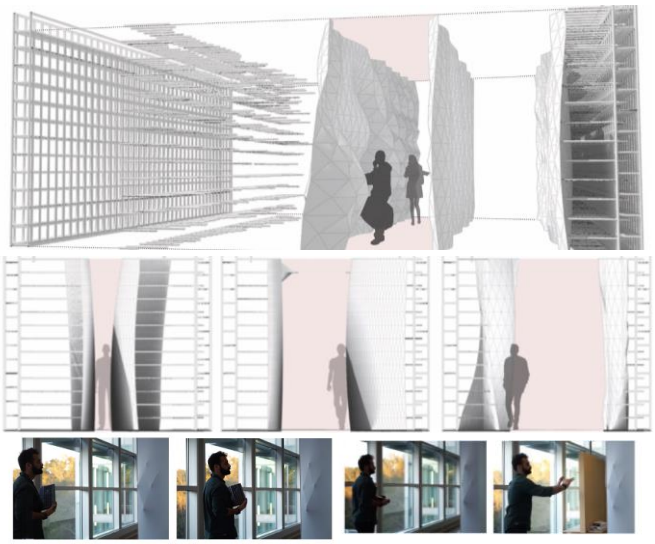


Fig. 5. Prototype of the Reconfigurable Wall System [15]

Then when passengers approach, for example, certain areas, the wall is formed with the appropriate scenario and interacts with users, for example in peak hours in the airport corridors, the number of users is more than the rest of the time, and it is not preferable to wait in this area, so the wall system is transformed in a reasonable way so as to change the nature of the space to provide more space or to avoid parking in this area. This responsive configuration can be used with users in therapeutic and medical buildings, especially in spaces that allow the gathering of a number of users, such as residence rooms, isolation rooms, and others. They are of great importance in the treatment spaces for those who are unable to move, whether injured or elderly, as the response of these structures to the user's movement contributes to anticipating behavior and physical movements and contributing to avoiding falls and collisions, and helping to practice the daily behavior of movement without being restricted to the presence of a human assistant or nursing.

TABLE 3
THE RECONFIGURABLE WALL SYSTEM ANALYSIS
(THEAUTHORS, BASED ON [15])

Type of Space/application	Reconfigurable Wall System
Interior/ Design Elements	wall
Functional Usability / Design Shape	Interactive/ Dynamic, Folding, Parametric, Fabrication, and programing of an interactive, responsive
Target Achievements	- Unique, improving occupants' social and physical experiences of the architectural space. - To create multiple human spaces with different uses and able to meet the changing needs of users. - Developing dialogue between people, buildings, and the environment. - Designing a Responsive Structure, Reactive to Socio-Environmental Conditions.
Typology of Kinetic	Architecture, Responsive, Kinetic, The system collects data in a responsive interaction mode from the surrounding environment by using a built-in sensor, The data is analyzed and reported to the structure to determine the appropriate configuration of the wall.
Kinetic Shape	Origami, Parametric, Transformation, Curvature, and concavity
Interaction Solutions	Saving Spaces, a response to the surrounding environment aiming at improving occupants' social and physical experiences of the architectural space
responsive determinants	Motion tracking –human behavior
Control systems	Collecting data from the surrounding environment using Kinect, reacting to the skeletal mapping viewed in Rhinoceros and Grasshopper.
Proposed application in healthcare Scenario	in therapeutic and medical buildings, especially in spaces that allow the gathering of a number of users, such as residence rooms, isolation rooms, and others. Treatment spaces for those who are unable to move, whether injured or elderly, as the response of these structures to the user's movement, contributes to anticipating behavior and physical movements and contributing to avoiding falls and collisions,

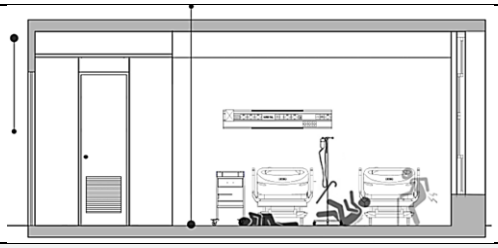
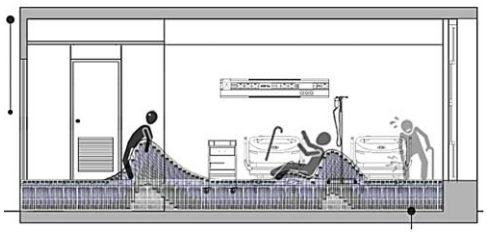
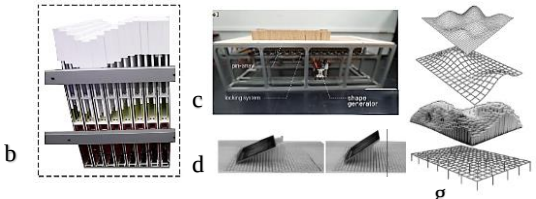
Suggested application in the therapeutic space:

1) Fall resistant floors:

Some sick cases are related to accidents or physical injuries that affect the nerves, bones, muscles, or brain so that they hinder the patient from movement, they need a period of physical rehabilitation to contribute to the restoration of the injured parts to the normal position, by doing some exercises and different physical positions, Therefore, here the patient needs the help of the nursing staff, and not fall, which may complicate his condition, but what if the floors serve as a nursing staff supporting him during the movement?.

This is what we proposed in this application, which is that the floors can be interactive with the user's condition and position, and measure the distances between his body parts and the surface he walks on, in addition to monitoring the biometrics that includes body language, facial gestures, and physiological measurements, and through all these inputs, the Sensing how to fall, and then trying to take a reverse position to avoid falling, as the formation of these floors, which includes a set of smart hydraulic jacks and a highly flexible and stretchy vinyl layer, contribute to this.

TABLE 4
A PROPOSAL TO DESIGN INTERACTIVE FLOORS WITH THE USER'S MOVEMENT TO RESIST FALLS. (THEAUTHORS)

	In this case, the nursing staff must be monitored, otherwise, he may lose control and lead to Falling accompanied by the symptoms of collision that worsen the situation. The floor finish appears non-slip and non-shock resistant.
CASE 1:Walking unsupervised.	
In one of the treatment stages for physical injuries or physical treatments, the patient is asked to walk continuously to contribute to the treatment of his physical illness or to lubricate the movement joints and restore their normal movement and contribute to the speed of recovery and other reasons.	
 a	What if the walking path designated for the movement of the patient in this period of physical therapy is designed to interact with his movement and senses the distances between movement, where it is possible to monitor biometrics that indicates confusion, imbalance, and nodding of the fall, and thus respond in real-time with resistance to falling, and also help To stand and straighten the physical position.
CASE 2: Walking with biometrics	
Shapeshifting (f) floors are modern designs that interact with the movement of users, where their units are inserted within the raised floors, and controlled through hydraulic presses linked to smart motors that receive their response signals from biometric sensors installed within their structure, thus enabling accurate monitoring of the movement and location And the position of walking above it.	
a [16] , b [17], c [16] , d [18], e [19], f [20] g(the author)	
	To maintain the purity of the internal environment of the patient's room and free from bacteria and microbes, these units can be covered with a hygiene material suitable for the therapeutic environment, but it is distinguished by flexible expansion and the ability to return to the original position without sagging. This material is highly elastic and moldable stretch vinyl.

B. *Prototype of Ghandi Cyper Kinetic System:*

In Gandhi research, she implemented an experimental model that implements simulation, development, and manufacturing techniques to be able to reach a design method capable of influencing the sense of space, through the intertwining of artificial, physical, and virtual dimensions of space, where she achieved two goals in this project: Firstly, analyze and measure vital signs and then translate them These references to changes in the structures of adaptation [21]. In its experimental model, it considered that biological and neural signals are of great importance in determining the feelings of users, and contribute to the treatment of autism, depression, and post-traumatic stress disorder in sufferers (fig 6).

In its approach, it relied on the use of emotional computing and creating spaces that have the ability to be reconfigured, and it also used vital signals such as (skin conductivity, sweating, heart rate, muscle, sweat secretion, and body temperature) for users, in order to respond independently to their needs and feelings. Among these responses in this model is a change in the location, size, and shape of the window, display screens, walls, or the general shape of the space, which is good for improving user status. This data will help to link emotions with biological data and the ability to change the built environment according to the feelings of users.

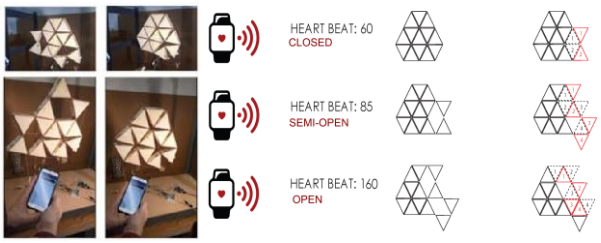


Fig. 6. Emotional interaction via touch commands and wall reconfigurations based on tactile collected data.[21]

This configuration can be used in the accommodation rooms by activating the electronic sensory nursing role, where emotions, gestures, facial reactions, physical response, movement behavior, and the changing results of biofeedback during treatment are sensed, and all of them are translated as alert signals to the architectural vocabulary surrounding the room for optimal response and achieving the actual requirement in this Time to achieve the maximum environmental quality for the patient, which helps him to speed up the recovery process.

TABLE 5.
GHANDI CYPER KINETIC SYSTEM ANALYSIS (THEAUTHORS, BASED ON [21])

Type of Space/application	Emotive system
Interior/ Design Elements	Kinetic system
Functional Usability / Design Shape	Interactive/ Dynamic, Expandable, Parametric, fabrication, and programing of an interactive, responsive
Target Achievements	- An experimental model that implements simulation, development, and manufacturing techniques to be able to reach a design method capable of influencing the sense of space. - considered that biological and neural signals are of great importance in determining the feelings of users. - Link emotions with biological data and the ability to change the built environment according to the feelings of users.

Continue in the next page

TABLE 5: Continued

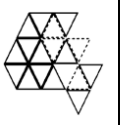
Typology of Kinetic	Architecture, Responsive, Kinetic, Cyber, Mechanical
Kinetic Shape	Dynamic ,Origami ,Parametric
Interaction Solutions	Illumination and operation of the wall prototype using user's emotional data, Emotional interaction via face gesture, vision commands, mobile app, and wall reconfiguration based on facial, tactile, and visual emotional expressions.
responsive determinants	facial reaction – biofeedback (physical state)
Control systems	the smartphone app, voice, vision, and emotions
Proposed application in healthcare Scenario	-Among its many attributes, it has significant implications in the medical field, providing augmented assistant living for people with physical disabilities, motor system disorders, elderlies, and neuromuscular diseases, ultimately empowering them to regain control over their environments and live a more equal and independent lifestyle. -Help children with autism spectrum disorder (ASD), who suffer from the inability of the nervous system to filter sensory input to determine an appropriate response, regain their ability for appropriate responses by amending their sensory regulatory environment, integrating physical and visual feedback.

Suggested application in the therapeutic space:

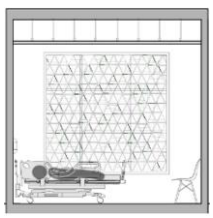
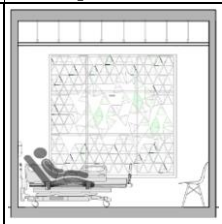
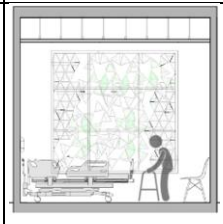
1) Interactive windows:

These openings are designed to interact with the current activity of the user. Through sensors and surveillance cameras, a set of data is monitored that includes the user's biometrics, including his gestures, mood, and physiological state. Commands are sent to the smart engines for real-time kinetic interaction, as the distances between them are increased and the entry of the proportion of air and natural light required according to the patient's needs. As this contributes to his calm and comfort and improves the quality of his treatment.

TABLE 6.
A PROPOSAL FOR OPENINGS CONSISTING OF INTERACTIVE UNITS WITH USER MEASUREMENTS TO ENTER THE AMOUNT OF LIGHTING AND VENTILATION AT THE REQUIRED RATE. (THE AUTHORS)



The more the architectural space is commensurate with the condition and behavior of each individual user, the more this enhances the patient's belonging to the space in which he resides, and thus contributes to raising the quality of space and its positive impact on his physiological and psychological condition, and thus the speed of his recovery.

CASE 1: relative stability position	**CASE 2: relative calm position**	**CASE 3: different behavior position**
		
a	b	c

a- The interactive units of the windows are in a close position and are almost connected to each other, based on what has been observed from the biometric measurements of the patient, which is often in a stable position during sleep

b- The interactive units interact with the biometrics proportionally according to their rates, as the distances between the formative units begin to increase as the patient's condition moves from stability to interaction and this happens gradually, which helps to improve the quality of the place by providing the appropriate ventilation rate for the current situation of the patient.

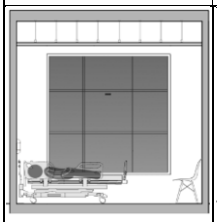
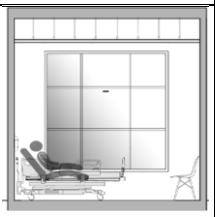
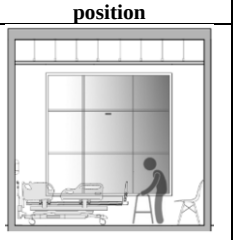
c- The rate of interaction between the interacting units increases with the increase in the variance in the conditions and behavior of the patient inside the room, where it is at the maximum distance and dispersion according to the varying and kinetic changes in the patient's behavior, in order to contribute to providing light and natural air in the appropriate amount for his need while practicing these behaviors, to automatically improve his health condition and enhance His sense of belonging to the place.

2) Interactive shading system:

The interaction can also be through the glass used, where it is possible to control the rate of solar radiation entering the space (Halio smart glass [22], its percentage from the flat of the openings, and the direction of the shadows themselves, as this is done by sensing the patient's movement, proximity and position relative to the openings, and directing the percentage of gradual shades on the glass automatically In this space in which it is located so that the user can communicate with the external environment without being bothered by high solar radiation.

TABLE 7
INTERACTIVE SHADING SYSTEM PROPOSAL WITH BEHAVIOR. (THE AUTHORS)

One study found that only 47% of patients preferred to have a direct view outside from the window next to their bed, and privacy and lighting control were more important. Clinical staff reported that patients likely prefer to have windows next to their bed to have a view outside, but not in direct sunlight.

CASE 1: sleeping mood	**CASE 2: laying mood**	**CASE 3: different behavior position**
		
a	b	c

a- Although most patients did not want their window directly next to their bed, more than half changed their position within their room to better view outside or move away from light disturbances, gaze, and unwanted lighting reflections.

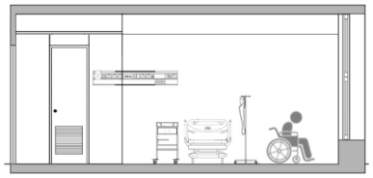
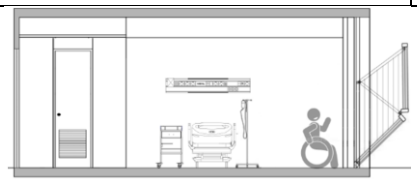
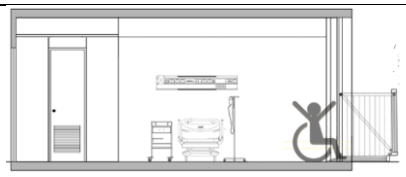
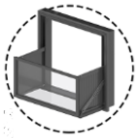
b- Clinical staff reported that patients likely prefer to have windows next to their bed to have a view outside, but not in direct sunlight. So by using Halio smart tinting glass, this will allow easy control of the amount of light appropriate to the user's desire and the extent of his sensitivity to solar radiation, as this allows to increase the contact between patients' beds and the outside nature.

c- The interaction of the window shading system is not only limited to the user's biometrics, but also interacts with his kinetic behavior within the space, where the distance between the user's body and the glass surface is calculated, and the tinting increases in the surface near his body, so as to prevent his exposure to a high rate of light radiation that Annoys him.

3) Interactive wall structure:

There is another proposal that contributes to increasing the interior surface of the room, and also helps to reduce the walls separating the user and the external environment somewhat, where the interaction of the openings can be done in a dynamic and flexible manner and transform into a structural element that defines another space attached to the room represented in the open balcony, and this may be Interactive with the psychological state of the patient, given that the open spaces with larger surfaces give a feeling of freedom, disengagement, and release, and reduce the feeling of distress, boredom, and detention within a closed space.

TABLE 8
INTERACTIVE SPACE EXTENSION SUGGESTION.
(THE AUTHORS)

	The window size can also impact patient satisfaction with the room and other health outcomes [23].it found that a group of patients was negatively affected by windows with sills that were too high (above the floor, at 48").
CASE 1: without space extension	 
CASE 2: interact with mood	 
CASE 3: Wider feels free	 
These patient groups who were negatively affected included patients with mobility problems, impaired vision, paralyzed patients, and disabled patients who could not access the view outside the window due to windowsill height.	
Therefore, interactive windows[24], have been designed with the presence of users near them, as well as with the biometrics related to their psychological state, where the window mechanism interacts with these measurements so that it opens and increases the internal space of the space and increases the entry of natural light and air, and also increases the connection of patients with external nature, and reduces From the presence of window barriers, which enhances the feeling of freedom.	

C. Open Columns:

One of the applications responsive to the behavior of residents is also open columns, which is a multi-user environment capable of fundamentally exploring how plastics are used in architecture. It responds These columns installed in the ceiling respond to changes in the level of carbon dioxide gas within the occupied space (fig 7), where the levels of this column change depending on the location and number of exhalations or (the rate of carbon dioxide in the space), and once the air is saturated with this gas in a specific area of the room, a multi-column or grid spreads, as it slowly falls from the ceiling of the room and helps to disperse the groups of people gathered under it, and then gather them in another place in order to reduce the concentration of carbon dioxide in a specific area.

Fig. 7. OPEN COLUMNS [25]

These columns operate so slowly that it is difficult or impossible to predict the relationship between the architectural response and the behavior of the inhabitants through interaction. Therefore, this application is considered its main goal is to reorganize the people used in the inner space, where the ulterior motive is to make people aware of their surroundings, as well as to achieve different forms of crowding in the space at the same time, through the movement of columns made of urethane. Therefore, this application is considered its main goal is to reorganize the people used in the inner space, where the ulterior motive is to make people aware of their surroundings, as well as to achieve different forms of crowding in the space at the same time, through the movement of columns made of urethane[25].

TABLE 9.
OPEN COLUMN APPLICATION ANALYSIS (THE AUTHORS, BASED ON [25])

Type of Space/application	Kinetic skeleton
Interior/ Design Elements	column
Functional Usability / Design Shape	Interactive/ responsive /tracking
Target Achievements	This application is considered its main goal is to reorganize the people used in the inner space.
Typology of Kinetic	Architecture, Sensory, kinetic the levels of this column change depending on the location and number of exhalations or (the rate of carbon dioxide in the space)

Continue in the next page

TABLE 9: Continued

Kinetic Shape	Kinetic, transformation, expansion, and contraction
Interaction Solutions	The ulterior motive is to make people aware of their surroundings, as well as to achieve different forms of crowding in the space at the same time, through the movement of columns made of urethane.
responsive determinants	movement –human behavior
Control systems	A more complex program ties the columns to real-time sensing such that they can respond to inhabitants' perturbations in space. The columns, working from a simple set of rules, respond to data coming from a carbon dioxide (CO2) sensor
Proposed application in healthcare Scenario	this application is considered its main goal is to reorganize the people used in the interior space, where the ulterior motive is to educate people about their surroundings, as well as to achieve different forms of crowding in the space at the same time, through the movement of columns made of urethane, and that is one of the most important requirements of the times The current situation, especially due to the outbreak of the Covid-19 virus, and the constant urging of social distancing, in addition to the possibility of applying this structure in treatment rooms for rapidly contagious diseases.

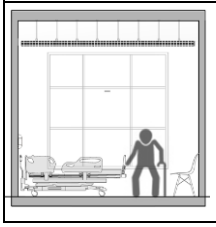
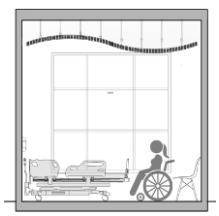
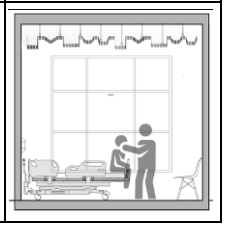
Suggested application in the therapeutic space:

1) Interactive ceiling:

The ceiling can have a big role in the positive or negative impact on the health of the patient [26], so the ceiling is designed interactively that can be formed in several shapes and designs according to the type of user, for example, males and the elderly tend to stable or straight lines, while the ceilings tend to females to the ceilings with soft and smooth lines in movement, while children tend to fun and varied geometric formations as a kind of entertainment, so this proposal gives the space a fingerprint for each user during his presence during the treatment period, and it changes as soon as he leaves and a new patient enters.

TABLE 10.
INTERACTIVE CEILING ACCORDING TO USER AGE/ GENDER. (THE AUTHORS)

During the therapeutic stay, the patient goes through many psychological changes and different moods, in addition to the physiological impact of his health condition on psychological comfort. Therefore, the therapeutic space can be designed interactively, which helps it to overcome the difficulties of treatment, as the ceilings can be designed in a way that suits them and according to their requirements.

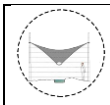
CASE 1: elderly male user	CASE 2: female user	CASE 3: Kid user
		

A dynamic interactive ceiling is designed with the type of user, as males and the elderly tend mostly to fixed ceilings and straight lines, while females tend to smooth and smooth lines, and children tend to differentiated geometric shapes, so it interacts with each situation and moves in a way that suits the type of each user, This is to add joy, improve mood, distract from pain and the monotony of treatment during their hospitalization stay.

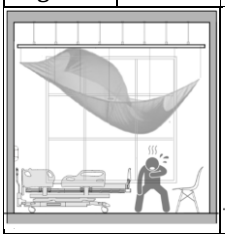
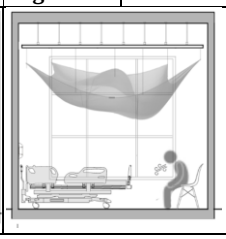
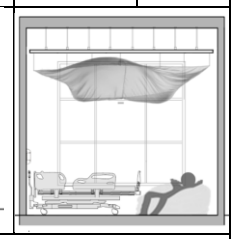
2) Motivated ceiling:

The ceiling can also be interactive with the physiological state of the user. This proposal contributes to improving the patient's respiratory rate the same way Exobuilding [27] when he is exposed to seizures, or even due to his feeling of malaise, boredom, or anger. Therefore, the tent-like ceiling design begins to relax and approach it, as a warning sign. He has the need to practice breathing behavior (inhale-exhale), given that increasing the rate of oxygen in the blood helps to improve vital conditions and the flow of blood circulation in his body.

TABLE 11
INTERACTIVE CEILING ACCORDING TO PHYSICAL STATE. (THE AUTHORS)



When the health of a healthy human, is one of the most important factors in this is the low oxygen rate in the body, therefore weakness of vital functions, tractable and fully and the difficulty of movement and concentration.

CASE 1: low breathing rate		CASE 2: normal breathing rate		CASE 3: high breathing rate	
					
					

set of interactive ceiling blinds are designed with the user's vital measurements, particularly breathing rate, where these curtains are controlled through intelligent drives increase from the fall distance whenever the rate of breathing is reduced, so as to stimulate the continuous breathing to improve the health situation and to restore Lift the design for the highest to increase space and feel freedom and comfort, as the human mind tends to the place with a high surface sight more than the low surface.

D. Emotive Facades:

Usually, the fans in the stadiums watching sports show many different feelings and passion for encouragement, unlike those who watch these matches at home with very coherent feelings, the situation in the stadium is always more enthusiastic and encouraging to show and express different feelings, but what if this stadium is a reflection for the different feelings of all viewers.

In the following example (fig 8), the London Olympic Stadium illustrates the assumption of interactive facades with fans, where one facade consists of panels of fabric wrapped at angles of 90 degrees, and this despite the stability of the original facade of the project, but with the addition of a control unit in these panels, the facade became a movable surface that fits The interactive system of the viewers, during the match the feelings of the fans are stimulated by the performance of the players, and thus their feelings are revealed through these interfaces, at the same time the algorithm chooses a kinetic recorder pattern to increase and reflect these feelings regardless of whether they are feelings of anger, happiness or sadness. The interface is fixed in the original project, and therefore it is transformed into a kinetic surface to spread the feature of effective movement over the entire face, by adding a set of control points for each strip of panels until it achieves a regression matrix similar to undulating surfaces, where the movement data needs to be modified to adapt to species restrictions. Different kinematics.

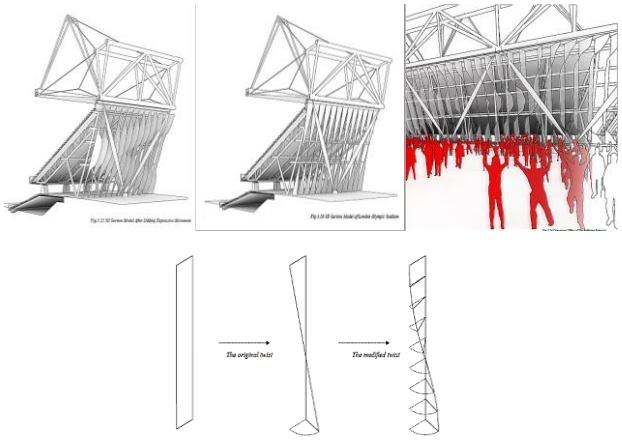


Fig. 8. 3D Section Model of London Olympic Stadium[28]

Once the types of emotions that occur in the stadium are identified, the system selects the appropriate pre-recorded kinetic pattern from its data library in order to enhance this emotion for the spectators by translating it into a specific context that appears on the interface. This application may contribute to its use in the medical fields and treatment rooms, as it helps to respond to the feelings and requirements of the patient without manual intervention or making decisions that require movement, as once he translates his biological data inputs and converts them into signals and stimuli for the surrounding architectural vocabulary, thus it can respond and contribute to meeting his needs, For example, when the patient's temperature rises, the windows are automatically opened at a certain rate appropriate to introduce a reasonable percentage of natural air that calms the patient's psyche without the need to take a decision from him or the nursing team [28].

TABLE 12
EMOTIVE STADIUM APPLICATION ANALYSIS
(THE AUTHORS, BASED ON [28])

Type of Space/application	Olympic Stadium
Interior/ Design Elements	interactive facades
Functional Usability / Design Shape	Interactive/ responsive /tracking
Target Achievements	The facade became a movable surface that fits The interactive system of the fans.
Typology of Kinetic	Architecture, Sensory, kinetic Once the types of emotions that occur in the stadium are identified, the system selects the appropriate pre-recorded kinetic pattern from its data library in order to enhance this emotion for the spectators by translating it into a specific context that appears on the interface.
Kinetic Shape	Kinetic, transformation, twisting
Interaction Solutions	This stadium is a reflection of the different feelings of all viewers. The interface is fixed in the original project, and therefore it is transformed into a kinetic surface to spread the feature of effective movement over the entire face, by adding a set of control points for each strip of panels until it achieves a regression matrix similar to undulating surfaces
responsive determinants	movement –human EMOTION behavior-biofeedback (physical state
Control systems	There are 13 panels in total; each panel has 20 control points. Instead of the vertical displacement, the movement data from the Kinect inputs leads to a flexible twist transformation.
Proposed application in healthcare Scenario	This application may contribute to its use in the medical fields and treatment rooms, as it helps to respond to the feelings and requirements of the patient without manual intervention or making decisions that require movement, as once he translates his biological data inputs and converts them into signals and stimuli for the surrounding architectural vocabulary, thus it can respond and contribute to meeting his needs

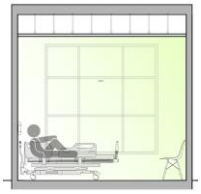
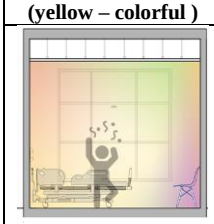
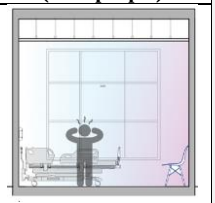
Suggested application in the therapeutic space:

1) Interactive Lighting system:

Since colors have an effect on the psychological and physiological state of a person [29], it is possible that the artificial lighting used has multiple colors. These colors are activated according to the patient's current condition, through which his condition can be improved according to the significance of each color, for example in cases of anger or boredom. Or the intensity of pain, can be automatically sensed through the biometric monitoring sensors, and then the cold blue or violet light is activated, and in cases of boredom and loneliness, colors are activated that give joy and manliness, such as orange or yellow[30].

TABLE 13
INTERACTIVE COLORED LIGHTING WITH USER REAL-TIME STATE. (THE AUTHORS)

Colors are powerful communication tools that can be used to indicate actions, and they have a significant impact on human physiology and mood. Certain colors are associated with a change in the human body's condition, such as eye strain, increased blood pressure, or an increase in metabolism.

Relax – calm - health (green-white)	**Boring – lonely – sad (orange-red)**	Coloriology is still used today as an alternative or holistic treatment. The red color is used in this treatment to stimulate the mind and body and increase blood circulation, the yellow color purifies the body and stimulates the nerves, and the orange color is used to increase energy levels and heal the lungs, the blue color is believed to treat pain and calm diseases, and shades of indigo relieve skin problems.
		
Happy – cheerful (yellow – colorful)	**Stressed- nervous (blue-purple)**	
		

In short, the patient's biometrics and mood will be monitored, and the appropriate light colors will be activated in the room to improve his condition and reach the optimum situation.

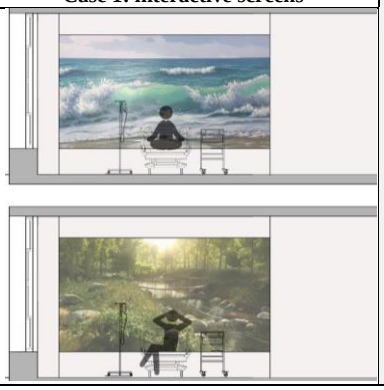
2) Interactive walls:

One of the factors that give a feeling of familiarity, lack of boredom, and a feeling of loneliness, is the interactive elements [31], which simulate part of his behavior, whether kinesthetic, vocal, or others, so it was suggested that the walls should have interactive screens with the user's kinetic behavior, as they play the role of the entertaining companion in the room, as they During which the user's movement and his physical conditions are sensed and simulated by means of formations and shapes that move in the same way as his shadow, and it is also possible that they are of different colors according to the intensity and speed of the movement.

TABLE 14
INTERACTIVE WALL SCREENS WITH HUMAN MOOD (THE AUTHORS)

During his stay in the hospital treatment room, the patient always feels bored, isolated, and lonely, especially if he suffers from symptoms of his health condition, as this may negatively affect his psychological condition in a negative way.

Case 1: interactive screens



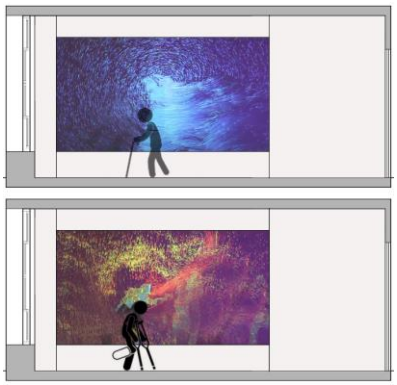
Exposure to nature makes you feel better emotionally and also contributes to your physical health, reducing heart rate, blood pressure, muscle tension, and production of stress hormones, as well as possibly lowering mortality, according to scientists such as public health researchers. Studies have indicated lower levels of pain and anxiety and stress in patients when they are certainly exposed to build environment design interventions.

Therefore, through these interactive screens, it is possible to create landscapes with picturesque sounds that reflect the quality of the patient's condition and contribute to enhancing his vital measurements.

These interactive screens can also be used by displaying a set of landscapes [32], that helps the patient to relax and rest simply by hearing the sound of the sea, for example, or the chirping of birds or the rustling of trees. These sounds have a great positive impact on his psychological state, improving his vital functions, and distracting him from long treatment periods.

TABLE 15.
INTERACTIVE WALL SCREENS WITH HUMAN MOTION BEHAVIOR. (THE AUTHORS)

Case 2: artificial natural views



Therefore, through the interactive walls with his kinetic behavior in the room, we can create a virtual person that simulates what the patient suffers from, as a way of support, as if someone close to him accompanied him, as this enhances his sense of belonging to the place and loneliness, and this has a positive impact on his psychological and physiological health. This simulation is through interaction with body movements, distance, and proximity to the wall.

The visual scene of these screens, colors, and ripples of their lines can be affected according to the psychological state of the patient, and their exciting interaction encourages the patient to physical movement and takes different positions to create amazing scenes.

VIII. COMPARATIVE ANALYSIS RESULT

The objective of the analytical study is to understand and identify the modern architectural applications in the current era of advanced technology that will affect the future of dynamic medical care buildings.

This study analysis answers the question of whether these interactive designs and concepts have the ability to cross the restrictive boundaries of movement in the architectural field that architects and designers face during the process of designing interactive buildings, especially for the therapeutic category and those unable to act and move.

We aim to connect human cognition and emotions with the built environment, in order to improve the user's mental health and enhance their well-being, where the focus will be on adaptive cyber-physical spaces through which the physiological needs of the patient or the user, in general, can be met based on their neurobiological data.

The following (table 16) shows the relationship, the characteristics of each application, and the extent to which it can be applied in the design vocabulary in the therapeutic space:

TABLE 16.
APPLICATIONS ANALYSIS OUTLINE (THE AUTHORS)

PROJECT / CHARACTERISTICS	Reconfigurable Wall System	Ghandi cyper kinetic System	Emotive stadium	Open Columns
Kinetic (dynamic)	●	●	●	●
Transformative				●
Intelligent(sensory acuter)	●		●	●
Adaptive			●	
Responsive devices	●	●	●	●
Interactive interface		●		
Ceiling				●
Walls	●		●	●
Interior envelope skin		●	●	
Floors				●
Openings	●	●		●
Furnishing	●	●	●	
Structure	●			●
Mental health (psychological)	●	●	●	●
Physical state (Physiological)	●	●	●	●
Thermal health	●	●	●	●
Acoustic quality				
Lighting quality		●	●	
Indoor environmental quality		●		●
Visual comfort	●	●	●	
Single	●	●		
Multiple			●	●
Physical motion	●			●
Facial reaction		●	●	
Biofeedback		●		●
Human behavior	●		●	
Mood		●	●	

At this stage, we seek to create user-oriented spaces that can learn from the user's behavioral patterns in real-time, through artificial intelligence and emotional computing, as well as contribute to reducing user anxiety and depression and improving the quality of their internal environment, as well as promoting many designs with great flexibility, with Focus only on humans, for people with mental and physical problems and disabilities. To achieve these goals, it is necessary to integrate these tangible computing devices/interfaces, with automated self-tuning structures, interactive control systems, human behavior, programmable materials, and sensory networks. Through physical intelligence and embedded response, the goal is to blur the line between Digital, physical, and biological domains, creating electronic physical spaces that can (feel and control) the user's mind and feelings.

TABLE 17.
PROPOSAL FOR BIOMETRICS AS A RELATIVE VECTOR FOR FLEXIBLE APPLICATION INTERACTION (THE AUTHORS)

Architectural vocabulary target / Suggested application method / Embodied Adaptive examples	Reconfigurable Wall System	Ghandi cyper kinetic System	Emotive stadium	Open Columns
Ceiling: - openings (natural lighting &natural ventilation) - artificial lighting & HVAC system - interactive hanged applications				
Walls & structure: - dynamic partitions - nursing devices - interactive handles - lighting system - user interface - expansion space - folded walls - space orientation				
Interior envelope skin: - interactive wall sheets & finishing materials - degree of transparency - cyber-physical materials - biofeedback trackers - artificial views - intelligent patient diagnosis				
Floors: - Sensory tiles - lighting path guiding - biofeedback sensors - slippering protecting texture - thermal quality				
Openings: - Biofeedback sensors - shading gradient system -Ventilation and natural lighting - natural view & soundscape				
Furnishing: - biofeedback sensors - colors - fabrics - flexibility and dynamism - user movement and behavior adapting				

Personal Actions and Signs of Emotions (Identity Tracking Biometric Vectors)		
	physical expressions & body movement	facial expression, body motion, touch, Movement routine
	Facial reactions & Gesture	Gaze, Vocal information, verbal communication, mental states
	Biofeedback & physiological state	Heart rate, Pulse, Blood pressure Breathing levels, Temperature Perspiration, CBC test
	Human behavior	Movement routine, Gaze, Vocal information, Body language, semantic speech
	Mental & psychological response	Heart rate, Pulse, Blood pressure Breathing levels, perspiration Muscle actions, Skin conductivity, Temperature

(Table 17) is a proposed description of the therapeutic architectural space, and how to apply the interactive and kinetic techniques in the studied applications within the proposed design, through the vocabulary of intelligent, dynamic interactive design in the space, and a proposal for BIOMETRIC identity tracking vectors in each application, which includes personal actions and signs of emotions.

IX. CASE STUDY (INPATIENT ROOMS IN HOSPITALS):

In this study case, we learn about the extent to which the identity of the user is enhanced through interactive architectural design through biometrics, at **the Oncology Center at Mansoura University**, in order to find out the importance of linking these relative and varying measurements from one user to another, to the interior design and the impact of the quality of the interactive space on the health of the user and the speed of his recovery (fig 9).

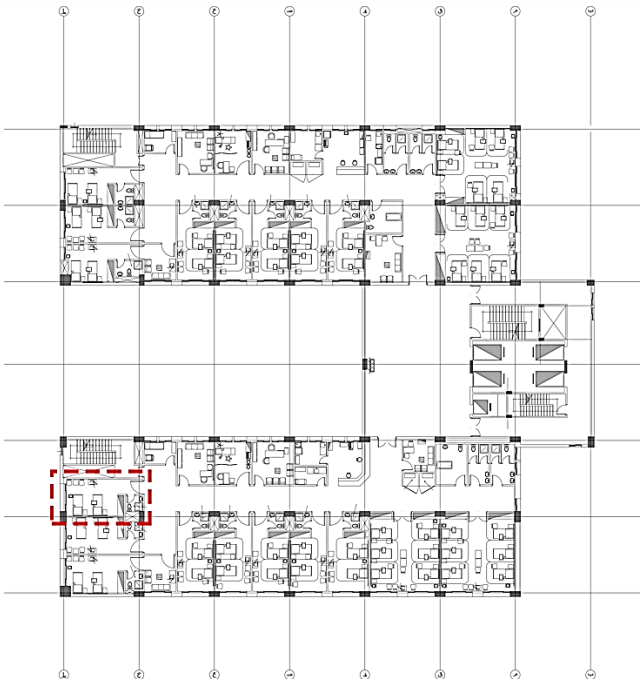


Fig. 9. The location of the individual room at the 8th floor. [33]

A. Reasons for Choosing the Case Study (Fig 10):

- The multiplicity of types of categories used for this building, whether in terms of age, gender, culture, or level of illness, and the great disparity between each case and the other, and treatment requirements.
- It is one of the largest oncology centers in Egypt, which receives a very large number of cases[34] .
- This single room was chosen (perhaps because it expresses a large segment or a model for most room shapes).

B. Aim of the Study:

- Testing the validity of the theoretical hypotheses of this research by developing a set of procedures and design proposals for the architectural space of the room and clarifying the extent of its impact on more than one category of users.
- Knowing the extent of the impact of linking the relative biometrics between users to the architectural vocabulary of space, and the extent of its impact on the user, negatively or positively.

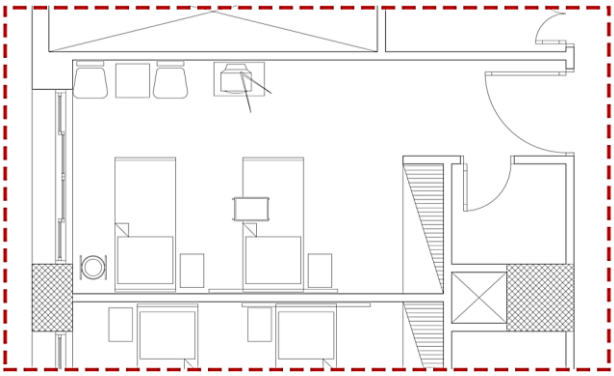


Fig.10. plan showing the room under study. [33]

C. Introduction to the Center:

It is an educational center specialized in oncology, consisting of a basement, a ground floor, and eleven floors, with a capacity of 250 beds. The beds are classified between surgery, oncology, and chemotherapy, and others for hematology and marrow transplantation.

D. The Center's Goals:

One of its most important goals is to provide integrated and preventive treatment services and health care for patients with critical and acute cases in all specialties of tumors (digestive system - liver - blood - bones - marrow transplant cases).

E. Center's Site:

The center is located at the beginning of the city of Mansoura within the university campus, bounded to the north by the therapeutic and diagnostic radiology building, and the eye building, while the eastern side has the magnetic resonance imaging building, and the southern side has a wall separating it from the university housing area. The area of this center is 2500 square meters.

F. Analysis of the Current Situation of the Room:

1) Plan Formation and distribution (fig 11):

- To contain two beds, one for the patient and the other for the accompanying person, but three beds are placed, causing the patient to lose part of the space allocated to him.
- The lack of distances between them and their proximity to each other, the patient loses the human need for boundaries.
- The bed is modular, but not flexible enough to respond to the needs of patients in different situations.

Fig.11. current situation of the interior space of the room.(the author).

2) Natural and artificial lighting:

- Glass openings allow the entry of daylight, in addition to direct sunlight, which makes the patient uncomfortable.
- Indirect artificial lamps of white color, but there are no other gradations of color lighting the room.

3) Finishing materials

Ceramic was used on the floors, and this is not preferred because of the accumulation of bacteria in the tiling joints, and it is one of the types of floors that may cause slipping. As for the walls, they are also ceramic.

G. Biometric Interactive Architecture Development Proposal:

After analyzing the previous interactive architectural applications, knowing the interaction stimuli in each of them, and developing a parallel design proposal that is valid for application in the environment or therapeutic space, whether it is for one patient or several, and according to the variables of each user, it is also possible to develop a complex visualization of all these proposals within a room Accommodation for one patient as shown in the following, as this shows the flexibility of the architectural characteristics of the architectural space, and its susceptibility to change according to the change of users, in order to achieve the highest efficiency and environmental quality.

Those are a set of proposed designs for the architectural vocabulary of the room (fig 12), so that it is more interactive with sick users, and meets the needs and requirements of each of them according to his condition, behavior, and biometrics, as this contributes to strengthening his identity to the space, and improving the quality of his internal environment, which is positively reflected on his mental health And physiological, and contributes to shortening the length of stay in the hospital for treatment.

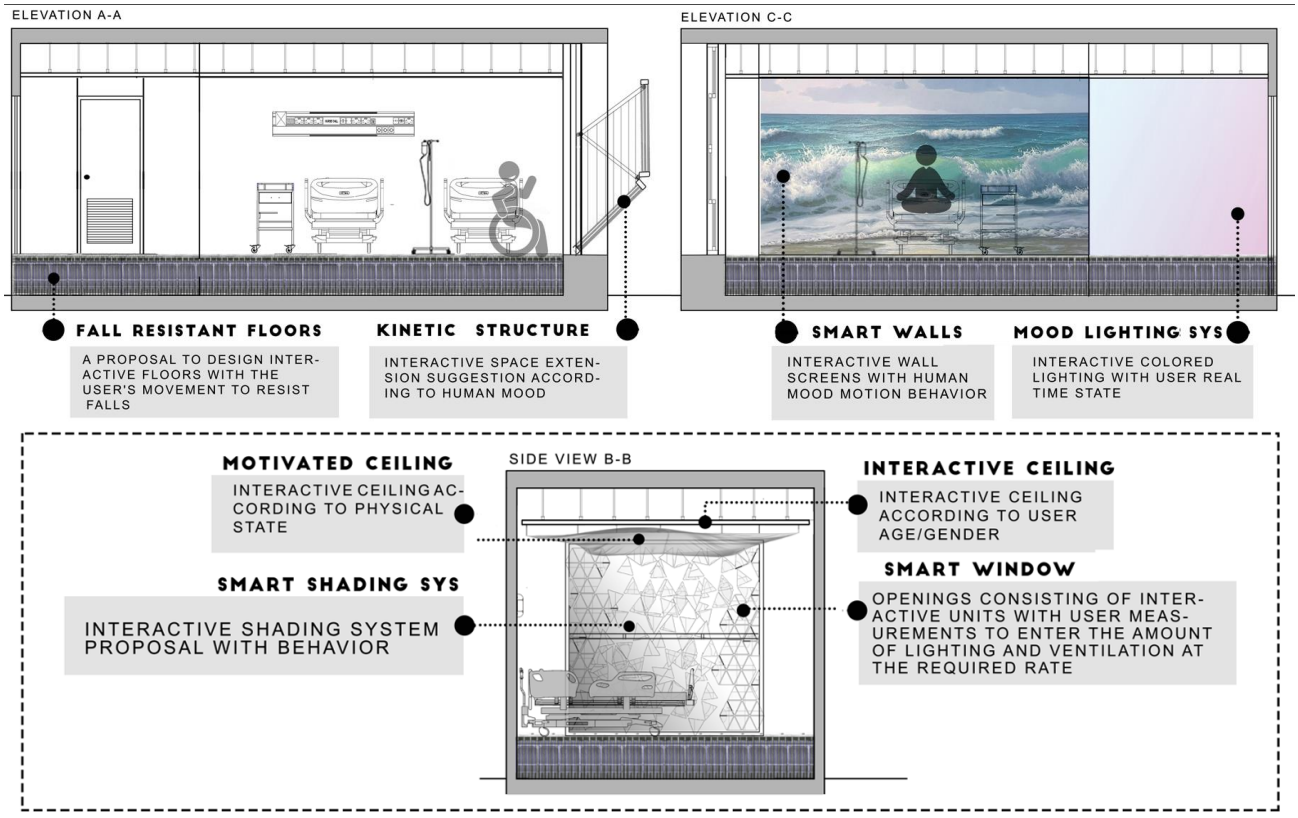


Fig. 12. Biometric interactive architecture development proposal. (the author).

X. RESULTS

The kinetic and adaptive engineering of the future will be able to transmit and share information about how users feel, simulate their thoughts and activities in space, monitor their physical condition, address cognition or mood problems, and contribute to accelerating recovery.

By collecting biometrics, the interaction between smart environments can dramatically improve the requirements of their occupants by automatically responding to their anxiety,

depression, or health setbacks. The influence of surrounding environmental factors on stress reduction and meeting the rest and recovery needs is measured by emotional computing. The functional user will be able to adapt to the reinforced space to enable him to practice his normal behavior and the daily routine of his activities. In short, the building will become a physician treating the user, hearing from him, adapting to his condition, contributing to his recovery, and even comforting him as he overcomes his pathological ordeal.

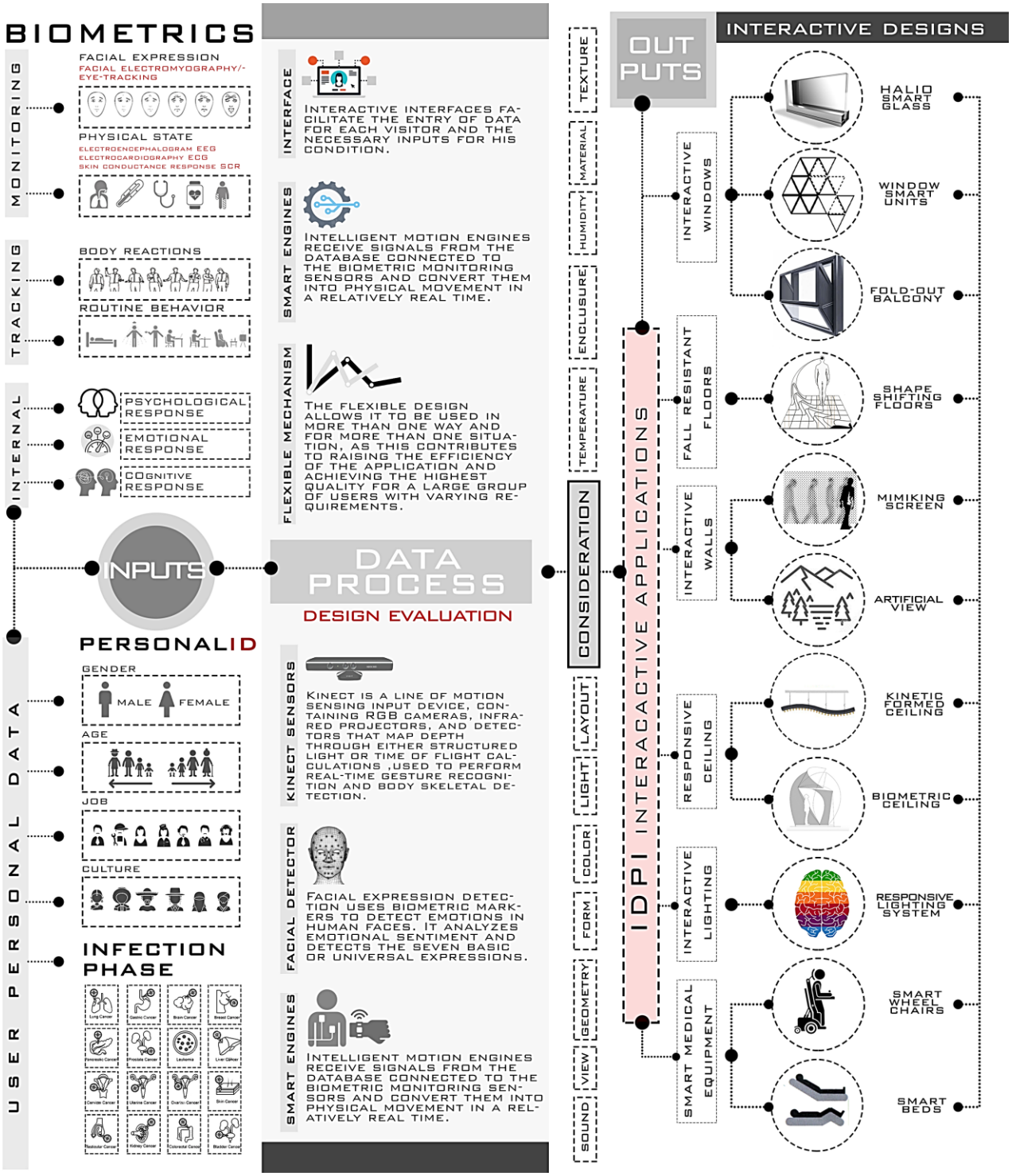


Fig. 13. Diagram showing the mechanism of intelligent interactive design with user biometrics.(the authors)

The architectural design is evaluated based on the well-being of the users, where data and information are presented using available methodologies to monitor the set of biometrics for each individual person. Therefore, a mandatory protocol is required to assess how the characteristics of the architectural design affect the biometric reaction of the user, which in turn

will express the standards of quality and psychological comfort of the internal environment. The evaluation of the effects of relative design variables on cognition in indoor environments suggests solutions that achieve individual well-being.

From an architectural perspective, it is important to understand the mechanism of making decisions about the internal built environment, and how mechanisms related to the psychological aspect affect our mental states and feelings. Therefore, architects may be hindered from predicting how their design decisions will lead to different perceptions of specific spaces when they lack an understanding of design mechanisms that enhance user comfort and belonging to the space.

It is expected that after conducting an analysis of facilities, buildings, and designs supported by interactive technologies with user behavior, movement, response, and its impact on the internal environmental factors of the building, it is possible to support patient rooms in hospitals and treatment centers with this technology, and benefit from the behavior of the smart dynamic physical environment with sensors of the user's physical condition and his vital measurements Personal, in order to enhance the quality of the building's internal environment and improve the physical and mental condition appropriate to the patient's condition and response in real-time, which in turn contributes to raising the rate and efficiency of treatment.

The response of the physical environment is an automatic dynamic movement that depends on the patient's input, which creates a link between the architectural vocabulary (windows - doors - floors - ceilings ... etc.) and these data, as his physical measurements such as pulse rate, breathing, blood pressure, etc., include the gestures of his features and his body language And his motor behavior, in addition to his emotional, psychological and cognitive response, and also includes a set of information about his identity such as age, gender, race, religion, occupation, culture, etc., and finally his sick condition. Therefore, the controller of the environmental conditions and the architectural design of the room is the human mind and the body's vital measurements, with the aim of providing the appropriate conditions for the user in an adaptive and automatic manner without the need for manual tuning, which is facilitated by the use of smart technologies, sensors, monitoring cameras and galvanic measurements of the human body. Therefore, it is important to take into account the identity of the therapeutic user, which varies proportionally from one user to another, especially in treatment centers and medical facilities, because the design has a direct impact on the psyche and health of the patient.

The previous figure (fig. 13) shows the mechanism of intelligent interactive design with user biometrics.

XI. CONCLUSION

Good architectural design has many obvious physiological and psychological benefits, which go beyond the sense of aesthetic appearance as well. We now clearly understand the strong and direct link between poor architectural designs and execution and health and psychological issues. Recently, we now have a better understanding of the human evolutionary foundations, with all that has to do with the physiological and psychological responses to architectural designs.

The results of this research are summarized in the following set of points:

- Interactive architecture comes at the top of the classification of engineering designs, as it contributes to meeting the maximum requirements and needs of users.
- it can adapt to the surrounding environment in an ideal and intelligent manner, but it is expected to be more positive if this interaction is relative between the target groups.
- it is possible through its applications to respond to each user individually according to his behavior and requirements in the architectural space, which contributes to raising the level of comfort and the quality of the internal environment to the extent that makes the building more efficient than other typical rigid buildings.

Treatment centers are among the first social segments that can be targeted, due to the great variation in treatment cases, whether in gender, age, culture, social level, or medical condition. There are a set of results related to this type of space, as follows:

- A treatment room can be more efficient if it is designed in a way that keeps track of user identity and data entered than if it is a modular room with fixed specifications applicable to all users.
- Enhanced user identity design in treatment rooms includes all the smart applications in the architectural vocabulary that make up the space, such as walls, windows, ceilings, lighting, mattresses, finishing materials…etc.
- This design contributes to placing a fingerprint for each user in the specifications of the space in which he lives, which in turn enhances his belonging to the place and improves his health condition, whether physiological or psychological, and this is done by monitoring all the biometrics of each user individually.
- Architectural features are determined by the therapeutic space as soon as the patient chooses the room by connecting to surveillance cameras, sensors, motion sensors, and sensors for physiological and psychological states.

XII. RECOMMENDATIONS

The trend towards enhancing the personal identity of interior design is not only confined to treatment facilities but may have many areas that contribute to user comfort when in contact with their biometrics, personal data, and relative requirements. These proposed applications can be employed in different types of spaces, including (table 18):

TABLE 18.
A PROPOSAL FOR FUTURE INTERACTIVE APPLICATIONS WITH USER BIOMETRICS IN DIFFERENT TYPES OF SPACES IN THE TARGET GROUP OR ACTIVITY. (THE AUTHORS)

TECHNIQUES / PROJECTS	shape- shifting floors	Smart windows	smart shading sys	smart wall struc.	reformed ceilings	motivated ceiling	emotive screens	moody lighting system
Public spaces Open spaces, whether covered inside buildings, such as public entrances to malls, airports, etc., or open spaces, such as squares and parking lots on the streets.			O	O		O	O	
Residential building Houses and residential villas, as well as hotel rooms, target different categories of visitors for varying and close periods.	O	O	O	O	O	O	O	O
Transportation private transportation, which, through this interactive feature with user measurements, enables the vehicle to be used by more than one user without feeling the need to reset its settings after using each one, or public transportation that targets passengers with different needs and characteristics.		O	O				O	O
Unified style Compound Where there can be design constants for residential spaces, but they can be modified when the user reaches certain requirements.		O	O	O	O	O		O
Office building Co-working spaces between employees, the offices of a number of them, or the offices of one user.		O	O	O		O		O
Medical buildings Rooms targeted for one or more users, physical therapy and rehabilitation spaces, nurseries for children, psychological treatment, and so on.	O	O	O	O	O	O	O	O
Sports buildings Training spaces or performances with different modes, such as gymnastics, karate, and others.	O			O		O	O	

It is expected that this trend in the coming years will be the basic method used to design any architectural spaces targeting different categories of users, in order to raise the efficiency of space use and enhance the principle of responding to the requirements of users, each according to his circumstances and condition.

AUTHORS CONTRIBUTION

Samar Belal Elbatrway,

1-Conception and design of the work (50%)
2-Data collection and tools (50%)
3-Data analysis and interpretation
4-Methodology (50%)
5-Drafting the article (50%)
6-Final approval of the version to be published (50%)
7- Supervision (50%)
8- Critical revision of the article. (50%)

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4-Methodology (50%)
5-Drafting the article (50%)
6-Final approval of the version to be published (50%)
7- Supervision (50%)
8- Critical revision of the article. (50%)

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TITLE ARABIC:

تعزيز الهوية الشخصية للتصميمات الداخلية التفاعلية من خلال القياسات الحيوية: غرف المرضى بالمستشفيات كدراسة حالة.

ARABIC ABSTRACT

اليوم ، تعد تأثيرات جودة البيئة الداخلية على صحة الناس ورفاههم موضوعًا مهمًا للغاية ويتطلب نهجًا شاملاً يتم من خلاله تقييم العوامل البيئية الرئيسية وتعزيزها في نفس الوقت ، بهدف تحسين حالتهم الصحية البدنية والنفسية ، واستهداف المعاقين والعاجزين عن الحركة والمرضى بمراكز العلاج الطبية والنفسية لكبار السن. مع تعدد وتنوع الفئة المستخدمة لهذه الأمثلة ، فقد أصبح من الصعب تحديد متطلبات كل مستخدم على حدة وتوفير الظروف المثلى لتسريع عملية الاستشفاء وتحسين جودة الصحة الجسدية والنفسية . ففي بعض الاحيان قد لا يشعر المستخدم بالراحة دون معرفة السبب ،على الرغم من توفر الكثير المتطلبات والمرافق بالنسبة له ، فيتعزز بذلك الشعور بعدم الانتماء للفراغ ، وذلك بسبب عدم وجود تصميمات ومحددات برموز ودلالات تحاكي طبيعة المستخدم ومتطلباته ومعتقداته وظروفه الجسدية والمعنوية. لذلك تساهم العديد من محفزات التصميم الحركي التفاعلي في منح بصمة معمارية لكل مستخدم ، لتسهيل التفاعل معه ومحاكاة ظروفه ، أو حتى المساهمة في تحسين حالته السيكولوجية والفسيولوجية معا ، من أجل تحقيق أعلى إنتاجية للنشاط الذي يمارسه بالفراغ الداخلي الذي يقطنه. من المؤكد أن هذا النهج سيعزز انتماء المستخدم إلى بيئته المقيم بها لفترات طويلة، ويسهم في خلق هوية شخصية للتصميم المعماري بناءً على قياسات المستخدم الحيوية . هذا البحث يوسع مدارك الفكر التصميمي لتحسين التجربة العاطفية للإنسان داخل الفراغ ، كما انه يعد إطار عمل لتحويل البيئة المبنية إلى كائن حي متصل بالشبكة وذكي ومتعاطف وحساس وقابل للتكيف ، ولكن تحت السيطرة الشاملة للمستخدم ، وذلك من خلال المدخلات (القياسات الحيوية) التي تُستخدم كمدخلات توجه مفردات العمارة الحركية الذكية المستجيبة بلتصميم الداخلي ، للتفاعل المباشر بالسرعة المناسبة للظروف الحالية للمريض أو المستخدم بشكل عام.

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